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Visual Motor Integration and relationship to the level of Processing Speed Index among students with Learning Disabilities

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Abstract: The study aim of this research was to determine (Visual Motor Integration, VMI) and its relationship to the level of (Processing Speed Index, PSI) in students with (LD). To achieve the study's objectives, the correlative descriptive method was used. The study comprised (100) Saudi students, including (50) students with (LD) and (50) normal students. Their ages ranged from 8 to 13 years. A Wechsler Scale-4 was also employed. The content validity and concurrent validity of the (cancellation) test in its two sub-categories (Random and Regular) was (80%), and the construct validity was greater than (0.30). The correlation between the sub-tests (Random and Regular) and the total score of the (VMI) test was 0.934-0.937), And for normal students are (0.965, 0.920). The construct validity of the values of the correlation coefficients between the sub-tests and the total score of the (PSI) test was higher than (0.30), and the correlation through the construct validity of the (PSI) test among students (LD), with the (PSI) among normal students. the correlation coefficients for the sub-tests (Coding and Symbol Search) were (0.770, 0.474). and for normal students (0.820, 0.876).

Indications of the (VMI) test's reliability were also obtained through the Content Validity test (Cancellation) with its two branches (Random and Regular) using Cronbach's alpha coefficient (0.700). The reliability of the (PSI) test was determined using the internal consistency method and Cronbach's alpha test (0.825). The study's findings revealed that the level of (VMI) (cancellation) and (PSI) of (LD) students was extremely low. In addition, no statistically significant relationship exists between (VMI) and (PSI) levels. There were also statistically significant differences in the level of (VMI) due to age in favor of (LD) students in the age group (11–13). There were no statistically significant differences in the level of (VMI) compared to the (Regular) test among students with (LD). There were also statistically significant differences in total intelligence (PSI) levels due to variable students (LD and normal), with an arithmetic mean for (LD) students (65.06) and an arithmetic mean for normal students (101.06).

The study recommends teachers' awareness of the importance of (VMI) intelligence in the (LD) category and conducting studies comparing (PSI) intelligence with the Mild Intellectual Disability category.

Keywords: Learning Disabilities, Visual Motor Integration, Processing Speed Index, Wechsler Scale-4.

Introduction

The field of special education has received great attention in many societies, believing in the rights of people with (LD), and psychologists have played the most important role in studying, analyzing, and understanding complex cognitive processes, as it is known that reading and writing are the most important things that require the student to realize and be aware of them in the form that is correct in the stages of their life, following the methods and strategies that the teacher has developed.

Research Problem

Because of the prevalence of (VMI) problems among students with (LD) and their impact on their abilities to learn and perform the tasks in (PSI), as well as the increasing complaints of parents and teachers alike about their children's slow presence and weakness in many skills, such as reading and writing skills, As a result, students with (LD) require special efforts as well as organized and sequenced services to implement (VMI) skills that allow them to practice their daily activities without help from others, especially if appropriate educational methods are used for the characteristics of students with (LD) that show success. Their education and qualification are heavily reliant on education through the use of the sensible, as the student uses all of his senses, and from here we try to answer the following fundamental question:

- What is the relationship between visual motor integration and the processing speed index level for students with learning disabilities?

The following sub-questions arise from the research problem, which deals with the psychometric properties:

1- What is the significance of the validity of the visual motor integration test and the processing speed index for students with learning disabilities?

2- What is the significance of the reliability of the visual motor integration test and the processing speed index for students with learning disabilities?

3- What is the level of visual motor integration and the processing speed index for students with learning disabilities?

4- Is there a statistically significant relationship at the level of significance ($\alpha = 0.05$) between the visual motor integration test and the processing speed index among students with learning disabilities?

5- Are there statistically significant differences at the level of significance ($\alpha = 0.05$) in the level of visual motor integration and the processing speed index among students with learning disabilities attributable to the age variable?

6- Are there statistically significant differences at the significance level ($\alpha = 0.05$) in the overall intelligence level of the processing speed index attributable to the type of students (students with learning disabilities and normal students)?

Research Importance

First: The theoretical importance of this research lies in:

- This study is a theoretical addition and support to research in (LD) and educational standards, and it is hoped that this study will encourage in-depth scientific research in the Kingdom of Saudi Arabia, particularly studies conducted by researchers and graduate students whose focus is on educational standards (LD).
- Identify strategies for developing (VMI) for students with (LD) in the Kingdom of Saudi Arabia.
- This study may contribute to the theoretical framework for the field of (LD) caused by poor coherence of visually oriented motor behavior.
- Shedding light on the concept of intelligence (PSI) from the standpoint of (VMI).
- The importance of the target group in the study, who are primary school students with (LD).

Second: The practical importance:

- Based on the results of the (VMI) test, to show its significance and to encourage the development of diagnostic programs for (PSI).

- The results contribute to the diagnosis of educational problems, including (LD) caused by the weak ability to (VMI).
- The test aids in evaluating students' (VMI) levels, diagnosing their shortcomings, detecting disability and the extent of (PSI) for the activities of (LD) students, and thus identifying individuals to be referred to specialists.
- This study provides practical solutions for general education teachers and (LD) specialists on how to successfully deal with students who have (VMI) in proportion to their levels and differences.

Research Goals:
Verification of (VMI) and (PSI) level of students with (LD) by arriving at indications of validity and reliability.
Research Justification:

- The scarcity of Arabic studies that dealt with the subject of (VMI) and its relationship to (LD) students and their intelligence (PSI).
- The lack of measures that measure the relationship between (VMI) and (PSI) for students with (LD).
- Using the results of the measurement process to create individual educational plans for students with students (LD).

Research Limitations:
Research limits include the following:

- Age limits: The application of this study was limited to (LD) students whose ages ranged between (8 - 13) years.
- Spatial limits: This research was only applied to the Kingdom of Saudi Arabia (middle) through schools.
- Temporal limits: Research data was collected during 2022/2023.

Research Delimitations:

- The findings of this research are influenced by the validity and reliability of the study tools applied to students.
- The difficulty in generalizing the findings of this research relates to the research subjects' representation of the research population.

Definitions of Terms:
Visual Motor Integration: It is defined as "the ability to achieve synchronization between visual information and the movements of different body parts." El-Fanhrawi and Nour (2018). And it is the score obtained by students with difficulties (LD) in the (VMI) test.
Processing Speed Index: One of the five Wechsler Intelligence Indexes, with which the following sub-tests (Coding, Symbol Search, and Cancellation) are associated. (Wechsler, 2003) And the student's speed of processing visual and nonverbal information on all the tests he takes on the Wechsler Scale-4 tests. Represented through:
1- Coding: the individual is presented with a key in which the numbers (1 to 9) are paired with a different code; His job is then to use this key to place the symbols for the list of numbers between (1 and 9).
2- Symbol Search: The individual has to look at two target symbols and then examine a group of symbols to see if the target symbols are duplicates.
3- Cancellation: The child looks at a random sequence of pictures the first time and then a regular sequence the second time, and asked him to cancel the target pictures.
Learning Disabilities: Those who have been diagnosed with (LD) using (LD) diagnostic tests and scales.

Theoretical framework and Previous studies
First: Literature Review
First :Learning Disabilities

Those suffering from (LD) According to Abdul Wahid (2015), it is a heterogeneous group of disorders that manifest themselves as difficulties in acquiring and using listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are subjective and endogenous and are thought to be caused by central nervous system dysfunction. Although (LD) can coexist with other disabilities, such as sensory impairment, mental retardation, emotional disturbance, or external influences (such as cultural differences, insufficient or inappropriate teaching or education), it is not caused by these conditions or influences. Based on the results of (LD) diagnostic tests and scales.

According to Abdullah (2020), there are a variety of disorders that affect the acquisition, comprehension, organization, or use of verbal or nonverbal information. They are severe and always obstruct the development of one or more of the following skills: oral language for listening, speaking, understanding, reading for decoding, comprehension, written language, dictation, written expression, mathematics, arithmetic, and problem-solving. These disorders may also impair organizational abilities, social cognition, and social interaction.

Second: Visual Motor Integration

Disorders (VMI) are a common denominator in many neurodevelopmental disorders, disabilities, and various other syndromes, in addition to (LD), and the importance of studying the visual-motor skills of students with (LD) aims to reveal the ability of the visual-motor synergy test in predicting disorders. (VMI) also plays an important role in the development of writing skills, such as the ability of the eye and hand to work effectively together and with an important skill related to the student's functional skills such as writing, pen use, and other academic skills.

According to Yasmina (2018), it is the ability of an individual to pair vision with the movement of the body or some of its parts, or the ability to achieve synchronization between visual information and the movements of different parts of the body, and this skill is required for many academic fields such as writing, mathematics, and physical education.

Ibrahim (2018) defined it as coherence, integration, and consistency between visual perception and limb movement, i.e., finger and hand movement, and the defect in (VMI) is the inability to use vision to perform motor tasks.

According to Sebaa (2017), (VMI) skills are among the most basic and important skills in the lives of students with (LD). Without them, the student becomes an impediment to progress in his daily life skills, academic skills, and behavioural skills because VMI skills are included in all of an (LD) student's skills. While (Johansson, Westling, Bäckström, & Flanagan, 2001) discovered that coordination between eye and hand movements leads to accurate hand movement control, which is essential for learning to read, write, and arithmetic operations, some children struggle to learn to read because their eyes are not trained to follow steadily and in one direction, for the brain sees and translates what the eyes have seen in terms of images, drawings, sentences, phrases, and arithmetic operations.

According to (Vidoni, McCarley, Edwards, Boyd, 2009), (VMI) is one area of visual perception, and scientists have discussed the relationship between visual-motor synergy and the nervous system, and how the development of (VMI) helps to improve awareness of the educational process. Individuals who do not achieve this growth and, as a result, attend school without sufficient ability to take part in learning and individual incompetence (VMI) represent a negative.

According to Al-Ayeb (2020), the role of movement of the head, arms, hands, and fingers in the child's learning to write is important, and a deficit in the growth and development of the cognitive-motor aspect may negatively affect one of them in learning to perform motor activities such as copying, tracing, and writing letters and words, and it disrupts the ease of development and continuation of the motor patterns in a subsequent stage.

Third: Processing Speed Index

Determining abilities and cognitive processes have piqued the interest of cognitive, educational, and social psychology researchers. The most important of these processes that have recently emerged as a

predictor of school performance is a psychological intelligence (PSI) indicator, which is part of the Wechsler Scale-4 indicators, whose significance stems from its broad contribution to the treatment and mental ability. Information gathering, collection, and selection.

According to Khudair (2018), it is one function of the brain's frontal lobe that plans, abstract thinking, solves new and complex problems, corrects errors, and starts and controls responses. also defined by Salamouni and Mousa (2019) as intentional metacognitive processes such as planning, structured search, impulse control, goal-directed behaviour, employing flexible strategies, and selective attention.

Ibrahim (2018) confirmed that people with (LD) are academically ineffective because of executive function deficiencies, such as difficulties entering and organizing tasks, and suffer from ineffective participation in mental activities associated with academic activities, such as reading comprehension and written expression, and they show a specific level of awareness of the strategies used. Problem-solving and learning that works.

According to Al-Sadiq (2014), students with (LD) have a basic problem, which is a low level of academic abilities in reading and mathematics, or problems with attention and memory, despite their average or above-average intelligence, and this may be because of a defect in the planning and organizing processes as well as executive functions.

For intelligence in students with learning disabilities, the Wechsler Children's Intelligence Scale provides an important diagnosis for detecting problems that may predict low mental ability and negatively affect achievement. We discover that (Wechsler, 2003) has shown that (LD) learning ranges between (75 and above) intelligence and that the intelligence of these students may be affected by a deficiency in visual memory or working memory. Because intelligence is so important, David Wechsler (1939) created the Wechsler-Bellevue Scale of Intelligence for Adults and Adolescents to assess a variety of primary mental abilities that he believed interacted with some of them to form general intelligence or general mental ability, which Wechsler defines as the ability to perform purposeful action, rational thinking, and deal effectively with the environment. According to David Wechsler, the WISC-IV includes (15) tests: Block Design, Digit Span, Similarities, Picture Concepts, Coding, Vocabulary, Letter-Number Sequencing, Matrix Reasoning, Comprehension, Symbol Search, Picture Completion, Information, Arithmetic, Cancellation, and Word Reasoning.

When the Wechsler Scale-4 sub-tests were divided into clinical characteristics, (Wechsler, 2003b) found that (PSI) requires visual perception, organization, visual scanning, and the ability to use hands and eyes efficiently. According to (Sattler, Dumont, 2008), the test (Cancellation) measures visual sensory recognition and visual processing speed, and it comprises two sub-tests (regular and random) scanning to arrange images and mark the target images during a specified time for each subtest.

Also (Chen, Keith, Chen, & Chang, 2009) clarified that the (coding) test requires children to copy symbols associated with simple geometric shapes or numbers over a set period. In addition to measuring (PSI), successful completion of this task may show recall ability. And (Keith, Fine, Taub, Reynolds, & Kranzler, 2006) confirms that the Wechsler Scale-4 subtest (Symbol Search) requires the child to quickly scan a set of matching and non-conforming symbols in the answer space provided. This task requires quick execution and the ability to perceive and think using visual stimuli.

As a result, recent studies have focused on the (PSI) process that underpins (LD), and many psychologists believe that the concept of (PSI) appears to be more related to (LD).

Second: Previous studies

First: Visual Motor Integration for People with Learning Disabilities

Badran (2021) conducted a study titled "The Effectiveness of a Training Program Based on Learning by Play in Developing Sensory Integration Skills for Students with Learning Disabilities." The sample comprised (second and fourth) grade (10) students. To achieve the study's objectives for the second semester of the year (2020), the sensory integration scale was developed, and a training program was built. The scale had (10) dimensions, which included (VMI, perception of the relationship between shape and

ground, place in space, copying the shape, completing the missing part, tactile stimulus location, finger recognition, writing on the palm, kinetic balance, and simulating body position). The findings revealed:
- There are statistically significant differences in how students with (LD) use the training program based on learning by playing to develop sensory integration skills.

And Al-Hanaia (2019) conducted a study titled "Full-Range Visual Motor Integration Test FRTVMI: Psychometric Characteristics and Standards for Students in Grades 7 to 12 in Oman" to validate the psychometric properties and criteria of the VMI test for students in grades (7 to 12). The sample included (1213) male and female students, and the reliability of the test was checked using three methods: the method using Cronbach's Alpha, the test-retest method, and the results showed:
- The test had acceptable levels of reliability.

And Al-Fanhrawi and Nour (2018) conducted a study titled "Visual Motor Integration for Students of Special Education Classes and Normal Students in the Province of Babylon," with the goal of identifying the level of (VMI) and then the statistically significant differences in the level of (VMI) of the sample members based on type of students (special education-normal students), and gender variable (males-females). To achieve these objectives, the VMI test was developed and its statistical characteristics were developed before being administered to a sample of (200) male and female students. The results showed:
- The level of (VMI) was low among special education students and high for normal students, and the difference between the levels of (VMI) of special education students and normal students is statistically significant at the level of significance (0.05) in favour of ordinary students.
- When comparing the level of performance of the sample members on the gender variable, males outperform females.
- The test's reliability was satisfactory.

Also, Ibrahim (2019) studied the "Discriminative implications of sensory-motor domain tests on the (II NEPSY) scale in diagnosing those with learning disabilities for dysgraphia in fourth and sixth graders in basic education." The researcher used Raven's tests for successive matrices and a list of criteria for analysing handwriting and observation cards (prepared by the researcher), as well as diagnostic rating scales for people with (LD) (visual perception scale, kinaesthetic perception scale, reading scale, and book scale) prepared by (Al-Zayyat, 2007), and the results showed:
- On NEPS II scale tests, there are no differences in the mean scores of fourth and sixth graders with dysgraphia.
- On the NEPS II scale tests, there are differences in the mean scores of dysgraphia and their normal peers.

Second: Learning Disabilities associated with the Wechsler Scale

As for the studies related to the Wechsler Intelligence Scale, especially the intelligence of (PSI), Abu Drei and Al-Rosan (2021) conducted a study entitled "The psychometric characteristics of the Jordanian version from the Wechsler Intelligence Scale for Children- Fourth Edition (WISC-IV) for the school stage. "This study aimed to identify the characteristics of the psychometric features of the Wechsler Intelligence Scale for Children- Fourth Edition (WISC-IV) on a Jordanian hearing sample to assess mental capacity at the school level. (418) students were part of the study sample. To achieve the objectives of the study, the items of Validity, and reliability. Concurrent Validity with Goodenough- Harris Drawing Test Man (0.946), achievement (0.887), Pearson's correlation coefficient for (Verbal Comprehension Index, VCI) = (0.414-0.824), (Perceptual Reasoning Index, PRI) = (0.734-0.922), (Working Memory Index, WMI)= (0.743-0.930), (Processing Speed Index, PSI) = (0.643-0.954), Correlation coefficients for all subparagraphs between (0.602-0.823), Indications of the stability of the scale were also found in using Cronbach's alpha (0.928), the Test-Retest Reliability method was the coefficient of stability (0.888), reliability of standard are conveyed, Resident Agreement (0.890), Resident stability by Holste method (86.5%). The study recommends measuring and diagnosing students with the (WISC-IV) scale to identify strengths and weaknesses. And make an individual educational plan. Carrying out qualitative studies on the scale sub-tests.

Also, Abdul Rahman (2022) carried out a study titled "Comparing the psychological page of the Wechsler Intelligence Scale for Children and Adolescents, fourth picture, among a sample of children with

learning disabilities and normal children." The study sample included (30) children with (LD) with an average age of (91.5) months and a standard deviation (9.88) months, and (30) children without (LD) with an average age of (96.07) months and a standard deviation (15.1) month. They were chosen from the schools in the eastern region of Egypt and used the following tools: The Wechsler Children's Intelligence Scale-4, Abdul Raqib Al-Behairi Standardizing (2017), and the Illinois Test of Psycholinguistics, which was translated by Azza Abdel Aziz, yielded the following results:

- There are statistically significant differences in the total IQ score of the Wechsler Children's Intelligence Scale between children with (LD) and normal children.
- Statistically significant differences between performing children with (LD) and normal children in the scores of the main global indicators on the Wechsler Children's Intelligence Scale.
- It also revealed the existence of a separate psychological page on the Wechsler Intelligence Scale for Children for both (LD) and normal children.

AL-Saeed (2020) also carried out a study titled "The Knowledge Page of the Wechsler Scale of Children's Intelligence, Fourth Edition of a Sample of Children with Dyslexia, Abused." On the cognitive scale of the Wechsler intelligence scale for children, a comparison was made between the abused and LD children and the only children with dyslexia. The findings revealed:

- The presence of a distinct psychological page for children with dyslexia, whose treatment is not based on the Wechsler Scale of children's intelligence.
- Word Reasoning had the highest percentage of total domains, followed by (VCI) and speed (PSI).
- The sample of children with dyslexia and their mistreatment has an average IQ score as a percentage of their total IQ score.

And we discover this through a medical study about intelligence (PSI) and its significance in explaining the decline in mental ability. Each (Allen, Thaler, Donohue, Mayfield, 2010) conducted a study titled "The Wechsler Scale-4 for children with brain damage and compared the similarities and differences with The Wechsler Scale-3. aimed to assess children with brain damage, and although little information is available about these children's psychological characteristics, the current study dealt with the Wechsler Scale-4, as the sample included (61) children with brain damage. Compared to a subset of the standards used. The findings revealed:

- The children with brain damage had a relatively low score on all subtests of the Wechsler scale, as well as a significant decrease in intelligence (PSI) and subtest scores (Coding).

In addition, (San, Allen, Daniel, Puente, Neblina, 2010) conducted a study titled "The Validity of the Spanish Version Scale of the (WISC-IV) Scale for Clinical Diagnosis of a Sample of Children," with the study sample comprising (n = 107) Spanish-speaking children. The sample was divided for clinical diagnosis of (LD, ADHD, and epilepsy) for (n = 35) children diagnosed with various forms of brain dysfunction and the comparison group (n = 72) for normal children, with comparisons made between these two groups. The results of the groups and rationing sample showed the results:

- On working memory indicators, the clinical sample performed worse than the comparison samples (PSI). These findings support the validity of the WISC-IV Spanish language criteria, particularly when applied to a clinically referred sample with impaired brain function.

Also, (Calhoun, Mayes, 2005) conducted a study titled "Speed of execution in children with clinical disorders" to learn the ability of (PSI) for the first time on the Wechsler Scale (WISC-III) (1991) by David Wechsler, and little is known about its clinical significance. The study sample included children with neurological disorders in a reference sample (n = 980). (ADHD, autism, bipolar disorder, and LD). The results showed:

- The mean scores of (PSI) and (FDI) were lower than IQ and less than IQ (Verbal Comprehension, VCI), respectively (Perceptual Organization, POI).
- The (coding) test is less difficult than the (Symbol Search).

Most of these kids struggled with learning, attention, writing, and processing.

- The intelligence index (PSI) score was low.

When using the test (cancellation) on patients in hospitals to find out its effectiveness, (Ferber, Karnath, 2001) each conducted a study titled "How to evaluate spatial space, bisector line, and cancellation?" The (Cancellation) and (Division of the Line) tests were used to evaluate the spatial space. A recent comparison of these tests revealed double line dissociation, as patients performed poorly on the "half line" test but not on the "cancellation" test. This disparity raises the question of whether spatial space is still a theoretically meaningful entity. The tasks of the (line grading and cancellation) tests were compared in terms of their accuracy in detecting spatial space. (35) patients with a very specific spatial space were included in the study sample. The results showed:

- In the spatial space, 40% of patients had a severe decrease in the midline test.
- Cancellation tests were much better, as only (6%) of the cases were registered.
- The deviation in the meridian line is not primarily related to spatial space but may also be caused by other factors (visual problems, or which hand is used), and should thus be treated with caution in clinical diagnosis.

- Cancellation tests are a more useful tool for finding space.

Also, (Zhu, Chen, 2013) also conducted a study titled "The Clinical Diagnostic Benefit of the Wechsler Scale-4 Cancellation Test," which aimed to examine the empirical evidence for the clinical diagnosis of the Wechsler Scale for Children (WISC-IV) for the sub-test (Cancellation) by comparing data from (597) clinical and (597) matched children. The results of the Logistic Regression Model revealed that:

- The Cancellation subtest revealed significant deficits in children with mental disabilities, motor impairments, head injuries, autism, disorder, Asperger's, ADHD, LD, and math disorder.
- Children with intellectual disability and Asperger's disorder benefited from the (cancellation) test's random branch, whereas children with ADHD benefited from the (cancellation) test's regular branch.
- Variation in overall IQ, general ability, and cognitive efficiency index, where the cancellation sub-test added a unique diagnostic power to identify children with dyslexia, mild intellectual disability, head injuries, and motor disabilities.
- The existence of the benefit of the test (cancellation) in the clinical evaluation.

Methods and Procedures

This section provides a detailed description of the study subjects, the method of selection, and a description of the Wechsler Intelligence Scale as a study tool. It also describes methods for verifying the validity and reliability of these tests, as well as the study method and data statistical analysis.

Research approach:

This study is based on the use of the correlative descriptive approach, in order to suit the purposes of the study related to (VMI) and its relationship to the level of (PSI) among students with (LD).

Population and Sampling

The study population included (LD) students from Dammam's government schools, which totaled (81) in number.

Sample

The study sample consisted of (100) students, which consisted of (40) students from (LD), (40) normal students from Abdullah bin Yasser School, and (20) students from Amr bin Al-Jumouh School, which consisted of (10) students from (LD).and (10) normal students. The following table (1) shows the demographic distribution of the study sample by age, and the demographic Table (1) shows the distribution of subjects by age:

Table 1. Distribution of subjects (n=50) by age

Age	Frequency	Ratio
8-10 years	29	58.0
11-13 years	21	42.0
Total	50	100.0

Table (1) clearly showed that (58%) of the study sample members of students with (LD) were aged within the age group (8-10) years, and it was found that (42%) of the study sample members were aged within the age group is (11-13) years, and Figure No. (1) shows this:

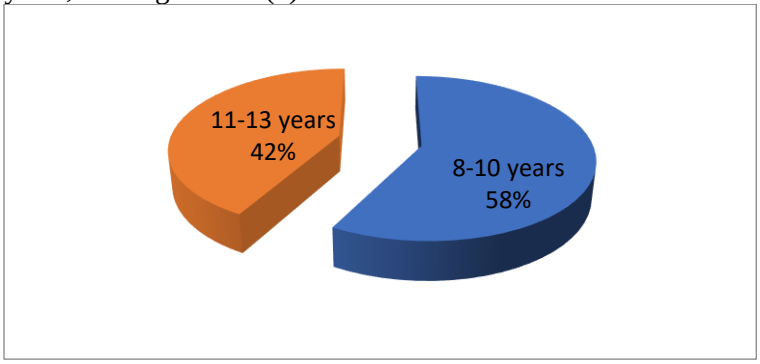

Figure No. (1) Distribution of the study sample by age

Instrument

Wechsler Scale (WISC-4) for children's intelligence for the age group (6-16.11) years.

The Wechsler Scale-4 for intelligence was standardized by Abu Drei (2017). The scale in the original version consisted of (4) sub-scales.

Description of the scale: The scale consists of verbal and performance tests, where the researcher used the following sub-performance test:

Intelligence (PSI): It comprises (3) tests, represented by:

1- Coding test: it includes (119) items.

Test application time: (120) seconds.

Duration of the test correction: (4) minutes

2- Symbol Search test: (60) items

Test application time: (120) seconds.

Duration of the test correction: (4) minutes

3- Cancellation test: It comprises two tests:

- Random Cancellation Test: (68) items
- Regular Cancellation Test: (68) items

Test application time: (45) seconds per test

Test correction time: (7) minutes for each test.

- Age group: It comprises (6-16.11) years

Test application method: individual

Cancellation is an additional, not essential, test in the scale.

Debug Test Key:

First: The Visual Integration Test Correction Key (Cancellation).

The visual synergy test (cancellation) comprises (random cancellation and regular cancellation), and each test had its assigned mark, which was the highest (68.00) and the lowest (0.00 zero), and a total score of (136.00) for both tests, by adding the scores of each test to get a total tag. Depending on the students' scores (LD) from the Cancellation sub-tests, the students' scores were treated as follows to determine the students' achievement level according to the following equation: The highest value of the sign - the lowest sign divided by the number of levels, i.e.,

$\frac{68 - 0}{3} = \frac{68}{3} = 22.66$ and this value is equal to the length of the category

Therefore, the low level of the visual integration level (cancellation) on the subtests (random cancellation and regular cancellation) is from (0.00 - 22.66). The average level of visual integration on the tests (random

cancellation and regular cancellation) is from (22.67 - less than 45.33). The high level of visual integration (cancellation) (random cancellation and regular cancellation) is from (45.34 - 68.00).

As for the total score of the Visual Integration Test (Cancellation), the correction key for the obtained marks was as follows:
The highest value of the sign - the lowest sign divided by the number of levels, i.e., $\frac{136 - 0}{3} = \frac{136}{3} = 45.33$ and this value is equal to the length of the category.

Thus, the low level of total visual integration (Cancellation) is from (0.00 – less than 45.33). And the average level of total visual integration (Cancellation) is from (45.34 – 90.67). The high level of total visual integration (Cancellation) is higher than (90.67–136)

Second: The key to correcting (PSI) intelligence tests.

The (PSI) test comprises two sub-tests (Coding; the lowest score was 0.00; the highest score was 119.00); and (Symbol Search; the lowest score was 0.00; the highest score was 60.00). total marks.

Depending on the scores of (LD) students got from the (PSI) tests, the scores of the students were dealt with as follows to determine the level of students' achievement according to the following equation:

Coding Test Debug Key
The highest value of the sign - the lowest sign divided by the number of levels, i.e., $\frac{119 - 0}{3} = \frac{119}{3} = 39.66$ and this value is equal to the length of the category.

So, the low level of Coding is from (0.00 - 39.66). And the average level of Coding is from (39.67 – less than 79.33). The high level of Coding is from (79.34 - 119).

Symbol Search Test Debug Key
The highest value of the sign - the lowest sign divided by the number of levels, i.e., $\frac{119 - 0}{3} = \frac{119}{3} = 39.66$ and this value is equal to the length of the category.

The highest value of the sign - the lowest sign divided by the number of levels, i.e., $\frac{60 - 0}{3} = \frac{60}{3} = 20.00$ and this value is equal to the length of the category

So, the low level of Symbol Search is from (0.00 – less than 20.00). The average level of Symbol Search is from (20.00–<40.00). The high level of Symbol Search is from (40.00 - 60.00).

Procedures for preparing the study tools for the Saudi sample
1- Permission to use part of the WISC-4 standard.
2- Preparing clear copies of the tests that match the original version of the tests.
3- Using the Saudi dialect in applying and explaining the test instructions.
4- Determine the age group.
5- All the tests were administered in the resource room individually.
6- Choosing the mourning period from (7 to 9:30) provided that this period does not conflict with the extra-curricular classes.
7- Correction of study tools after application to the study sample.
8- Unloading the results for each case according to the specified form for statistical treatment.

Study Procedures:

1- It was applied to an experimental sample (n = 10) in order to achieve the extent of language formulation and correction procedures.
2-The scale applied to a sample (LD) (n = 50).
3-The scale was applied to a sample of normal students (n = 50).
4- Divide the students into age groups (8-13).
5- Indications of validity and reliability of the study were reached.

Statistical Analysis:

To answer the research questions, the following statistical methods were utilized:
- Extracting frequencies and percentages to describe the study sample members
- Using the Pearson Correlation test and using Cronbach's alpha test to ensure the validity and reliability of the study tests.
- The orthogonal rotation test was used to verify the validity of the construction of the study tests.
- Arithmetic averages and standard deviations were used to identify the students' scores on the (Cancellation) and (PSI) tests.
- Using the Independent Sample T-test to identify the significance of differences in the levels of the study tests (Visual Integration "Cancellation", PSI "Coding, and Symbol Search") that are due to the variable of age, and verify the significance of the differences in the level of total intelligence (IQ) due to the variable of the type of students with (LD, and normal).
- Using the Pearson Correlation test to verify the relationship between visual integration (cancellation) and (PSI) among students with (LD).

Results and Discussion

The study's findings were sorted into the following categories:

The first question: What is the significance of the validity of the visual motor integration test and the processing speed index for students with learning disabilities?

The validity of the (VMI) and (PSI) tests for students with (LD) in the Kingdom of Saudi Arabia was verified through the following:

First: The validity of the visual integration test:

The validity of the visual integration test, which includes the cancellation test with its sub-dimensions (random and regular), was verified through the following methods:

1- Content Validity

The content validity method was used to validate the visual integration test (cancellation) and its two sub-tests (random test and regular test). Whereas the test was presented to (4) members of the faculty of Al-Balqa Applied University to express their opinions on the validity of the content, the affiliation of the questions to the test, and their suitability for measuring what they measured, and the clarity of the questions for students with (LD), a standard (80%) was adopted to show the validity of the test questions, and the researcher considered the arbitrators' opinions a source of information.

2- Construct Validity

The significance of the Construct Validity of the test was calculated by calculating the correlation of the sub-test score with the main test to which it belongs, for the study subjects where (n = 60), and Table (2) shows those results:

Table (2) Correlation coefficients of the subtest with the total score using the Pearson Correlation test to identify the Construct Validity of the Visual Integration test

Visual Integration (Cancellation)	

Random	Pearson Correlation	**934.
	Sig. (2-tailed)	.000
	N	30
Regular	Pearson Correlation	.937**
	Sig. (2-tailed)	.000
	N	30

**Statistically significant at (0.01)

Table (2) clearly shows that the correlation coefficients between the sub-tests and the total score of the Visual Integration test (Cancellation) were greater than (0.30), which is the minimum and acceptable value for distinguishing the test questions, and it approaches the value (1.00) significantly, showing that the sub-tests effectively contribute to the overall score of the Visual Integration test and that all sub-tests measure the same characteristic (random and regular).

The construct validity of the Visual Integration Test (Cancellation) was verified by (Varimax) method to reveal the importance of each subtest in the explained variance in the degree of the Visual Integration Test, and Table (3) shows this.

Table (3) Construct Validity for Visual Integration Test by (Varimax) Method

Factors of (VM)	Eigen Value	% of variance	Cumulative %
Random (1)	1.751	87.525	87.525
Regular (2)	.249	12.475	100.0

Table (3) clearly shows that the first component (random) accounted for (87.525) percent of the explained variance in the visual integration test (Cancellation), while the second component (regular) accounted for (12.475%) of the explained variance in the integration test. So, each sub-test is an important and complementary test to the other tests that comprise the visual integration test, with the sum of the explained variance for the two tests together accounting for (100%) of the explained variance in the formation of the visual integration test (Cancellation).

3- Concurrent Validity

The construct validity coefficient for the Visual Integration Test for Students (LD) was compared to the Visual Integration Test for Normal Students, where the correlation coefficients for the sub-tests (random, regular) with the total score for the Visual Integration Test for Students (LD) were (0.934, 0.937), respectively, with a statistical significance less than (0.01).

While the correlation coefficients for the subtests (random and regular) with the total score of the visual integration test for normal students were (0.965, 0.920), respectively, and the statistical significance was less than (0.01), the values are very similar and close to (1.00). for both groups (LD and normal students), as well as the concurrent validity range between the visual integration test (cancellation) for (LD) students and the visual integration test for normal students.

Second: The validity of the (PSI) test:

The validity of the (PSI) test, which includes the (Coding and Symbol Search) test, was verified by the following methods:

1- Content Validity

The Content Validity method was used to validate the (PSI) test and its two sub-tests (coding and symbol search). A standard (80%) was adopted to indicate the Validity of the test question, and as a result,

the test consisted of (2) two sub-tests (Coding and Symbol Search). The researcher regarded the arbitrators' opinions and amendments as evidence of the Content Validity Test (PSI).

2- Construct Validity

The Construct Validity of the test was calculated by calculating the correlation of the sub-test score with the main test to which it belongs, among the study members where (n = 60) are students with (LD), and table (4) shows those results:

Table (4) Correlation coefficients of the subtest with the total score using the Pearson Correlation test to identify the Construct Validity test (PSI)

(PSI)		
Coding	Pearson Correlation	.770**
	Sig. (2-tailed)	.000
	N	30
Symbol Search	Pearson Correlation	.474**
	Sig. (2-tailed)	.001
	N	30

**Statistically significant at (0.01)

Table (4) clearly shows that the values of the correlation coefficients between the sub-tests and the total score of the (PSI) test were higher than (0.30), which is the minimum and acceptable to distinguish the test questions, showing that the sub-tests effectively contribute to the total score of the (PSI) test. All sub-tests measure the same characteristic, confirming the test's construct validity, and thus the (PSI) test comprises two important sub-tests related to (PSI), namely (Coding and Symbol Search).

The Construct Validity test (PSI) was verified using the (Varimax) method to reveal the significance of each subtest in the explained variance in the degree of the (PSI) test, and Table (5) shows this.

Table (5) Construct Validity for (PSI) Test by (Varimax) Method

Factors of (PSI)	Eigen Value	% of variance	Cumulative %
Coding (1)	1.474	73.69	73.69
Symbol Search (2)	.526	26.31	100.0

Table (5) shows that the first component (coding) test explained (73.69%) of the explained variance in the (PSI) test, while the second component (Symbol Search) explained (26.31%). Each sub-test is an important and complementary test to the other tests that comprise the (PSI) test, with the sum of the explanatory variance of the two tests combined accounting for (100%) of the explained variance in the formation of the (PSI) test.

3- Concurrent Validity

The Concurrent Validity was used to confirm the validity of the (PSI) test for (LD) students, where the value of the construct validity coefficient of the (PSI) test for (LD) students was compared with the (PSI) test for normal students, where the value of the correlation coefficients for the tests (coding and symbol search) with the total score of the (PSI) test for (LD) students was (0.770, 0.474), respectively, and with a statistical significance less (0.01).

The value of the correlation coefficients of the sub-tests (Coding and Symbol Search) with the total score of the test (PSI) for normal students is (0.820, 0.876), respectively, and the statistical significance is less

than (0.01), which shows concurrent validity between (PSI) tests. For (LD) students with the (PSI) test for ordinary students.

The Second question: What is the significance of the reliability of the visual motor integration test and the processing speed index for students with learning disabilities?
The reliability of the (VMI) and (PSI) tests for students with LD has been verified through:
First: reliability test for visual integration (Cancellation):

The overall score was calculated by using the consistency of each sub-test of the sub-tests (random, regular) with the total score of the test to which the visual integration test belongs, where it was then used to calculate the correlation coefficients between each sub-test of the tests with the total score by using the coefficient (Cronbach's alpha). The reliability coefficient of Cronbach's alpha for the sub-tests and the overall score was (0.700), which is acceptable for the curriculum study.

Second: reliability test for (PSI):
The reliability of the (PSI) test, which includes the (Coding and Symbol Search) test, is verified by the following methods:
Internal consistency method using the Cronbach Alpha test.

The correlation coefficients between each sub-test of the tests (Coding, and Symbol Search) and the total score of the test to which it belongs (PSI) were calculated using Cronbach's alpha coefficient. Cronbach's alpha reliability coefficient was (0.825) for the sub-tests and overall score, which is acceptable for the current study.

The third question: What is the level of visual motor integration and the processing speed index for students with learning disabilities?
Arithmetic averages and standard deviations were extracted to identify the level of visual integration and (PSI) among (LD) students, and the results are:
First: The level of visual integration (Cancellation) among (LD) students:
Arithmetic averages and standard deviations were extracted to identify the level of visual integration (Cancellation) of (LD) students through the students' scores on my tests (random and regular), and table (6) shows that:

Table (6) Arithmetic averages and standard deviations to identify the level of visual integration among (LD) students

				verified marks		Arithmetic mean	standard deviation	Rank	Level
NO.	visual integration (Cancellation)	Minor degree	Grand degree	Mino	Grand				
2	random	0.00	68.00	6.00	25.00	12.46	6.00	1	Low
1	regular	0.00	68.00	4.00	23.00	10.50	4.00	2	Low
	Total of visual integration (Cancellation)	0.00	136.00	11.00	48.00	22.96	11.00		Low

Table (6) shows that the arithmetic averages of (LD) students' scores on the sub-tests ranged between (12.46 and 10.50), with the score for visual integration (cancellation) of the (LD) students receiving an arithmetic mean of (22.96 out of 136) with a standard deviation of (11.00), which is very low.

The (regular) test came in first, with the highest arithmetic mean (12.46 out of 68.00) and standard deviation (6.00), both of which are very low, and the random test came in second, with an arithmetic mean of (10.50 out of 68.00) and standard deviation (4.00), both of which are also very low.

Second: The level of (PSI) for students of (LD):

The arithmetic means and standard deviations were extracted from the students' scores on the Coding test and the Symbol Search test to identify the level of (PSI) among (LD) students, as shown in table (7):

Table (7) Arithmetic averages and standard deviations to identify the level of (PSI) for students of (LD)

				verified marks		Arithmetic mean	standard deviation	Level
NO.	(PSI) tests	Minor degree	Grand degree	Mino	Grand			
1	Coding	0.00	119.00	0.00	14.00	6.80	3.12	Low
2	Symbol Search	0.00	60.00	4.00	13.00	7.10	2.26	Low
	Total of (PSI)	0.00	179	7.00	24.00	13.90	3.48	Low

Table (7) shows that the arithmetic averages of (LD) students' scores on the (PSI) tests ranged between (6.80 and 7.10) on the Coding and Symbol Search tests, where the (LD) students received the (PSI) with a total score of (13.90). And with a standard deviation (3.48) that is close to zero from a very low level.

The coding test came in first, with the highest arithmetic mean (6.80 out of 119) and standard deviation (3.12), both of which are very low, and the Symbol Search test came in second, with an arithmetic mean (7.10 out of 60.00) and standard deviation (2.26), both of which are also very low.

The fourth question: Is there a statistically significant relationship at the level of significance ($\alpha = 0.05$) between the visual motor integration test and the processing speed index among students with learning disabilities?

Correlation coefficients were extracted using the Pearson Correlation test to identify the relationship between visual integration and (PSI) among (LD) students, and Table (8) shows these results.

Table (8) Pearson Correlation Test to identify the relationship between visual integration and the level of (PSI) for students of (LD)

		Random	Random	Total visual integration
Coding	Pearson Correlation	-.042	.017	-.013
	Sig. (2-tailed)	.774	.906	.930
	N	50	50	50
Symbol Search	Pearson Correlation	.271	.199	.251
	Sig. (2-tailed)	.057	.166	.079
	N	50	50	50
Total of (PSI)	Pearson Correlation	.139	.145	.152
	Sig. (2-tailed)	.335	.316	.293

	N	50	50	50

Table (8) showed that there was no statistically significant relationship at the significance level (0.05) between visual integration and the sub-tests (coding, symbol search) and the level (PSI) with the sub-tests (random, regular), with all correlation coefficient values being non-significant. According to statistics, visual integration has no effect on (PSI) among (LD) students in the Kingdom of Saudi Arabia.

The fifth question: Are there statistically significant differences at the significance level ($\alpha = 0.05$) in the overall intelligence level of the processing speed index attributable to the type of students (students with learning disabilities and normal students)?

Arithmetic averages and standard deviations were extracted and an Independent Sample t-test was used to identify the significance of differences in the overall intelligence level of (PSI) due to the variable type of students (LD, and normal students), and table (10) shows that:

Table (10) An Independent Sample T-test to identify the significance of the differences in the total intelligence of (PSI) due to the variable of the type of students

source	student type	No.	Arithmetic mean	Standard Deviation	The difference between the mean and the value (t)	value (t) table	Degrees of Freedom	Statistical Significance
Total of (PSI)	LD	50	65.06	6.80	36.00-	-26.435	98	*0.000
	Normal students	50	101.06	6.82				

*: Statistically significant at significance level (0.05) or less, tabular t-value = (±1.96).

Table (10) shows that there are statistically significant differences in the overall intelligence level of (PSI) due to the variable type of students (LD and normal students), where the statistic (t) reaches (-36.00), which is greater than its value. Tabular (-1.96). (-1.96). According to the findings, the arithmetic mean of total intelligence (PSI) for students with LD was (65.06), while the arithmetic mean of total intelligence (PSI) for normal students was (65.06). (101.06). The differences in arithmetic average values favored the category of ordinary students, with a noticeable increase in the arithmetic mean value of total intelligence (PSI) for them.

Discussion

1. **What are the signs of the validity and reliability of the tests of visual memory and intelligence of working memory among students with Learning Disabilities?**

The study's findings revealed that the validity of the visual integration test was (80%) through the validity of the (cancellation) test with its two sub-tests (random and regular). The construct validity of the correlation coefficient values between the subtests and the total score of the visual integration test (cancellation) was greater than 0. (0.30). Concurrent validity for (LD) students compared to normal students, with the correlation coefficients for the sub-tests (random, regular) with the total score of the visual integration test for (LD) students being (0.934, 0.937), respectively.

And for normal students, the correlation coefficients of the sub-tests (random and regular) with the total score of the visual integration test are (0.965, 0.920), respectively, and the statistical significance is less than (0.01), showing similarity for both groups (LD and normal students).
The results showed that the PSI test's content validity was (80%). The construct validity of the correlation coefficient values between the sub-tests and the total score of the (PSI) test was greater than (0.30). Concurrent Validity Through Construct Validity for the (PSI) test for (LD) students with the (PSI) test for normal students, the value of the correlation coefficients for the sub-tests (Coding and Symbol Search) with the total score of the (PSI) test for (LD) students (0.770, 0.474) respectively.

And the correlation coefficients for the sub-tests (coding and symbol search) with the total score of the test (PSI) for normal students are (0.820) and (0.876), respectively, and the statistical significance is less than (0.01). This shows a concurrent validity between tests (PSI) for both groups (LD and normal students).
- The results of the study agreed with Abu Drei and Al-Rusan (2021) and the study (Abu Drei, 2017) that the content validity was represented by an agreement percentage (80%), and construct validity was higher than (0.30). She also agreed with (San, Liza, Daniel, Allen, Puente, Cris, 2010) that the validity of the Spanish version of the WISC-IV scale can evaluate the clinically referred sample with poor brain function.
- The researcher's interpretation: of the researcher: that the various validity coefficients by any of the previous methods are acceptable and good, and show that there is a correlation between the scales used and the measures of the characteristics of students with (LD).

2. What is the significance of the reliability of the visual motor integration test and the processing speed index for students with learning disabilities?

The results showed the reliability of the visual integration test through content validity of the test (cancellation) with two sub-tests (random and regular) using Cronbach's alpha coefficient for the sub-tests and the total score (0.700).

The results showed that the reliability of the PSI test using the internal consistency method using Cronbach's alpha test was the value of Cronbach's alpha reliability coefficient for the sub-tests and the total score (0.825).

- The results of the study agreed with Al-Hanaiah (2019), Abu Drei and Al-Rusan study (2021), and Abu Drei study (2017) that the test has acceptable degrees of reliability.
- Interpretation of the researcher: that the various reliability coefficients obtained using any of the methods described above are acceptable and good, and that there is a correlation between the measures used and the characteristics of students with (LD).

3. What is the level of visual motor integration and the processing speed index for students with learning disabilities?

The results showed that the level of visual integration (cancellation) of the (LD) students was such that the arithmetic mean of the student's scores on the sub-tests ranged between (12.46 and 10.50), which is a very low level.

The results showed that the level of speed (PSI) of (LD) students that the arithmetic averages of their scores on tests ranged between (6.80 and 7.10), which is a very low level.
- The study's findings agreed with AL-Saeed (2020) that the last test is the Coding test. Noor (2018) also agreed that the level of (VMI) was low. It also agreed with (Allen, Thaler, Donohue, Mayfield, 2010) that the group of children with brain damage had a relatively low score on all Wechsler scale subtests and a significant decrease in intelligence (PSI) and Coding subtest scores. It also agreed with (San, Liza, Daniel, Allen, Puente, Cris, 2010) that the clinical sample performed worse on working memory indicators than the comparison samples (PSI). also agreed with (Calhoun, Mayes, 2005) about the low IQ level. I also agreed with Calhoun and Mayes (2005) that the (Coding) test is less demanding than the (Symbol Search) test. I

also agreed with (Ferber, Karnath, 2001) that the cancellation tests were far superior to the Coding and Symbol Search tests. It also agreed with (Zhu, Chen, 2013) that students with learning disabilities performed significantly worse on the sub-cancellation test.
- The results of the study differed from AL-Saaed (2020) in that the percentage of total domains was the highest in cognitive reasoning, followed by verbal comprehension, and then (PSI).
- The researcher's interpretation: the level of (PSI) of (LD) students in (VMI) was low because the overlap of shapes and similarity of some symbols led to a lack of distinction between them, resulting in a clear decline, which is a characteristic of (LD) students (LD).

4. Is there a statistically significant relationship at the level of significance (α = 0.05) between the visual motor integration test and the processing speed index among students with learning disabilities?

The results showed that there was no statistically significant relationship at the significance level (0.05) between visual integration with the sub-tests (coding, symbol search) and the level (PSI) with the sub-tests (random, regular).
- The results of the study agreed with Ibrahim (2019) that there are no differences in the grade averages of students with (LD) handwriting on the kinesthetic domain tests.
- The findings differed from Mubarak's (2021) findings that all sub-tests of the Wechsler Scale, except for the Comprehension and Coding tests, can predict cognitive problems and that the four components of the Wechsler Scale's psychological page, except the (PSI) component, can predict cognitive problems. It also differed from Badran (2021) in the presence of statistically significant differences in using the learning-by-play training program in developing sensory integration skills among students with autism (LD). It also differed from Al-Najjar (2020), who claimed that there is a positive, statistically significant correlation between cognitive flexibility (VMI) and emotional change in students with nonverbal (LD) in the primary stage.

- The researcher's interpretation: the cancellation test (regular or random) used on them is considered an important clinical test because it measures the ability to think, pay attention, focus, distinguish shapes and colors, and then cancels the images designated for that. We are seeing a clear decline in (LD) students during this process. While the (Coding and Symbol Search) test is important, it shows that the students are not accustomed to holding the pen and writing accurately with special symbols under time constraints, and they are in a poor position in their response to this test because of the motor and visual speed factors.

5. Are there statistically significant differences at the significance level (α = 0.05) in the overall intelligence level of the processing speed index attributable to the type of students (students with learning disabilities and normal students)?

The results showed that there were statistically significant differences at a significant value (0.05) in the level of total intelligence of (PSI) due to the variable type of students (LD, and normal students), with an arithmetic mean of total intelligence for students with (LD) (65.06), while the arithmetic mean of total intelligence reached for (PSI) for ordinary students (101.06), and the differences between the values of the arithmetic averages were in favor of the category of ordinary students.
- Results agreed with Abd al-Rahman (2022) that there are statistically significant differences between performing children with (LD) and normal students in the overall intelligence of the Wechsler scale.
- The results differed from AL-Saeed (2020) in that the percentage of the total intelligence degree of the sample of children with dyslexia who were abused falls into the category of average intelligence.
- The researcher's interpretation: We conclude that the LD students had a mild intellectual disability in terms of intelligence (PSI) based on the previous results and the clinical significance coefficients of the sub-tests, noting that if the Wechsler scale was used in all of its tests, the result would be within the category (LD) only, but because of the importance of (PSI), as well as their characteristics, this resulted in an intersection with a category of mild intellectual disability.

Recommendations:

- Educational recommendations:
  - Raising the level of awareness among teachers of the importance of (VMI) in the category of (LD).
  - Training (LD) students on (VMI) skills.
  - Interest in mental ability tests associated with (VMI).
- Suggestions for research purposes.
  - Conducting studies related to comparing intelligence (PSI) with the category of mild intellectual disability.
  - Conducting studies related to comparing intelligence (PSI) with categories (LD).
  - Conducting studies related to comparing intelligence (PSI) with memory and attention (LD).

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