

Cognitive Intervention for Learners with Neurogenic Learning Disabilities

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Abstract: This paper explores the concept of neurogenic learning disabilities, a category of learning difficulties rooted in neurological dysfunctions that affect the cognitive and academic performance of learners with otherwise average or above-average intelligence. The study highlights the historical evolution of the concept, its diagnostic criteria, and the neurological, hereditary, developmental, and environmental factors contributing to its emergence. It further examines major diagnostic tools and multidisciplinary assessment procedures used to identify learners with neurogenic learning disabilities. Particular emphasis is placed on cognitive and therapeutic pedagogical strategies, including psychological processing training, cognitive strategies of attention, encoding and retrieval, task analysis, multisensory structured teaching, and computer-assisted intervention. The paper concludes by underscoring the crucial need for accurate diagnostic practices, specialized multidisciplinary teams, and coordinated institutional efforts to ensure effective cognitive intervention and improved educational outcomes for this population.

Keywords: Neurogenic learning disabilities; cognitive intervention; neurological dysfunction; diagnostic assessment; cognitive strategies.

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1- Introduction

There is no doubt that the concepts surrounding learning disabilities, as well as the authorities responsible for providing services to this population, remain blurred and often overlapping. Therefore, there is an urgent need to clarify the term *learning disabilities* in an official and precise manner, and to emphasize that learners with learning disabilities constitute a distinct group that differs from other categories requiring remedial instruction. This distinction stems from their unique characteristics and from the diversity of theoretical models that explain their difficulties—models that highlight the necessity of adapting and developing the skills, abilities, and readiness of learners with learning disabilities in alignment with instructional content within a therapeutic–educational framework.

This perspective has given rise to a specialized orientation within the field of special education: therapeutic pedagogy, of which learning disabilities form one of the central domains.

Learning disabilities represent the most common category addressed by therapeutic pedagogy due to their high prevalence among school-aged children. Despite their frequency, diagnostic and classification procedures remain insufficiently precise. Learning disabilities are lifelong conditions often accompanied by secondary difficulties that may hinder the success of the teaching–learning process and, consequently, contribute to significant losses in educational outcomes.

2-The Nature of Neurogenic Learning Disabilities

The concept of learning disabilities has attracted the attention of numerous scientific disciplines, foremost among them the medical field, which attributes learning disabilities to mild brain dysfunction or neurological injury. As a result, the term *learning disabilities* later became a central focus for psychologists and educators alike. Due to this multidisciplinary interest, several related terms emerged—such as *hidden disability*, *minimal brain dysfunction*, and *brain injury*—yet the term *learning disabilities* itself did not appear until the 1960s, following extensive debates among specialists in medicine, psychology, and education. Samuel Kirk was the first to introduce the term in 1962.

Before becoming an established concept, learning disabilities underwent several developmental stages. The first was the *brain injury stage*, rooted in the work of Strauss and his colleagues. The second stage—shaped by the efforts of Clemons—was known as *minimal functional impairment*. The third and final stage was the period during which the term *learning disabilities* emerged, due largely to the work of Kirk (as cited in Ouda & Feqiri, 2016, p. 147). Despite this progression, the term continued to generate substantial debate, prompting specialized committees and professional associations to propose definitions acceptable across disciplines.

In practice, *learning disabilities* is an umbrella term describing a group of children in regular classrooms who demonstrate significantly lower academic achievement than their peers despite possessing average or above-average intelligence. These learners experience difficulties in cognitive processes essential for learning—such as comprehension, reasoning, perception, attention, reading, writing, spelling, speech, and mathematical operations. Importantly, learning disabilities exclude conditions primarily attributable to intellectual disability, emotional disturbance, visual or auditory impairments, or multiple disabilities (Ghani, 2010).

Kirk (1962), in Hallahan, Kauffman, Lloyd, and Weyss (2007, p. 51), defined learning disabilities as a delay, disorder, or deviation in the development of one or more of the processes involved in speech, language, reading, writing, mathematics, or other academic domains. These difficulties stem from psychological impairments arising from disturbances in brain functioning and/or behavioral–emotional disorders. Learning disabilities are not caused by intellectual disability, sensory impairments, or cultural or instructional deprivation.

3- Causes of Neurogenic Learning Disabilities

Identifying the causes of learning disabilities is essential for providing appropriate educational and clinical services. Although research has not yet reached definitive conclusions regarding their etiology, a large body of empirical studies indicates a strong association between learning disabilities and acquired brain injuries or minimal neurological dysfunction (Awwad, 2009, as cited in Al-Juhani, 2013, p. 34).

3-1- Neurological Functional Impairment

A significant portion of the rationale for viewing neurological functional impairment as a primary cause of learning disabilities is historical and inferential. Neurologists and specialists observed that many of the behavioral and learning characteristics displayed by individuals with brain injuries are remarkably similar to those observed in children with learning disabilities. Thus, behavioral patterns and learning difficulties found in individuals with brain lesions, strokes, or penetrating head injuries also appear—though to a lesser degree—among many children with learning disabilities.

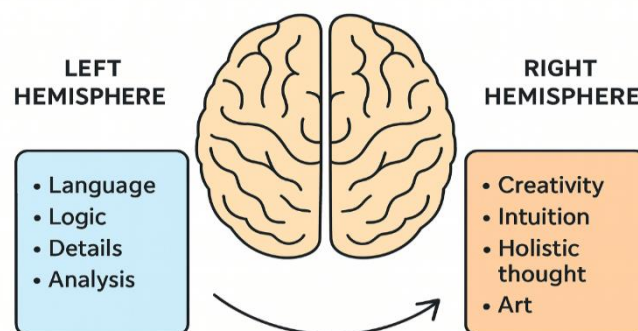
For example, behavioral patterns associated with cerebellar damage or cortical impairment—such as motor coordination deficits, attention difficulties, language problems, and memory weaknesses—have been documented among children with learning disabilities (Hallahan, Lloyd, Kauffman & Weyss, 2007, p. 114).

Independent research teams have also revealed significant structural and functional differences between the brains of individuals with learning disabilities and those without such difficulties. Although researchers do not always identify the exact same brain regions, a sufficient level of consistency allows for several conclusions:

- The **left cerebral hemisphere** is frequently implicated in functional impairment, although some research also reports abnormalities in the right hemisphere.
- Areas commonly associated with dysfunction include:
 - **Broca's area**
 - **The temporal lobe surface**
 - **Wernicke's area**
 - **The angular gyrus**

Research has been less consistent regarding other regions—such as the occipital lobes, parietal lobes, and the corpus callosum—although some studies suggest their involvement in specific learning processes (Hallahan et al., 2007, p. 116).

Figure(1) : A schematic illustration of the functional specialization of the cerebral hemispheres



3-2- Factors Contributing to Neurological Dysfunction

Several categories of factors may contribute to neurological impairment leading to learning disabilities:

a- Genetic Factors

Studies indicate that **20–35%** of learning disabilities occur among siblings, while rates rise to **65–100%** among identical twins (Mansour, 2003, as cited in Ibrahim, 2010, p. 57). Other research shows that **35–45%** of first-degree relatives of children with learning disabilities also exhibit similar difficulties. Additionally, Beitchman (1992) and Lewis (1992) reported a strong familial transmission pattern in language and communication disorders.

b- Teratogenic Factors (Factors Causing Developmental Abnormalities)

These include any influences that disrupt fetal development, such as medications taken during pregnancy, exposure to nicotine, alcohol, or drugs—all of which may cause neurological damage to the fetus (Ghani, 2010, p. 153).

c- Environmental Factors

Environmental pollutants such as **lead** and **cadmium** have been shown to negatively affect neural development (Muflih, 2004, in Ghani, 2010, p. 154). Malnutrition and inadequate healthcare can also contribute to neurological problems that lead to learning difficulties. Beckerman (2004) noted that severe early childhood malnutrition significantly impairs the acquisition of academic skills (Ibrahim, 2010, p. 57). Imbalances in biochemical elements essential for human functioning—such as vitamins and minerals—can also affect brain cells. Similarly, artificial food additives, colors, and preservatives may influence neurological functioning in susceptible children.

d- Pre-, Peri-, and Postnatal Factors

- **Prenatal factors:** prematurity, hemorrhage, poisoning, and low birth weight.
- **Perinatal factors:** difficult deliveries, cesarean sections, forceps use, or oxygen deprivation.
- **Postnatal factors:** injuries, accidents, infections, and head trauma.

4- Diagnosis and Its Steps for Individuals with Neurodevelopmental Learning Difficulties

4-1- Nature of Diagnosis

Diagnosis, whether educational or medical, represents the primary step in treatment and rehabilitation, as well as the first step in appropriately addressing any difficulty or disorder a child may experience. London (2007, p. 410) emphasizes that diagnosis is an essential process that precedes the determination of intervention strategies, and that the earlier it is conducted in a child's life, the more effective the intervention's impact on the child's behavior. He also notes that diagnosis is based on behavior rather than cause (Masad Abu Al-Diyar, 2012, p. 20).

Typically, the identification and diagnosis of learning difficulties begin during the primary school years when children are required to learn reading, spelling, writing, and mathematics. However, warning signs such as language delays or deficits, difficulties with counting or numerical concepts, and challenges in fine motor skills often appear in early childhood before formal schooling begins. Robinson (1995, p. 35), cited in Omnia Haroun (2018, p. 53), points out that the main purpose of early identification of children with significant developmental deviations is not merely diagnosis but rather the prediction of potential problems that could substantially impact the child's development and future.

Kirk and Calvant (1988, pp. 83–89), cited in Masad Abu Al-Diyar (2012, p. 70), proposed a six-stage plan to identify children with learning difficulties:

- **Identification of low-performing children**, which can occur at home or school.
- **Observation and description of behavior**, such as reading skills and methods.
- **Informal assessment**, excluding certain cases such as environmental or cultural deprivation.
- **Formal evaluation by a multidisciplinary team**, serving as a multi-criteria-based diagnostic process.
- **Documentation of diagnostic results.**
- **Planning a therapeutic program.**

4-2- Methods and Tools for Diagnosing Learning Difficulties

Diagnosis must be conducted by a **multidisciplinary team** using both formal and informal achievement, cognitive, and psychological tests. These tools assess and diagnose multiple aspects to provide a comprehensive diagnostic profile for individuals with learning difficulties. Notable instruments include:

- **Illinois Test of Psycholinguistic Abilities (ITPA):**
This test measures and diagnoses aspects of receptive and expressive language, particularly in children with learning difficulties. It is administered to children aged 2–10 years and is recognized as a standardized and widely used measure in the field of learning difficulties. The test consists of 12 subtests covering linguistic communication methods and levels, as well as the underlying psychological processes.
- **Michael Best Test for Identifying Children with Learning Difficulties:**
Designed to identify students with learning difficulties aged 6–12 years, this test provides scores for overall performance, verbal subtests, and non-verbal subtests. It consists of 24 items distributed across five subtests:
 1. **Auditory Comprehension Test** – 4 items
 2. **Language Test** – 5 items
 3. **General Knowledge Test** – 4 items
 4. **Motor Coordination Test** – 3 items
 5. **Personal and Social Behavior Test** – 8 items
- **Diagnostic Assessment Battery for Learning Difficulties (Zayat, 2007):**
This battery is often used for early detection and diagnosis of learning difficulties from grades 3 to 9. It consists of 16 independent scales: five assess cognitive processing disorders (attention, auditory perception, visual perception, motor perception, and memory), three assess academic learning difficulties (reading, writing, mathematics), and the remaining eight assess emotional and social behavior difficulties.
- **Rapid Neurological Screening Test (Abdel Wahab Kamel, 1998):**
A brief individual method to identify learning difficulties, taking approximately 20 minutes. It provides objective observations of neurological integration and includes 15 tasks derived from neurological examinations for children. These tasks assess hand skills, shape recognition, visual tracking, sound patterns, finger-to-nose accuracy, bilateral stimulation, rapid alternating movements, limb extension, tandem walking, standing on one leg, and irregular behavioral observations. Scores above 50 indicate a high level of difficulty, scores 25 or below indicate normal neurological function, and scores between 25 and 50 suggest potential neurological issues.

➤ **Early Detection Questionnaire for Developmental Learning Difficulties in Kindergarten Children (Ages 5–6) (Ismail Al-Farar, 2005):**

This questionnaire identifies developmental learning difficulties in four areas:

1. Motor difficulties
2. Cognitive difficulties
3. Language development difficulties
4. Socio-emotional difficulties (appropriate social interaction)

The questionnaire is completed by the child's kindergarten teacher, with scores assigned according to the response levels. The total score is 220; a score below 60% (i.e., 122 points) indicates developmental learning difficulties. A 60% score in a specific domain indicates difficulty in that particular area.

The foregoing is summarized in the table below

Table (1): Methods and Tools for Diagnosing Learning Difficulties

Diagnostic Tool	Purpose	Target Age Group	Key Components / Notes
Illinois Test of Psycholinguistic Abilities (ITPA)	Measures receptive and expressive language skills; identifies language-related learning difficulties	2–10 years	12 subtests covering linguistic communication methods and associated psychological processes
Michael Best Test	Identifies students with learning difficulties; provides overall, verbal, and non-verbal scores	6–12 years	24 items across 5 subtests: Auditory Comprehension (4), Language (5), General Knowledge (4), Motor Coordination (3), Personal & Social Behavior (8)
Diagnostic Assessment Battery for Learning Difficulties (Zayat, 2007)	Early detection of cognitive, academic, and behavioral difficulties	Grades 3–9	16 independent scales: 5 for cognitive processing (attention, auditory/visual perception, motor perception, memory), 3 for academic skills (reading, writing, mathematics), 8 for emotional/social behavior
Rapid Neurological Screening Test (Abdel Wahab Kamel, 1998)	Objective assessment of neurological integration and potential developmental disorders	Children (various ages)	15 tasks derived from neurological exams (hand skills, shape recognition, visual tracking, bilateral stimulation, motor coordination, behavioral observations). Score interpretation: >50 high difficulty, 25–50 potential neurological issues, ≤25 normal
Early Detection Questionnaire for Developmental Learning Difficulties (Ismail Al-Farar, 2005)	Identifies developmental learning difficulties in kindergarten children	5–6 years	4 domains: motor, cognitive, language, socio-emotional; total score 220. <60% indicates learning difficulties; 60% in a domain indicates difficulty in t

5- Educational and Learning Strategies Used to Support Individuals with Neurodevelopmental Learning Difficulties

The field of supporting individuals with learning difficulties encompasses a variety of strategies designed to help them learn effectively and efficiently. These strategies include cognitive, educational, and learning-based approaches (Zayat, 2007, pp. 35–36). Below, the most prominent therapeutic cognitive-educational strategies for individuals with learning difficulties are presented:

5-1- Strategy of Training Cognitive Processes

Proponents of this approach suggest that it is possible to identify the processes involved in learning tasks, after which children are trained to improve these processes. The assumption is that training these cognitive processes will enhance the acquisition of academic skills. In this approach, diagnosis and treatment of learning difficulties are based on identifying and analyzing the learner's strengths and weaknesses in specific learning skills (Suleiman Ibrahim, 2010, pp. 153–154).

5-2- Cognitive Strategies for Teaching and Learning

Cognitive strategies are significant because many cognitive tasks can be performed in multiple ways, depending on individuals' diverse mental structures. Different individuals adopt varied approaches to the same task, relying on their past experiences, current knowledge, and abilities. Bisanz and Kail (1982), cited in Zayat (2007, p. 33), note that the effectiveness of a strategy depends on its intended goals. Cognitive strategies describe:

- The most effective cognitive mechanisms for performing complex tasks.
- The qualitative and quantitative characteristics of the solver's cognitive structures, including experiences, skills, and knowledge.

Thus, cognitive strategies refer to the ability to regulate the pace of executive processing of cognitive operations when performing tasks or solving problems. Strategies vary according to the demands of the task. Zayat (2007, pp. 38–41) identified several types of cognitive strategies used with individuals with learning difficulties in remedial teaching:

- **Attention-related cognitive strategies:** Mechanisms that enhance an individual's focus on relevant aspects while avoiding distractions during task performance.
- **Encoding-related cognitive strategies:** Encoding processes (visual, auditory, verbal, semantic, motor, and spoken encoding) in individuals with learning difficulties are influenced by the severity of perceptual difficulties (visual, auditory, or motor) and the integration of cognitive systems. Developmental difficulties often underlie encoding challenges. Two types of encoding strategies are distinguished (Zayat, 2007, pp. 39–40):
 1. **Focus strategy:** Searching for all shared features constituting a concept.
 2. **Scanning strategy:** Examining one feature of a concept across its attributes.
- **Retrieval-related cognitive strategies:** Retrieval refers to attempting to recall or retrieve previously stored information, either from short-term or long-term memory. Retrieval occurs in two ways:
 1. **Recall:** Retrieving information or experiences along with the associated context of time, place, or conditions in the absence of the original stimulus.
 2. **Recognition:** Functionally different from recall; both depend on previous experience and learning. Recognition begins with the identified item, while recall ends with the retrieved item.

5-3- Task Analysis Strategy

This therapeutic strategy involves breaking down educational tasks into smaller, trainable units or skills. Some specialists extend the concept of task analysis to include the description of teaching procedures used to train a skill, while others limit it to analyzing the content to be taught. More recent approaches combine cognitive process training with task analysis for learners with learning difficulties (Suleiman Ibrahim, 2010, p. 154).

5-4- Direct Brain Training Strategy

This cognitive therapy approach focuses on information processing to address learning difficulties. Studies have applied this method based on the **balance model**, presenting stimuli to activate the non-dominant hemisphere of children with learning difficulties, tailored to their dominant hemisphere. For instance, children with severe difficulties in learning alphabet letters may first learn them through singing and then practice writing them (Suleiman Ibrahim, 2010, p. 155, in Abbas Abdel Wahid, 2015).

5-5- Constructivist Teaching Strategy Based on Language Fundamentals and Multi-Sensory Approaches

Rooted in mid-20th-century educational research, this strategy is based on several principles (Abdul Sattar Mahfouzi et al., 2010, p. 35):

- Using multiple senses simultaneously.
- Organized, systematic, and cumulative teaching.
- Direct instruction.
- Diagnostic teaching.
- Synthetic and analytic instruction.

5-6- Semantic Feature Analysis Strategy

This strategy enhances students' vocabulary by linking words to concepts, improving comprehension and forming mental representations. It is particularly valuable for learners with limited vocabulary, who often face challenges across various academic domains. The strategy can be applied before or after reading: pre-reading involves teaching key words and concepts, while post-reading involves analyzing terms and concepts (Halehan, Kaufman, Lloyd & Weiss, 2007, p. 511).

5-7- Computer-Assisted Remedial Instruction

Computer-assisted programs provide high interactivity, responding to learners' questions, offering assistance, signaling errors, and generating unlimited exercises with varying difficulty levels based on learners' abilities (Mohammed Ghoneim, 2003).

Thurman conducted a survey on the use of computers in special education schools across several U.S. states. Results showed that 37% of schools used computers for exercises, modeling, and storing student information. Additionally, 70% of remedial teachers considered computers highly motivating for students, and 40% reported that computers enhanced students' self-concept (Al-Hamad, 1994, in Mahmoud & Al-Nahdi, 2014).

Advantages of computer-assisted instruction include:

- Suitable for all students, allowing individualized pacing.
- Encourages sustained engagement without fatigue.
- Provides immediate feedback and reinforcement without embarrassment.
- Reduces routine teacher workload.
- Individualizes learning.
- Increases attention and memory through use of sound, motion, and color.

Computers can deliver extensive practice, offer individualized attention, provide feedback in various forms, adapt exercises across topics, monitor student progress, and record weaknesses for future remedial planning (Ayman Mahmoud & Ghalib Al-Nahdi, 2014; Said Al-Yamami et al., 2010)

The foregoing is summarized in the table below

Table(2): Educational and Learning Strategies Used to Support Individuals with Neurodevelopmental Learning Difficulties

Strategy	Purpose / Goal	Method of Implementation	Target Group
Training Cognitive Processes	Improve underlying cognitive processes to enhance academic skill acquisition	Identify specific processes in learning tasks and train children to strengthen them	Children with learning difficulties
Cognitive Strategies for Teaching and Learning	Facilitate problem-solving and task performance using individualized cognitive approaches	Utilize attention, encoding, and retrieval strategies based on learners' experiences and abilities	Children with learning difficulties
Attention-related Cognitive Strategies	Enhance focus on relevant task elements and reduce distractions	Use cognitive mechanisms to direct and maintain attention during tasks	Children with learning difficulties
Encoding-related Cognitive Strategies	Improve processing and storage of information	Focus strategy (identify shared features of a concept) and scanning strategy (analyze individual features)	Children with learning difficulties
Retrieval-related Cognitive Strategies	Support recall and recognition of learned information	Recall (retrieve from memory) and Recognition (identify learned item)	Children with learning difficulties
Task Analysis Strategy	Break complex tasks into smaller, trainable units	Decompose educational tasks into sub-skills and apply sequential training	Children with learning difficulties
Direct Brain Training	Stimulate non-dominant hemisphere to enhance learning	Provide stimuli tailored to activate underused hemisphere; e.g., learning letters through singing and writing	Children with severe learning difficulties
Constructivist Multi-Sensory Teaching	Reinforce learning using multiple senses and structured instruction	Simultaneous multi-sensory input, organized cumulative teaching, direct and diagnostic instruction	Children with learning difficulties
Semantic Feature Analysis	Expand vocabulary and conceptual understanding	Teach key terms pre-reading or analyze terms post-reading to enhance comprehension and mental imagery	Children with limited vocabulary and learning difficulties
Computer-Assisted Remedial Instruction	Provide interactive, individualized learning and feedback	Use computer programs to generate exercises, monitor progress, provide immediate feedback, and maintain records	Children with learning difficulties; all ability levels

6-Conclusion

It is well established that educational measurement and diagnosis provide essential information that supports decision-making across all aspects of the educational process, including planning and monitoring. Accurate diagnosis of individuals with learning difficulties, which serves as the primary gateway to understanding their challenges and identifying their symptoms, is crucial for designing effective remedial programs.

Accordingly, the utmost importance lies in addressing the needs of individuals with learning difficulties, particularly through cognitive interventions. This requires a diagnostic approach based on precise and accurate description and interpretation of the difficulties encountered by this population. Achieving this depends on the expertise of the professionals involved, the objectivity and accuracy of tests and assessment tools, and the broader educational and societal awareness of the need to provide appropriate resources and conducive conditions for supporting and treating individuals with learning difficulties.

Therefore, it is essential to develop mechanisms that ensure coordination among all entities responsible for supporting individuals with learning difficulties, with the aim of academically and professionally qualifying specialists in this field.

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