Learning disorders: From the diagnostic manuals to the classrooms

What does it mean that a child presents with one or more learning disorders? Which criteria are used to establish such a diagnosis? Are children, parents, teachers, school administrators, and policy makers sufficiently informed about the implications of such a diagnosis?

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Executive summary

- The diagnostic criteria for learning disorders (LD) are included in the two most recognized classification systems of mental disorders: the International Classification of Diseases and Related Health Problems (ICD), developed by the World Health Organization (WHO), and the Diagnostic and Statistical Manual of Mental Disorders (DSM), from the American Psychiatric Association (APA).
- The definition of LD describes persistent difficulties in learning academic skills that remain unaccounted for by intellectual, neurological or motor disorders, sensory impairment, lack of availability of education, or by psychosocial adversity. A significant impairment in academic or occupational performance is also required for the diagnosis.
- Neuroscience research challenges the traditional classification systems and provides evidence in favour of a dimensional approach in researching the neurocognitive underpinnings of LD. Some neuroscience evidence is already integrated into the latest revisions of the definition of neurodevelopmental disorders (ICD-11 and DSM-5).
- The implementation of internationally shared criteria for the identification of individuals with LD and the dissemination of these criteria is strongly recommended, based on its implications for further research in diagnosis and remediation/intervention strategies, and for implementation of individual access to resources and support.

Introduction

What does it mean that a child presents with one or more LD? Which criteria are used to establish such a diagnosis? Are children, parents, teachers, school administrators, and policy makers sufficiently informed about the implications of such a diagnosis? Here, you will be presented with the two most recognized classification systems of mental disorders, which include definitions and diagnostic criteria for neurodevelopmental disorders in general, and for LD in particular. The rationale and key concepts behind the design of the diagnostic classifications, their application to clinical practice and research, and the implications in terms of access to health services and educational resources will also be discussed.

Classification systems of mental disorders

A classification is "an exhaustive set of mutually exclusive categories to aggregate data at a pre-prescribed level of specialization for a specific purpose (ISO 17115)"[1]. In other words, classification involves the categorization of events, objects, or behaviours in accordance to specific rules or criteria that allow identification of a common set of traits or fundamental "nature" across the collection under analysis but also reflects a specific intentionality, since they are established for attaining specific purposes.

From a philosophical point of view, in science, there are different views regarding how to classify phenomena. One view is that a scientific classification system should reflect the inherent "true essence" or "natural" structure of the world ("essentialism"). Hence, membership to a specific class is decided in accordance to definitive, binary criteria, so that it is always clear whether something belongs or not to a specific category because it is the inherent structure of the world in itself, and not our interests, that guides classification. On the other hand, arbitrary or artificial classifications are also possible when the phenomenon at hand can be measured and better described as a continuum or "dimension." In this case, it is possible to assign different values along the dimension used to quantify events or, say, behaviours, such as those relating to emotional expression or physical activity. In this instance, some people might be assigned higher and some lower values on the dimension. Of course, it is possible to produce a categorical classification out of dimensions, by using arbitrary cutoffs and creating subgroups. It is also possible to combine clear-cut categorical classifications and dimensional classifications that have been proven relevant when studying specific phenomena ("empiricism"). Finally, the goals behind uncovering consistent patterns and producing classifications are also highly influential when designing and adopting a classification system ("pragmatism")[2].

All these factors are critical. Take, for example, the case of psychiatric classification of mental health disorders. This stems from the observation of patterns of signs, symptoms, and traits that co-vary with the presence of specific forms of mental illness. This, in turn, may be traced back to the existence of biophysical and psychological factors that act as determinants of human development and interact with a limited and repetitive range of experiences to which people are exposed throughout their lives[2], across cultures.

Clinical classification assumes that shared covariance of signs and symptoms can be used to distinguish among classes of patients (although even patients within the same diagnostic category can display differences in signs and symptoms between them). The goals for a classification system for mental disorders include selecting treatment, increasing the homogeneity in the study of the factors that cause the disorders by producing more similar groups of subjects to be studied, maximizing the detection of individuals exhibiting disorders ("true positives") and healthy ones ("true negatives"), being measurable, being consistent with genetics and physiology data, being culturally congruent and clinically informative[2].

Health practitioners, particularly psychiatrists, employ the diagnostic manuals derived from the classification systems to determine the presence of mental disorders in the population. However, the currently available manuals describe symptoms and signs but are not able to explain the disorders. Hence, additional efforts are required to ascertain the validity, clinical utility, and cross-cultural applicability of the adopted diagnostic criteria, and to avoid the reification of the classifications.

The most recognized classification systems for mental disorders are currently the International Classification of Diseases and Related Health Problems, now in its eleventh revision (ICD-11)[1], and the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5)[3]. The ICD, developed by the World Health Organization (WHO), provides a common language for defining and communicating data about diseases and health conditions, including, mental, behavioural, or neurodevelopmental disorders. WHO's member states have agreed to use ICD as a framework for reporting health information to make data internationally comparable. ICD-6, approved in 1948, was the first version to include a classification of mental disorders[4]. ICD-10, the version currently in use, is the international standard for reporting diseases and health conditions. It is proposed to be used as the diagnostic classification standard for clinical and research purposes and allows the monitoring of the incidence and prevalence of diseases and the description of trends in health reimbursements and resource allocation. The ICD-11 was approved by the 62[nd] World Health Assembly in May 2019, to come into effect on January 1[st], 2022. On the other hand, the DSM, developed by the American Psychiatric Association (APA) was heavily influenced by previous American classification systems and the ICD-6. DSM-5, adopted in 2013, is the most recent version of the manual and was designed as an evidenced-based tool to guide clinicians in the assessment and diagnosis of psychiatric disorders[5]. Due to its compatibility with the corresponding ICD codes, DSM-5 is also used for billing purposes and for providing access to educational support in the United States of America and elsewhere. Both diagnostic systems have undergone extensive international expert consultations and field trials, conducted in clinical practice settings, to test their clinical utility[5-6].

The results of a global survey including 4,887 psychiatrists in 44 countries regarding their use of diagnostic classification systems in clinical practice, and the desirable characteristics of a classification of mental disorders, in the context of the revision of the ICD-10, showed that ICD-10 is the classification system psychiatrists use most in their daily clinical work (70.1% of the global sample), while the next was the DSM-IV (23.0%). A reported 5.6% of the sample used other classification systems (the Chinese Classification of Mental Disorders, the Cuban Glossary of Psychiatry, or the French Classification of Child and Adolescent Mental Disorders) and the rest (1.3%) reported they used previous versions of the ICD (ICD-9 or ICD-8). Use of ICD-10 was predominant in Europe. The DSM-IV was nearly universally used in the United States but was also common in other countries such as Argentina, Australia, Kenya, and Turkey[7]. Whereas the ICD is mostly used in everyday clinical practice, most (psychopathology) researchers seem to use the DSM operational criteria.[5]

Neurodevelopmental disorders and learning disorders

What does it mean that a child presents with one or more LD? According to the DSM-5, the diagnostic criteria for specific LD include[3]:

1. Difficulties learning and using academic skills, as indicated by the presence of at least one of the following symptoms that have persisted for at least six months, despite the provision of interventions that target those difficulties:
    - Inaccurate or slow and effortful word reading (e.g., reads single words aloud incorrectly or slowly and hesitantly, frequently guesses words, has difficulty sounding out words)
    - Difficulty understanding the meaning of what is read (e.g., may read text accurately but not understand the sequence, relationships, inferences, or deeper meanings of what is read)
    - Difficulties with spelling (e.g., may add, omit, or substitute vowels or consonants)

- Difficulties with written expression (e.g., makes multiple grammatical or punctuation errors within sentences; employs poor paragraph organization; written expression of ideas lacks clarity)
- Difficulties mastering number sense, number facts, or calculation (e.g., has poor understanding of numbers, their magnitude, and relationships; counts on fingers to add single-digit numbers instead of recalling the math fact as peers do; gets lost in the midst of arithmetic computation and may switch procedures)
- Difficulties with mathematical reasoning (e.g., has severe difficulty applying mathematical concepts, facts, or procedures to solve quantitative problems)

2. The affected academic skills are substantially and quantifiably below those expected for the individual's chronological age, and cause significant interference with academic or occupational performance, or with activities of daily living, as confirmed by individually administered standardized achievement measures and comprehensive clinical assessment. For individuals age 17 years and older, a documented history of impairing learning difficulties may be substituted for the standardized assessment.
3. The learning difficulties begin during school-age years but may not become fully manifest until the demands for those affected academic skills exceed the individual's limited capacities (e.g., as in timed tests, reading or writing lengthy complex reports for a tight deadline, excessively heavy academic loads).
4. The learning difficulties are not better accounted for by intellectual disabilities, uncorrected visual or auditory acuity, other mental or neurological disorders, psychosocial adversity, lack of proficiency in the language of academic instruction, or inadequate educational instruction.

Additionally, the classification allows for the specification of current severity, in terms of:

- *Mild*—some difficulties learning skills in one or two academic domains, but the individual may be able to compensate or function well when provided with appropriate accommodations or support services.
- *Moderate*—marked difficulties learning skills in one or more academic domains, the individual is unlikely to become proficient without some intervals of intensive and specialized teaching during the school years. Some accommodations or supportive services at least part of the day at school, in the workplace, or at home may be needed to complete activities accurately and efficiently.
- *Severe*—severe difficulties affecting several academic domains, the individual is unlikely to learn those skills without ongoing intensive individualized and specialized teaching for most of the school years. Even with an array of appropriate accommodations or services at home, at school, or in the workplace, the individual may not be able to complete all activities efficiently.

All diagnostic criteria are to be met based on a clinical synthesis of the individual's history (developmental, medical, family, educational), school reports, and psychoeducational assessment.

In the case of ICD-11, which follows a developmental approach, the equivalent term is *developmental LD*, and it is characterized by significant and persistent difficulties in learning academic skills, which may include reading, writing, or arithmetic. The individual's performance in the affected academic skill(s) is markedly below what would be expected for chronological age and general level of intellectual functioning, and results in significant impairment in the individual's academic or occupational functioning. Developmental LD first manifest when academic skills are taught during the early school years. Developmental LD are not due to a disorder of intellectual development, sensory impairment (vision or hearing), neurological or motor disorder, lack of availability of education, lack of proficiency in the language of academic instruction, or psychosocial adversity (Chapter 6)[1]. Both diagnostic systems include specifiers for the different academic domains and subskills addressed in the definitions (see Table 1). For ICD-11, severity levels are not specified.

Table 1. Domains specified in the definitions of DSM-5 and ICD-11 of LD.

DSM-5: Neurodevelopmental disorders (31): Specific LD:	ICD-11: Neurodevelopmental disorders: 6A03 Developmental LD:
315.00 (F81.0) With impairment in reading: • Word reading accuracy • Reading rate or fluency • Reading comprehension **Note:** Dyslexia is an alternative term used to refer to a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding, and poor spelling abilities. If dyslexia is used to specify this particular pattern of difficulties, it is important also to specify any additional difficulties that are present, such as difficulties with reading comprehension or math reasoning.	6A03.0 Developmental LD with impairment in reading: Characterized by significant and persistent difficulties in learning academic skills related to reading, such as word reading accuracy, reading fluency, and reading comprehension. **Inclusions:** Developmental dyslexia **Exclusions:** Disorders of intellectual development
315.2 (F81.81) With impairment in written expression: • Spelling accuracy • Grammar and punctuation accuracy • Clarity or organization of written expression	6A03.1 Developmental LD with impairment in written expression: Characterized by significant and persistent difficulties in learning academic skills related to writing, such as spelling accuracy, grammar and punctuation accuracy, and organization and coherence of ideas in writing. **Exclusions:** Disorders of intellectual development
315.1 (FBI .2) With impairment in mathematics: • Number sense • Memorization of arithmetic facts • Accurate or fluent calculation • Accurate math reasoning **Note:** Dyscalculia is an alternative term used to refer to a pattern of difficulties characterized by problems processing numerical information, learning arithmetic facts, and performing accurate or fluent calculations. If dyscalculia is used to specify this particular pattern of mathematic difficulties, it is important also to specify any additional difficulties that are present, such as difficulties with math reasoning or word reasoning accuracy.	6A03.2 Developmental LD with impairment in mathematics: Characterized by significant and persistent difficulties in learning academic skills related to mathematics or arithmetic, such as number sense, memorization of number facts, accurate calculation, fluent calculation, and accurate mathematic reasoning. **Exclusions:** Disorders of intellectual development
	6A03.3 Developmental LD with other specified impairment of learning: Characterized by significant and persistent difficulties in learning academic skills other than reading, mathematics, and written expression. **Exclusions:** Disorders of intellectual development 6A03.Z Developmental LD, unspecified

However, which tests should be employed or how to determine if performance is significantly lower than expected is not specified in the manuals and is the decision of the specialists involved with the diagnosis (see ref. [8] for an analysis of the different approaches to LD identification).

Neuroscience and the definition of specific learning disorders

Although the diagnosis of LD may seem relatively straightforward, indisputable evidence of their neurocognitive underpinnings remains elusive. Neuroscientists have committed to elucidating the neurocognitive architecture underlying LD with one major focus seeking to determine whether LD arise from the damage of basic abilities (such as phonological awareness for reading or number sense for math) required to acquire and process information in specific domains (the so-called "single deficit view"), or whether LD is the combined result of several dysfunctional mechanisms[9-14]. The latter

hypothesis has driven most of the research conducted on the subject, although the former has been supported by evidence showing different cognitive processes are affected in children with LD[15].

In this context, some neuroscientists have challenged the notion of LD being specific or even whether they should be termed as disorders; and there are advocates for a dimensional description of learning and academic performance that incorporates children that might otherwise be diagnosed with LD[9]. They argue the classification relies on arbitrary and often variable cutoffs that do not reflect the existence of qualitatively different neurocognitive foundations of performance in children with LD. Also, they allude to the high heterogeneity in the neurocognitive and academic performance profiles within the groups identified and the consistent co-occurrence of difficulties across multiple learning domains, or comorbity, among disorders. However, neuroscientists do not deny the practical value and clinical necessity of the fundamentally categorical classification systems currently in place and suggest their criticisms apply primarily to the research agenda in the field[15].

Note the ICD-11 definition does not includes the term "specific," but does include the term "developmental." Also, the design of both major classification systems is fundamentally evidence-based and considers data produced from cognitive neuroscience and neuropsychology. Also, the diagnostic manuals, although they are not "dimensional" systems per se, acknowledge the continuous nature of performance and the variability at the core of LD. In fact, both systems have included deficits in all domains of learning in the same diagnostic category.

Implications for teachers and policy makers

The implementation of up-to-date, standardized diagnostic criteria for LD is strongly recommended and, more specifically, the ICD-11 criteria, given current agreements among the WHO member states. The dissemination of these criteria among parents, teachers, school administrators, and policy makers is advisable, since their timely implementation has practical implications in terms of early detection, appropriate diagnosis, and access to remediation/intervention strategies, resources, and support. Within clinical settings, the diagnosis of LD implies more access to remedial teaching, special programs, and accommodations[9]. In most countries, provision of medical services also depends upon a qualifying diagnosis and so, in the absence of LD diagnosis, children and families may encounter difficulty in getting access available resources and intervention programs.

The process of integrating ICD within clinical processes is already on the way. This has been facilitated by the development of electronic health records and infrastructure for health care, automated treatment algorithms and care pathways, and increased implementation of standards of care and evidence-based guidelines, most of which rely on diagnostic categories[4]. Hence, it is advisable to work towards matching and keeping track of diagnoses and services, both in clinical and educational settings. The resulting information will allow assessment of the delivery of specific resources or programs and their corresponding outcomes. However, the legal implications and instruments required to achieve these kinds of applications of ICD in health/education systems need to be revised in the light of national and local laws and regulations.

Finally, active participation of teachers, school psychologists, and administrators, and the inclusion of educational settings involved in the attention to neurodevelopmental disorders in the field studies of future revisions of the ICD are also recommended.

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