ÖSSZEFOGLALÓ

A dyscalculia pedagógiai vizsgálata egy speciális mérőeljárás. A Diszkalkulia Pedagógiai Vizsgálata koncepciója azon alapul, hogy a számolásban részt vevő numerikus rendszerek és egyéb, nem matematika-specifikus rendszerek (részképességek) különböző módokon és szinteken diszfunkcionálhatnak. A teszt feladatai adott életkorokhoz rendelt fejlődési fázisokhoz igazodnak. A vizsgálat a hibaelemzés módszerével és objektív kritériumokkal térképezi fel a diszkalkuliára utaló tipikus hibákat, majd további szempontokat ad az egyéb részképességek működésének megfigyeléséhez és a gondolkodási, kompenzáló stratégiák számbavételéhez. A hangsúlyozottan egyéni vizsgálóeljárás átfogó képet ad a gyermek matematikai és kognitív képességeinek szintjéről. Az egyéni teljesítményprofil alapján lehetővé válik a fejlődési diszkalkulia (súlyos tanulási zavar) és a tanulási nehézség elkülönítése, ezeknek megfelelően az egyénre szabott terápiás célok, feladatok és módszerek meghatározása (terápia-relevancia).

Kulcsszavak: numerikus rendszerek, részleges képességek, differenciáldiagnózis, speciális oktatási megközelítés, terápia relevanciája

ABSTRACT

Pedagogical examination of dyscalculia is a special measuring procedure. The Pedagogical Assessment of Dyscalculia concept is based on the fact that the numerical systems and other non-mathematical-specific systems (partial abilities) involved in the counting can be dysfunctional in different ways and levels.

The tasks of the test are adapted to the developmental phases assigned to given ages. The study discusses the discontinuity by using the method of error analysis and objective criteria and then gives additional considerations to observe the function of other sub-skills and to account for thinking and compensating strategies. The highly personalized examination process provides a comprehensive picture of the child's mathematical and cognitive abilities. Based on the individual performance profile, it is possible to differentiate between developmental dyscalculia (severe learning disabilities) and learning difficulties, and accordingly define individualized therapeutic goals, tasks and methods (therapeutic relevance).

Keywords: numeric systems, partial abilities, differential diagnosis, special education approach, relevance of therapy

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PEDAGOGICAL ASSESSMENT OF DYSCALCULIA

A diszkalkulia pedagógiai vizsgálata

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Introduction

The terminology of dyscalculia changes with the development of special education and border sciences (*Farkasné*, 2008).The natural sciences interpretations of cognitive functions have also led to significant changes in basic neuroscience research (*Márkus*, 2007, 2010). They can demonstrate that dyscalculation is a symptom with different symptom combinations and degrees and is often not clearly distinguished (*Krajcsi*, 2010). This problem is faced by the researcher when developing diagnostic gauges and the diagnostic specialist.

Pedagogical Examination of Dyscalculia is an individual (special) pedagogical measurement of the basic mathematical abilities of children aged 5 to 11, supported by neuropsychological/psychological examination. It not only compares a number of numerical subfields, but provides a comprehensive picture of mathematical abilities, skills and non-mathematical-specific cognitive functions, thinking strategies and compensation mechanisms of the child. The revised study uses the latest knowledge of remedial pedagogy and border sciences to seamlessly isolate inadequate education or environmental disadvantage, mathematical underdevelopment, failure, mathematical learning difficulty and developmental discontinuity as a specific learning disorder. The qualitative and quantitative analysis allows the design of individualized interventions. The measurement procedure helps to identify dyscalculia, but some of its functions can be used to recognize the acquired damage to arithmetic abilities (*Csonkáné*, 2013).

1. Calculation disturbance

1.1 Conceptual uncertainty

There is no uniform definition dyscalculia formation. This is partly explained by the shortcomings of our knowledge of the issue (*Márkus*, 2007). It is a major difficulty that a group of children with dysfunctions is extremely heterogeneous (multifactorial origin) and dyscalculia often associated with performance disorders of different origin, which are muted on a symptomatic, behavioral level, overlapping each other. In Hungary, the conceptual lack of clarity among practitioners is a serious problem (what is disturbance, difficulty or omission). To date, there is no clear consensus-based, valid definition. The terminological uncertainty is increased in Hungary by the changing legal categories of children/students in need of additional services (Inclusion, Learning and Behavior Disorder; Specific Education Needs), the content of which is not precisely defined. Due to the lack of clear criteria and standardized, legal and modern investigative procedures, there were many subjective elements in domestic diagnostic practice (*Csépe*, 2008).

In addition to the current status description, the problem of the socio-cultural condition, the history of life histories, and the perception and characterization of the reference persons, by parents and (the developer) pedagogues, of the child/student's mathematical abilities are becoming increasingly important instead of the deficit-oriented diagnostic approach. There is a need to gather information about the behavior of children and students, their other attitudes (task awareness, motivation, self-assessment, etc.) (*Lányiné* and *Takács*, 2004). The possibilities of further assistance, as determined by the personality dynamics and structure of the person under study (self-defense, coping strategies, frustration tolerance, etc.) (*Szabó* and *Mohai*, 2004). All this contributes to a more subtle interpretation.

1.2 Comorbidity

Frequency indicators show a difference between school children (mostly 8-12 years old). This is due to several factors: studies have been carried out in countries with varying degrees of development, with economic and socio-cultural characteristics; mostly in urban schools (sampling differences); different tests were used, the criteria were not uniform and under the undeveloped standard conditions the subjectivity of the investigator was raised (*Márkus*, 1999, 2007).

The first surveys of development dyscalculia and dyslexia were mostly studied together. The most important results of a 1000-population (*Gross-Tsuret al*., 1996, quoted by *Márkus*, 1999) were as follows: the frequency of dyscalculia in the examined population was 6.5%. In 26% of the dyscalculia cases, symptoms were associated with Attention Deficit Hyperactivity Disorder. The combined incidence of dyscalculia and dyslexia was 17%, and the three occurrences of learning disorder (dyscalculia, dyslexia, dysgraphy) were observed in 7.5% of the cases. The frequency of dyscalculia was higher in disadvantaged social conditions. Among the first-degree relatives of the discounts, 10% of discounts and

45% of other learning disadvantages were found. Based on the literature data, it can be said that the appearance of dyscalculia is less common than the dyscalculia associated with the associated disruption .Of particular importance is the attention deficit hyperactivity, with 30-80% of which contributes to learning disorder. Disorder is associated with *Attention Deficit Hyperactivity Disorder* in one-third of cases. The dual diagnosis of *Attention Deficit Hyperactivity Disorder* and dyscalculia is three times more common than when *Attention Deficit Hyperactivity Disorder* involves dyslexia. One of the causes of joint occurrence may be common genetic origin. In many cases, the common background of the two issues is the visual-motorized coordination, the attention, the constructivism and the underdevelopment of the fieldwork (*Márkus*, 2007). Another possible explanation is that several nervous system areas are damaged, for example the intraparietal sulcus and the prefrontal lobe, which, in addition to the analogue quantum representations, are implicated by the central executive system (*Rubinstein* and *Henrik*, 2009).

It is to be understood as a disorder or secondary symptom, when the primary disorder of *Attention Deficit Hyperactivity Disorder* is in the field of executive functions. As a consequence, the concept of number and operation is less affected, however, in the operation process, attention problems and weaker working memory have a lot of confusion and procedural error,a nd may be characterized by persistence, change of point of reference and fluctuating performance (*Márkus et al*., 2001). The drug treatment of the underlying problem has improved the mathematical functions most closely related to executive functions (*Rubinstein et al*., 2008). *Szűcs* and *others* (2013a, 2013b, 2014) and *Szűcs* (2016) conducted research exploring the role of multi-dimensional relations against the backdrop of mathematics learning problems, verbal and visual memory processes. Development dyscalculia is often associated with other learning problems, especially with reading and spelling problems (*Manor et al*., 2001). Due to the combined occurrence of dyscalculia and dyslexia, according to *Márkus* (2007,2010), common genetic factors can be assumed. Both can be caused by symbolic disturbances (uncertain or difficult to access symbolic representations, arithmetic and reading skills require both serial processing and visualization of the shape of the visuals and the sequence of multi-digit numbers).

Development dyscalculia often involves emotional disturbances (anxiety, depression), which may aggravate in the event of disturbances in attention (*Márkus*, 2007). Earlier research did not clearly clarify the relationship between mathematical anxiety and mathematical learning disorder. *Carey* and the team of researchers (2016) emphasize in their summary study the two-way relationship between mathematical anxiety and mathematical performance, the so-in mutual theory, mathematical anxiety and mathematical performance can "affect one another in a vicious cycle".

According to *Ashcraft* and *Kirk* (2001), mathematical anxiety can be activated for all phenomena associated with numbers. The implication of mathematical fear is that the capacity of the central executive system of working memory may be reduced, so slowing down problem resolution. Recent findings by *Devine et al*. (2018) also indicate that the negative correlation of mathematical anxiety and mathematical performance often coin-

cide and so many people think that a high level of mathematical anxiety results in poor mathematical performance. In their study, it was found that children with developmental dyscalculia are twice as likely to have high mathematical anxiety as children with typical mathematical performance. 77% of students participating in the study, who were characterized by high mathematical anxiety, also showed high mathematical performance. Our results suggest that cognitive and emotional mathematical problems largely dissociate and question the hypothesis that high mathematical anxiety is only a consequence of weak mathematical performance. According to *Ashcraft* and *Kirk* (2001), mathematical anxiety can be activated for all phenomena associated with numbers. The implication of mathematical fear is that the capacity of the central executive system of working memory may be reduced, so slowing down the problem solving. Fear can overwhelm us to generate stress and become anxious. While the so-called eustress is a positive, joyful state of stress, with its tensions and performance, an improvement in concentration can also be observed. Until then, distress is bad, unpleasant, harmful, so difficult to cope with, so our performance, concentration is deteriorating, and often block our brain. If stress persists for long periods of time, sustained stress can result in physical symptoms (e.g. headache, abdominal pain, sleep disorders, etc.), other psychological symptoms (e.g. mood swings, irritability, feeling of uncertainty, concentration problems) and behavioral disturbances (e.g. Chronic pain can also be aroused, with a great deal of strain on families' everyday lives (*Svraka*, *Major* and Ádam, 2017). These findings suggest that all of the mathematical learning problems should be addressed separately. Undoubtedly, they are common in accompanying emotional, behavioral, but at the same time the emphasis on the low intellect, anxiety, and the exclusivity of the bad teaching method is a very simplified, misguided approach to dyscalculia.

1.3 Determination of mathematics disability (developmental dyscalculia)

Judit Dékány (1989,1995) discloses in addition to the intact intelligence value, an organic background under-performance where the individual is abnormally under-math in mathematics. This may be a consequence of the motoric, perceptual function damage, not the difficulty of performing short-term, serial memory or attention, different thinking actions (for example analysis-synthesis, comparison, analogy),but most of all with the serious disturbance of abstraction it can be explained by the loss of abstract conceptual memory and the different development of speech and language. Modern Hungarian terminology is used to describe a specific learning disorder (in this case, developmental dyscalculia), rather than a part-time disorder used in special pedagogy: the 2013 DSM-5 diagnostic test reference manual. Compared to previous versions, the developmental disorder of the nervous system within the main group discusses a new approach to Specific Learning Disabilities, which means a comprehensive diagnostic category. The multi-axial approach of DSM-IV has been replaced by a one-axis concept, complemented by psychosocial and environmental problems, with a severity rating for functional impairment. The

purpose of widening the descriptive category, based on common phenomenology and pathology, is to assist in establishing a more accurate diagnosis and defining the treatment plan and possible outcomes. Disturbance in reading, disturbance of writing expression, and numerical disturbance characterize the categorization as a specific learning disorder. As a common criterion, the four following diagnostic criteria are "based on the clinical synthesis of personal life history (development, health, family, education), school reporting and psychoeducation" (*DSM-5*, 2014.100.).

2. Pedagogical Examination of Dyscalculia

Judit Dékány is a pedagogue-speech therapist with the elaboration and wide dissemination of the special pedagogical examination of the dyscalculia in Hungary (*Márkus* 2007; *Krajcsi* 2010; *Farkasné* 2007, 2008; *Dékány* and *Mohai*, 2012).

In the domestic diagnostic practice, it became increasingly necessary to provide standardized psychological, pedagogical and special pedagogical studies with objective criteria for practitioners (*Lányiné*, 2014). This legitimate claim corresponds to the Pedagogical Examination of Dyscalculia's advanced examination procedure. The measurement method with detailed documentation, evaluation and interpretation can provide a coherent framework not only for practice, but also for domestic research. The test is based on a valid diagnostic protocol for the expertise of children and students struggling with specific learning impairments (dyscalculia) (*Nagyné et al*., 2014) as an important component of complex need (medical, psychological/neuropsychological, pedagogical/special pedagogical) needs-orientated state knowledge, with systematic specialist anamnesis questionnaires (*Dékány* and *Mohai*, 2012).

The "Pedagogical Examination of Dyscalculia" fulfills the following conditions: it has a biweekly meter, which provides 10-year versions with analogous, interconnected structures. It sets objective criteria, in line with the requirements of the National Core Curriculum, provides an adequate response constraint requirement and allows for observation of reaction times. It enables the performance of individual performance background systems (detailed error analysis). It provides a comprehensive picture of the child's mathematical and cognitive abilities, skills levels, thinking strategies, compensation mechanisms (individual performance profile). It helps segregate dyscalculia, mathematics difficulty learning and weakness mathematics (low mathematical abilities in the lower level of intelligence in the intact area), and help alleviate problems arising from education failure, or underexecution of the environment, and backwardness (typical and atypical development separation).The complexity of the evaluation is based on the coordination of quantitative and qualitative results as well as the analysis of special anamnesis questionnaires. It has the characteristics of therapy relevance and process diagnosis (*Polgárdi, Láz* and *Dékány*, 2018). The basis for the special pedagogical approach was the experience of members of the dyscalculia working group, accumulated in the diagnostic and therapeutic work of long

years: the practice showed that the evocative signs of developmental dyscalculia have often been observed in kindergarten age and may manifest themselves as learning disabilities/ disabilities in school age. Prevention is therefore desirable in preschool ages, and often it is essential to follow the therapeutic treatment and development of the child at school age. Control tests over the years have shown that involvement in abnormal mathematical skills (numerals, numerals and operations) can be detected in older and older adults. This is supported by development psychophysical research carried out by the Psychological Research Institute of the Hungarian Academy of Sciences (*Soltész et al*., 2006). The more effective planning of therapy is greatly assisted by the development of discerning differential diagnosis (therapeutic relevance).

3. Methodological Fundamentals

The "Pedagogical Examination of Dyscalculia's" measurement procedure is based on two major cognitive neurological models of numerical cognition (*McCloskey*, 1992; *Dehaene* 1992, 2003). It examines the distinct hypothetical systems of the internal representation, the analog quantity system (comparison, approximate counting, estimation), the Arabic numeral format (symbolic system of Arabic numerals), the verbal system (arithmetical facts such as storing and recalling the spreadsheet) input modes (number processing, e.g. writing and reading of numbers). Of particular importance in the measurement process is the observation of calculation procedures (operation procedures) and conceptual knowledge (arithmetic rules and principles such as interchangeability, group-ability, inversion). The assay consideration is given to the main base functions (*Geary*,1996), visuo-spatial and central execution system (*Krajcsi*, 2005, *Szűcs et al*., 2014) as well as working memory (*Baddeley*, 2001; *Szűcs et al*., 2014) and also monitoring linguistic aspects. The main purpose of the study is to measure the concept of the sum (abstract, discrete semantic representation) and the condition of the operational concept, as well as to map the functions of the underlying base functions and partial capabilities. The error analysis method describes typical errors (objective criteria).The compilation of task sets, the formulation of instructions, the multi-level control of knowledge elements, skills, and detailed observation considerations serve this purpose. The study measures various skills and knowledge in stages corresponding to different class levels, at levels corresponding to the age and curriculum requirements. DPV combines the characteristics of knowledge measurement and ability testing (*Vidákovich*, 2001). There are three levels of learning in the process of learning: recognition (understanding), reproduction (e.g. use of analogy) and application level. For this purpose, the examiner provides a step-by-step, hierarchical way of responding to a given standard framework and, in some cases, specifies the correct answer (*Polgárdi*, 2015). This corresponds to the "test driveability" (exercise transfer) and the reaction time observation, which are the key pedagogical principles of "Pedagogical Examination of Dyscalculia's". "Pedagogical Examination of Dyscalculia's" maximum performance

limits are indicated by curriculum requirements, but "Pedagogical Examination of Dyscalculia" is not a standard oriented, but criterion-oriented examination procedure with its features and psychometric characteristics. "Since in the criterion-oriented process, the performance is not judged by the results of the group, the emphasis is not on the analysis of statistical parameters typical of the age or grade. The most important thing in this case is to examine the difference between individual achievements and the established criteria." (*Vidákovich*, 2001, 323.).

4. "Pedagogical Examination of Dyscalculia's" position in complex diagnostics

The test is based on a valid diagnostic protocol for the expertise of children and students struggling with specific learning impairments (dyscalculia) (*Nagyné et al*., 2014) as an important component of complex need (medical, psychological/neuropsychological, pedagogical/special pedagogical) needs-orientated state knowledge, with systematic specialist anamnesis questionnaires (*Dékány* and *Mohai*, 2012). For the purpose of the appropriate differential diagnosis, the proposals for renewal of the Hungarian diagnostic protocol include the extension of the range of additional tests (*Dékány* and *Mohai*, 2012). DPV also follows the modern requirements of complex special pedagogy and psychodiagnostics, which are presented by Ágnes Lányiné Engelmayer, PhD (*Lányiné*, 2014, 46-47.):

"Instead of the term diagnosis, the term "assessment" involves the comprehension, measurement, estimation of abilities, attributes, skills, and the term diagnosis of medical meanings. This means alignment with international practice. (...)

It should not be a defective inventory, investigate and explore the strengths, positive properties, and remaining functions of the individual. They often appear not only in cognitive abilities and in knowledge but in social relationships, emotional life, and motivation. (...)

Consider monitoring as a "test tool" (...).Testing for a state-of-the-art test is not just a test!

Consider lifelong events when evaluating test results. Consider life story to more than a medical history.

Examine the circumstances, social strata, attachments, positive or negative experiences of childhood, helping personality development and hindering circumstances.

In addition to the investigation (...), rely on written or oral reports of important reference persons.

The diagnostic process and the resulting expert opinion include both the individual status description and classification in the diagnostic categories, if at this time the world of domestic regulations is subject to discounts.

Encourage reviewing diagnostic categories and negotiating international practice.

Give a chance for later revision as the status may change. Be able to interpret the changes by the investigator.

Develop development-oriented, base on developing an individual education, development, rehabilitation, and therapeutic plan.(...)

The provision of diagnostic tasks should primarily serve access to individual surplus services and discounts, not labeling and exclusion.(...)"

5. Summary of the "Pedagogical Examination of Dyscalculia"

To sum up, the "Pedagogical Assessment of Dyscalculia" reflects a special pedagogical-psychological approach: it not only targets diagnosis of dyscalculia, but also provides useful points for the selection of appropriate therapy and the determination of the strengths necessary to create a positive therapeutic environment and, last but not least, differentiation diagnostics. In this context, it does not seek to achieve exclusive quantification, but rather focuses on the features of a client-centric tool, which focuses more on individual features than on the possibility of comparison with norms. In the measurements ,therefore, the individual is at the center, evaluating the results achieved in the different fields to the expected performance, i.e., based on scientifically well-established and detailed criteria (based on the characteristics of typical development and curricular requirements) and by themselves (*Rózsa*, 2015b). The measurements allow effective mathematical development and convergence of children (intensity and content designation) in the education and training institutions of children, guidance for the development professional, as well as for kindergarten teacher to notice children with learning difficulties. The Dyscalculia Research Group has been active for many years.

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