

DEVELOPMENTAL DYSCALCULIA- LEARNING DISABILITY OF NUMERICAL PROCESSING

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Abstract: Numerical processing is a methodical application of matter. It is so said because mathematics makes our life systematic and prevents chaos. Mathematics or numerical processing is an important part of our life without which the world cannot move an inch. But it is possible that a person of average intelligence (<85 on Arithmetic test and >90 on non-verbal intelligence test) can have learning disability of numerical processing that is Developmental Dyscalculia. This article deals with types and symptoms of persons of Developmental Dyscalculia. It also tells about latest techniques to tackle this problem.

Keywords: Learning Disability, Dyscalculia, Numerical Processing

1.0 Learning Disability

Learning disability sometimes called learning disorder or learning difficulty. The term learning disability emerges due to need to identify and help learning disabled students. The term was first coined by Samuel Kirk in 1963 to describe students who have serious problems in schools. This term was first introduced in 1963 by Kirk and immediately was recognized by the learning Disability Association established in America (LDAA). Hallahan and Kauffman (1976) define a learning disabled child as one who is not achieving his potential. In the 1980s, National joint committee on learning disability, therefore, defined the term learning disability as: a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to Central Nervous System Dysfunction.

2.0 Definitions of Learning Disability

According to Public Law 94-142 (The Education for All Handicapped Children Act of 1975), The term "children with specific learning disabilities" means those children who have a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. Such disorders include such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia.

The LDA(1986) defined Specific Learning Disabilities is a chronic condition of presumed neurological origin which selectively interferes with the development, integration, and/or demonstration of verbal and/or nonverbal abilities. Specific Learning Disabilities exists as a distinct handicapping condition and varies in its manifestations and in degree of severity.

Learning Disability Association of America(2001-2002) A learning disability is a neurological condition that interferes with an individual's ability to store, process, or produce information. Learning disabilities can affect one's ability to read, write, speak, spell, compute math, reason and also affect an individual's attention, memory, coordination, social skills and emotional maturity.

LDA (2001-2002) Individuals with this type of Learning Disability known as Developmental Dyscalculia may also have poor comprehension of math symbols, may struggle with memorizing and organizing numbers, have difficulty telling time, or have trouble with counting.

3.0 Types of Learning Disabilities

Various types of learning disabilities are as follows:

- **Dyslexia (Learning disability in Reading):** Students have problems in recognizing words and explaining written text. There will be difficulty in understanding the relationships between sounds, letters and words.
- **Dysgraphia (Learning disability in writing):** This refers to struggle to organize thoughts on paper. There will be error in spelling, grammar, punctuations, difficulty in composing sentences and paragraphs.
- **Dyspraxia (Learning disability in motor skills):** It refers to problems with movement and coordination whether it is with fine motor skills (cutting, writing, making diagrams, stitching, embroidery) or gross motor skills (running, jumping).
- **Dysphasia (Learning disability in language):** It involves the disability to understand or produce spoken language. Language is considered output activity because it requires organizing thoughts in the brain and calling upon right words to verbally explain something or communicate with someone.
- **Dyscalculia (Learning disability in math):** There will be difficulty in arithmetic skills. It involves problems of basic mathematical terms such as addition, subtraction, learning multiplication tables. Child faces problems with memorization and organization of numbers, operational signs and number facts. They may have trouble with counting principles or have difficulty telling time.

4.00 Developmental Dyscalculia

Mathematics has an important social role. Basic arithmetic and estimation is necessary in everyday life. It may be worth noting that many of the jobs that advance technology and society as a whole from computer programming to electrical engineering, scientific research, company management or finance – require a significant amount of mathematics. An individual must agree that teaching mathematics has been of enormous practical value to society as a whole. Studying mathematics exercises our brain in a manner that is quite different from most other human activities. There is much research regarding the relationship between mathematics and brain.

Learning disability in mathematics has not received as much attention from researches as disabilities in reading and language arts. This may be due to pervasive nature of skills in reading and writing in the school curriculum and the relative independence of math. It may also result from relatively lower incidence of problem. Most authorities place the incidence of mathematical disabilities at about 6 % (Lerner 1988, Geary 2000) with about one half of these students estimated to have problems with literacy skills as well. In schools of past when students with reading disabilities excelled in mathematics calculations this skill was probably the result of much practice with computational skills by their teachers because there were few provisions for appropriate work in reading and language available for them. It is clear now that some learning disabled students have specific disabilities in numerical processing and their teachers need to understand the impact of learning disability on mathematics.

Today's world requires us to process unprecedented level of numerical information. Numerical processing is a methodical application of matter. It is so said because the subject makes a man methodical or systematic. It makes our life systematic and prevents chaos. Certain qualities that are nurtured by mathematics are power of reasoning, creativity, abstract or spatial thinking, critical thinking and problem solving without which the world cannot move an inch. Be it a cook or a farmer, a carpenter or a mechanic, a shopkeeper or a doctor, an engineer or a scientist, a musician or a magician, everyone needs measurements in their day to day life. We use computations in day to day activities. Many aspiring carriers require a solid foundation in mathematics.

There is a learning disorder that specially affects the ability to acquire school level arithmetic skills. Dyscalculia comes from Greek and Latin and means COUNTING BADLY. The prefix DYS comes from Greek and means badly. The root calculi comes from Latin CALCULARE which means to count and which is also related to calculation and calculus. It is widely acknowledged that dyscalculia was first discovered in 1919 by Salomon Henschen a Swedish neurologist who found that it was possible for a person of high general intelligence to have impaired mathematical abilities. The term Dyscalculia was later coined by Dr. Josef Gerstman in 1940. There is well established evidence for specialized neural circuits for numerical processing in the parietal lobes of brain especially the left and right intraparietal sulci has less grey matter or less

As an indicator of the severity of the fact-retrieval deficit in DD children, typically developing children have been found to recall an average of three times as many arithmetic facts as those with DD (Hasselbring et al. 1988). Children with DD fail to develop fluent fact-retrieval mechanisms, continuing to employ procedural strategies long after their typically developing peers have progressed to memory-based strategies (Geary et al. 1993). Impaired fact retrieval in DD is the use of immature or inefficient problem-solving strategies (Geary et al. 2000). Shalev (2003) Developmental dyscalculia is defined as a specific learning disability affecting the normal acquisition of arithmetic skills in spite of normal intelligence, emotional stability, scholastic opportunity, and motivation. Traditionally, the defining features of DD have been poor retrieval of arithmetic facts from memory and the perseverant use of immature calculation strategies (Geary and Hoard 2005) The most consistently observed behavioral hallmark of DD is impaired arithmetic fact retrieval (Mazzocco, Devlin, and McKinney 2008. WHO ICD 10 F81.2 'Specific disorder of arithmetical skills' involves a specific impairment in arithmetical skills that is not solely explicable on the basis of general mental retardation or of inadequate schooling. The deficit concerns mastery of basic computational skills of addition, subtraction, multiplication, and division rather than of the more abstract mathematical skills involved in algebra, trigonometry, geometry, or calculus.

Developmental dyscalculia is defined by impaired arithmetic skills, is associated with deficient basic numerical magnitude processing, pointing to a developmental impairment or delay in the number sense as a possible root cause (Mazzocco et al. 2011)

5.0 Types of Problems of Developmental Dyscalculia and Symptoms

Geary proposed three types of problems faced by the persons of developmental dyscalculia

5.1 Semantic Memory Problems: In this group are students who have difficulty retrieving the addition and subtraction combinations and even when some facts are retrieved their rate of error is high. They may confuse signs in computation so they may add when sign calls for multiplication or subtract when sign requires addition. In adding the combination $4+2$ they cannot start with 4 say 4,5 to find sum but must say 1, 2,3,4,5,6 This has been called a problem in working memory that slows down and impairs the learning of basic combinations. They also find it hard to use extraneous cues that show a lack of basic concepts in quantity. Because of cumulative nature of knowledge in mathematics inadequate mastery of early skills interfere with these students learning more complex processes. The students who are uncertain about time tables will be lost when asked to estimate quotients in long division or to reduce improper fractions or to deal with factoring in algebra.

5.2 Procedural Deficits: Some children with math disabilities make adequate progress at the beginning of schooling but experience difficulties when a series of operations is required. For ex. They may appear to be ready for long division they may have fairly accurate multiplication and subtraction skills and may be able to understand the principle of division well. However these students may be unable to follow the order and sequence of the series of steps required for long division.

5.3 Visuospatial Problems: This group of problems includes errors in dealing with place value in multiplication, division and decimals. Illegible or untidy handwriting that misaligns columns in basic computational processes

It could be changed by experiences in the home (an environment which encourages attention to number), by teaching and by intervention programmers.

6.0 Intervention Techniques

Following techniques can be used to tackle the problem of developmental dyscalculia

6.1 Babakus: It is a calculator that combines the best qualities of western slide ruler with those of eastern abacus. Babakus is an excellent proficiency training tool for those deficits in counting as well the method is highly scalable to fit each student level of understanding.

6.2 Numicon: The Numicon shapes make numbers real for children because they can see them and touch them. The shapes make odd and even numbers very apparent and they help children to understand addition, subtraction, multiplication and division. There are kits available for groups of children.

6.3 Numbershark: It is a motivating computer programme that uses 45 games to teach and reinforce numeracy and improve understanding and use of numbers. The wide variety of carefully designed games provides many ways in which to practice at a chosen level and to build skills in very gradual steps. The games focus on the number system and sequencing (very useful for dyscalculia), addition, subtraction, multiplication, division, fractions, decimals, percentages.

6.4 Concrete Models: Using concrete models is the first step in building the meaning behind the mathematical concepts. These models include a variety of math manipulative measuring tools, building blocks, fractional boards, peg boards, chips, marbles, 2D and 3D charts and shapes, dice and stripes that students can handle during a lesson. Research base study show that students who use concrete materials develop more precise and more comprehensive mental representations.

6.5 Multisensory Approach: This approach uses all of a child's senses to help her learn skills and understand concepts. It also helps to teach math concepts systematically, where one skill builds on the next. This can help kids with dyscalculia make stronger connections to what they are learning. The teacher might give [informal supports](#) to help in class or with assignments and tests. There are a number of strategies teachers use to help kids with dyscalculia. (It can be tried at home, too). Here are a few examples:

6.6 The Dyscalculia Toolkit: It is a practical resource (book and companion website) that can help teachers and tutors of students from 6 to 14 years to understand and ameliorate the obstacles that may impede a student's progress in mathematics.

6.7 Classroom Survival Skills: Acquisition of survival skills, examples of which are assuming accountability for one's own behavior, arriving prepared for lessons, meeting deadlines, appropriate school behavior, following directions, and completing homework assignments, becomes indispensable with increasing age and mounting responsibilities.

6.8 Master (Mathematics Strategy training for Educational Remediation): It is program developed for teaching multiplication and division. It conveys the principle of these two arithmetic operations (eg, that multiplication is repeated addition) while learning how to choose appropriate strategies (eg, 7 6 could be solved by adding 7 six times or by adding the results of 5 6 and 2 6).

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