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A STUDY OF TYPES OF DYSCALCULIA AMONG SECONDARY SCHOOL STUDENTS AND EDUCATIONAL INTERVENTIONS TO IMPROVE THEIR MATHEMATICAL STUDY SKILLS

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Abstract

Children with dyscalculia face challenges like frustration, depression, school dropout, and emotional instability. School students with dyscalculia may have difficulty to understanding number-related concepts or using symbols or functions needed for achievement in mathematics. It is a common learning issue that impact students' capacity to do mathematics. Special education and remedial teachers find that these student's basic concept and skill development normally one to two years behind their peers upon detection. Students with dyscalculia also have difficulty with the mechanics of doing mathematics, such as being able to recall math facts. They may realize the logic behind mathematics, but not how or when to apply what they know to solve mathematics problems. Students with dyscalculia find math puzzling and difficult to learn. Their brains need more teaching, more targeted learning experiences, and more practice to develop these networks. This paper discusses about mathematics learning difficulties for school student's facing problems and reducing mathematical difficulties with educational interventions to improve their study skills.

INTRODUCTION

Someone living with Dyscalculia have difficulty in the areas of math reasoning, computation, math memory, math writing, sequencing and math speaking, as well as visual-spatial orientation. Some of us are blessed with brains that quickly develop networks that make math easy, obvious, and interesting. A math learning disability is called dyscalculia. Students with dyscalculia find math puzzling, frustrating, and difficult to learn. Their brains need more teaching, more targeted learning experiences, and more practice to develop these networks. When engaged in targeted learning experiences, the brain establishes a series of neural pathways. These routes are created in the brain through daily use and practice.

Communication between the relevant neurons is facilitated, cognition made faster and faster. Synaptic plasticity is perhaps the pillar on which the brain's amazing malleability rests. Students with dyscalculia have difficulties in understanding what numbers mean, remembering math facts, and steps to complete math problems or may have difficulty with visual-spatial concepts used in making patterns or in geometry. Dyscalculia may be related to language processing disorders which result in difficulties learning math vocabulary needed to understand math concepts and to solve more complex problems.

A Dyscalculic student will be challenged by both memory and retrieval difficulties, in addition to processing errors and will need to employ coping strategies his entire life. Those who suffer with the disability have been known to comment that Dyscalculia causes numbers to "slip their minds," that looking at large numbers is like trying to read an unknown language or even that it is as if their mathematics "memory banks" continually get erased after a lesson. Mathematics is a subject that consists of three aspects. Research has shown that visual perception, visual memory, visual spatial memory and logical thinking are the most important foundational skills of math.

Statement of the study: To study of types of Dyscalculia among secondary school students and educational interventions to improve their study skills

Objectives of the study:

- To study of symptoms of Dyscalculia among secondary school students
- To study of types of Dyscalculia among secondary school students
- To study educational interventions to improve secondary school student's mathematical study skills

Keywords: Dyscalculia, educational interventions, Learning experience, Mathematics Learning Difficulties,

Definition of the keywords:

Mathematics Learning Difficulties: These are the difficulties in the areas of math reasoning, computation (addition, subtraction, multiplication and division), math memory, math writing, sequencing and math speaking, as well as visual-spatial orientation.

Dyscalculia: Dyscalculia refers to a range of mathematics learning disabilities.

Learning experience: **Learning experience** refers to any interaction, course, program, or other experience in which learning takes place, whether it occurs in traditional academic settings or nontraditional settings or whether it includes traditional educational interactions or

nontraditional interactions students learning through games and interactive software applications.

Educational interventions: It provides students with the support needed to acquire the skills being taught by the educational system and should address functional skills, academic, cognitive, behavioral and social skills that directly affect the child's ability to access an education.

Mathematical skills: There are many things in mathematics that the learner must learn to do, like, for ex. The skills of counting, adding, subtracting, multiplication and division.

Review of Literature:

Dyscalculia: From Brain to Education, Brian Butterworth, Sashank Varma, Diana Laurillard, Department of Educational Psychology, University of Minnesota, Minneapolis, USA, *Science* 27 May 2011:Vol. 332, Issue 6033, pp. 1049-1053

Research in cognitive and developmental neuroscience is providing a new approach to the understanding sets and their numerosities, which is fundamental to all aspects of elementary school mathematics. The neural bases of numerosity processing have been investigated in structural and functional neuroimaging studies of adults and children, and neural markers of its impairment in dyscalculia have been identified. New interventions to strengthen numerosity processing, including adaptive software, promise effective evidence based education for dyscalculic learners.

Developing Fluency with Basic Number Facts: Intervention for Students with Learning Disabilities , Katherine Garnett, Learning Disabilities Research & Practice Division for Learning Disabilities

The effects of math learning disabilities are widespread and often seriously problematic. Common among the diverse manifestations of math learning disabilities is lack of fluency with the basic number facts of addition, subtraction, multiplication, and division. Insights from both cognitive psychology and LD intervention research are gathered here to shape teachers' understanding of the processes by which number fact fluency develops. For many students with learning disabilities, current methods of seatwork drill are wholly inadequate and possibly even counterproductive.

A case study of computer gaming for math: Engaged learning from game-play

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Employing mixed-method approach, this case study examined the in situ use of educational computer games in a summer math program to facilitate 4th and 5th graders' cognitive math

achievement, meta-cognitive awareness, and positive attitudes toward math learning. The results indicated that students developed more positive attitudes toward math learning through five-week computer math gaming, but there was no significant effect of computer gaming on students' cognitive test performance or meta-cognitive awareness development. The in-field observation and students' think-aloud protocol informed that not every computer math drill game would engage children in committed learning. The study findings have highlighted the value of situating learning activities within the game story, making games pleasantly challenging, scaffolding reflections, and designing suitable off-computer activities.

Symptoms of dyscalculia

- **Secondary School students** struggles to understand information on charts and graphs.

  Has trouble finding different approaches to the same maths problem, such as adding the length and width of a rectangle and doubling the answer to solve for the perimeter (rather than adding all the sides).
- May not understand maths language or be able to devise a plan to solve a maths problem.
- Finds it difficult to understand maths phrases like "***greater than* and *less than"*** Has trouble keeping score in sports or games. May avoid situations that require understanding numbers, like playing games that involve maths. Struggles to learn and understand reasoning methods and multi-step calculation procedures
- Have trouble measuring items like ingredients in a simple recipe or liquids in a bottle. Lacks confidence in activities that require understanding speed, distance and directions, and may get lost easily. Has trouble applying maths concepts to money, such as calculating the exact change
- Has Limited strategic planning skills (like used in chess) , they Relies on tangible supports such as fingers, tally marks.
- Has Difficulty with estimation and approximation , they find difficulty in different approaches to one problem. They have trouble with visualizing patterns, different parts of a math problem, or identifying critical information needed in problem solving.

TYPES OF DYSCALCULIA

• Verbal (interpretation of verbal math terms)

• Operational (performing basic arithmetic operations)

• Lexical (reading written math terms, symbols)
• Graphical (symbol manipulation)
• Ideognostic (mental calculations)
• Practognostic (pictorial representation)

There is much in math that one simply has to know and therefore has to learn for ex. Many terms, definitions, symbols, theorem and axioms. These are all the things that learner must know not things that he must know how to do. Learning is a stratified process. Certain skills have to be mastered first before it becomes possible to master subsequent skills. In order to be a basket ball player, a person first has to master the foundational skills., Ex. Passing, dribbling, defense and shooting.

In order to do math a child first has to learn the foundational skills of math, like visual perception and visual memory. The child who confuses the signs +, -, >, < may have a problem with visual discrimination of forms and or visual discrimination of position in space. A child who has a poor sense of direction that is North, East, South, West may have a problem with visual discrimination of position in space etc. The second step would be to master mathematical skills which must be done in a sequential fashion. One has to learn to count before it becomes possible for him to learn to add and subtract. The next step would be to ensure that a learner catches up in the knowledge aspect of math.

Mastering Basic Number Facts: Many learning disabled students have persistent trouble "memorizing" basic number facts in all four operations, despite adequate understanding and great effort expended trying to do so. Instead of readily knowing that 5+7=12, or that 4x6=24, these students continue laboriously over years to count fingers, pencil marks or scribbled circles and seem unable to develop efficient memory strategies on their own.

Narration of daily life facts:

Dyscalculia students can grasp the big concepts and easily understand how a problem can be solved. When you pay that bill, you may use a variety of methods, such as using cash, or you could use a credit card or a bank transfer. All of these methods need math to be completed. It is impossible to go to the store and pick up your weekly groceries unless math is used; either by you as you add up how much you are spending or by the cashier and the cash registers. If you want to decorate your home, or lay new flooring or carpet, you will need math to take the measurements so that you know exactly what materials you are going to need. Cooking needs math so that you will use the right amount of each particular ingredient, and you will also need to be able to calculate how much you will need for the amount of people you are

serving. Math affects every single part of our daily lives, every day. Even things like working out sell by dates and best before dates on the different foods that we eat uses mathematics. Play with your food. By asking question like, show me 9+5 with your almonds, show me 5* 3 grapes.

Developing interest through Correlation in mathematics: Types of correlation Incidental Correlation: To establish this type of correlation, a teacher must have versatile knowledge of basic elements of different subject. Index, Indices, Volume of a cylinder, Photosynthesis, Titration, Chain reaction Systematic Correlation: In daily life Within other branches of the subject mathematics With other subjects like Physics, chemistry , Biology, computer science, music , geography, History, languages)

Peer learning: Peer learning is one of the best resources and occurring during an outdoor activity. As there are many opportunities and tasks that would naturally require students to collaborate with each other

Arithmetic Weakness: Some learning disabled students have an excellent grasp of math concepts, but are inconsistent in calculating. They are reliably unreliable at paying attention to the operational sign, at borrowing or carrying appropriately, and at sequencing the steps in complex operations. These same students also may experience difficulty mastering basic number facts. Because there is much more to mathematics than right-answer reliable calculating, it is important to access the broad scope of math abilities and not judge intelligence or understanding by observing only weak lower level skills.

The Written Symbol System and Concrete Materials: Many younger students who have difficulty with elementary math actually bring to school a strong foundation of informal math understanding. They encounter trouble in connecting this knowledge base to the more formal procedures, language, and symbolic notation system of school math. Teachers often compound difficulties at this stage of learning by asking students to match pictured groups with number sentences before they have had sufficient experience relating varieties of physical representations with the various ways we string together math symbols, and the different ways we refer to these things in words. The fact that concrete materials can be moved, held, and physically grouped and separated makes them much more vivid teaching tools than pictorial representations. Because pictures are semiabstract symbols, if introduced too early, they easily confuse the delicate connections being formed between existing concepts, the new language of math, and the formal world of written number problems.

The Language of Math: Some mathematics LD students are particularly hampered by the language aspects of math, resulting in confusion about terminology, difficulty following verbal explanations, and/or weak verbal skills for monitoring the steps of complex calculations. Teachers can help by slowing down the pace of their delivery, maintaining normal timing of phrases, and giving information in discrete segments. Such slowed down "chunking" of verbal information is important when asking questions, giving directions, presenting concepts, and offering explanations.

Visual-Spatial Aspects of Math: A small number of mathematics LD students have disturbances in visual-spatial-motor organization, which may result in weak or lacking understanding of concepts, very poor "number sense," specific difficulty with pictorial representations and/or poorly controlled handwriting and confused arrangements of numerals and signs on the page. Students with profoundly impaired conceptual understanding often have substantial perceptual-motor deficits and are presumed to have right hemisphere dysfunction.

Dyscalculia refers to a range of math learning disabilities. Students with dyscalculia have difficulties in understanding what numbers mean, remembering math facts, steps to complete math problems or may have difficulty with visual-spatial concepts used in making patterns or in geometry. Dyscalculia may be related to language processing disorders which result in difficulties learning math vocabulary needed to understand math concepts and to solve more complex problems. A Dyscalculia will be challenged by both memory and retrieval difficulties, in addition to processing errors and will need to employ coping strategies his/her entire life. Those who suffer with the disability have been known to comment that Dyscalculia causes numbers to "slip their minds," that looking at large numbers is like trying to read an unknown language or even that it is as if their mathematics "memory banks" continually get erased after a lesson. Children with learning disabilities are vulnerable to multiple risks, including persistence of the learning handicap, school dropout, and emotional instability; children with dyscalculia apparently face similar challenges. Therefore, treatment of dyscalculia should address the multiple facets of the disorder while focusing on educational interventions to improve study skills in general and strengthening number perception and arithmetic concepts in particular. Research in this domain indicates that students with learning disabilities can improve their overall study skills and benefit from specific techniques and assistive technology for their individual problem.

Role of language in conceptualization and in problem solving: Mathematics has its own vocabulary, syntax and rules of translation from native language. Some children have difficulty in mathematics because of language difficulties. Most children have difficulty with word problems. It is necessary to teach this language effectively and help students become proficient in word problem solving.

Multisensory resources for maths :

Multisensory help for dyscalculia Because children with dyscalculia have problems relating abstract number symbols to physical quantities and amounts, using the senses to establish a physical connection to the symbol is helpful. Programs like "Touch Math" encourage children to establish a tactile connection to number symbols by tracing, touching, or outlining them, creating a physical understanding of quantity and size relationships

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 7 groups of children and 'One to One' kits that are ideal for tutors and parents. Included in the kits are guide books with structured teaching ideas.

Nuggets: Glass nuggets are very tactile, so good for any counting exercise.

Cuisenaire Rods: The Rods come in 10 different colours and lengths representing different numbers. Young children soon get used to the colour system and older students find Cuisenaire Rods acceptable to work with too. They can be used to demonstrate things like number bonds, area, perimeter, factors, multiples, double numbers, near doubles, fractions, ratios. Cuisenaire rods can be used in conjunction with the number tracks from Numicon.

Plastic Peg Board & Peg Set. Peg Boards with 100 holes are good for demonstrating percentages and fractions.

Base Ten or Dienes Blocks: The blocks are good for illustrating the number system and place value. They can be used for adding and subtracting numbers and concepts such as 'carrying' and 'borrowing'. f. Stile System this is a self checking system. The tiles are placed in a special tray, and if all the answers are right, a given pattern, which matches with the exercise from the book, will be revealed when the tray is turned over. There are three packs; 'Numbers and the Number System' (which is especially helpful for children with dyscalculia), 'Calculations' and 'Shape and Measure'. Suitable for children in Key Stage 2 and older children who need reinforcement at this level. The packs offer a systematic approach.

Abacus: wide spread and popularly known supporting tool for dyscalculia as it facilitate the drill and practice for counting

Number shark: Number shark is a motivating computer programme that uses 45 games to teach and reinforce numeracy and improve understanding and the use of numbers. The wide variety of carefully designed games provides many ways in which to practise at a chosen level and then to build 8 skills in very gradual steps.

The games focus on: the number system and sequencing (very useful for dyscalculics); addition, subtraction, multiplication, division, fractions, decimals and percentages. h. Stern's Structural Arithmetic Stern's multi-sensory maths system was designed to develop a child's emergent number sense by building-up number knowledge and number facts in a logical and structured manner thus enabling children to think logically and reason mathematically. Stern facilitates the understanding and application of the four number operations. Since the system is based on two tangible sets of number representations, the blocks and patterns promote a clear image of number in the concrete enabling pupils to discover for themselves all of the attributes on a physical level. When numerals are introduced they correspond to the blocks and patterns by embodying the intrinsic qualities and values of those numbers. i. Concrete models Using concrete models is the first step in building the meaning behind 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, straws and strips that students can handle during a lesson. Research-based studies show that students who use concrete materials develop more precise and more comprehensive mental representations, often show more motivation and on-task behavior, understand mathematical ideas and better apply these ideas to life situations.

Discussion: This paper discussed about symptoms of dyscalculia, different types dyscalculia prevailing among children and the importance of technology in the lives of dyscalculia children both at home and in classrooms. The treatment of dyscalculia should address the multiple facets of the disorder while focusing on educational interventions to improve study skills in general and strengthening number perception and arithmetic concepts in particular. Research in this domain indicates that students with learning disabilities can improve their overall study skills and benefit from specific techniques and assistive technology for their individual problem. It widely discussed about the various assistive tech multisensory and multimedia. It also looked at the disadvantages that surround the area of technology in Indian context for the children with dyscalculia.

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