Original Research Paper

Volume : 5 | Issue : 12 | December-2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 78.46

IMPORTANCE OF BRAIN COMPATIBLE INSTRUCTIONAL STRATEGY IN DEVELOPING PROBLEM SOLVING SKILLS AMONG CHILDREN WITH DYSCALCULIA

Education

KEYWORDS: - Dyscalculia, Brain Compatible Instructional Strategy, Problem Solving, Arithmetic and Numerals

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ABSTRACT - This thematic paper deals about the importance of brain compatible instructional strategy for children with dyscalculia. Some themes about nature of children with dyscalculia, instructional strategies and principles and working nature of instruction about the brain compatible instructional strategy are discussed. Finally this paper pictures the effectiveness of brain compatible instructional strategy as a best remedial measure for children with dyscalculia.

INTRODUCTION

Children in early stages exercise some skills to learn a concept in real life and those skills may contribute them in performing all activities. On growing, and the children entering to their school environment and they implement numerous skills to understand, to learn and to study a concept. This realization of applicability of skills will help the children to retain their progress in learning path that to shine in studies. In depth these realization of skills also contribute as a vital agent in academic performance of children, especially in mathematics. Mathematics skills are fundamental to perform arithmetic and numerical activities and to survive in the numerate society. On talking about arithmetic, Greeno et al. (1984) Munn (1997) says "arithmetic is a broad component and it includes counting, memory for arithmetic facts, understanding of concepts, and the ability to follow procedures". An understanding of how concepts of numeracy develop, and to understand how the manifestation of difficulties in acquisition of concepts and skills related to mathematics is very important at early stage. Geray (2005) observed that between 5 and 8 percent of children between the ages of 6 and 14 have a particular type of cognitive deficiency that limits their aptitude to acquire knowledge and understanding of fundamental ideas in numeracy. In the view of Ansari & karmiloff-Smith (2002) increasingly, researchers in cognitive sciences are studying this deficiency under the name dyscalculia, a disorder in which normally intelligent children demonstrate specific disabilities in learning mathematics. Geary (1993), Geary & Hoard (2001) Ginsburg (1984) Shalev & Gross-Tsur (2001) concluded in their studies as generally agreed that the children with dyscalculia have difficulty in learning, remembering arithmetic facts and in executing calculating procedures.

DYSCALCULIA

Dyscalculia is a disability that seems to involve the children's abilities alone in mathematics, where abilities in other area are normal. It is one of the specific learning difficulties that have also been referred as "number blindness". Dyscalculia includes all types of mathematical problems ranging from inability to understand the meanings of numbers, to an inability to apply mathematical principles to solve problems. This range of inabilities in children was caused by difference in brain function in the area that involves calculation.

Dr. Linday Peer (2006) defined dyscalculia is a combination of abilities and difficulties that affects the learning process in one or more of reading, spelling and writing. Tony Attwood-Learning Support Service (2011) described dyscalculia as an "unexpected" difficulty that some people have in dealing with mathematical problem. Also Butterworth (2003) defined dyscalculia as "... a deficit in the ability to represent phonetic/semantic information in long-turn memory. . ." and a deficit in the ability to inhibit irrelevant associations from entering working memory during problem solving. According to Johnson & Myklebust (1967), children initially who demonstrate poor skills in numerical calculation abilities were described as dyscalculia.

IDENTIFICATION OF DYSCALCULIA

Early stage suspicion of dyscalculia is very important in children and there are several tests used to assist with testing of arithmetic skills and diagnosis of dyscalculia. This kind of testing is done by neuropsychologist, clinical psychologist, school psychologist, and educational psychologist. Perhaps one of the simplest tool is 'Check list' and also "Wide Range Arithmetic Test" (Arithmetic test), "Young's Group Mathematics Test" and Von Aster (2001) developed a standardized arithmetic test "Neuropsychological Test battery for Number Processing and Calculating in Children" (NUCALC) are some other test to diagnose dyscalculia. IDEA (2004) says if dyscalculia is suspected in particular children, then the child is eligible to receive special educational program services if the instructional needs met the criteria.

Apart from the various tests a final evaluation of dyscalculia will fulfilled by gathering information about familial and academic history of the children. Since the state of children with dyscalculia is vulnerable to multiple risks including emotional instability, school dropout etc., therefore along with the special educational programs the children are in need of remedial program as in general and in particular. General remedial program denote "interventions to improve study skills" and remedial program in particular denote "strengthening mathematical perception and arithmetic concepts". This remedial program seems to be a profile for children with dyscalculia. Therefore remedial program should be attached as a part to special educational services to overcome dyscalculia since there are no chances for cure of dyscalculia.

ADDERSSING PROBLEM WITH DYSCALCULIA

Occurrences of dyscalculia in children may be innate or acquired; they may need to be addressed with remedial action and it is must for them. Results by Wadlington & Wadlington (2008) conclude that there may be three types of dyscalculia namely semantic dyscalculia, procedural dyscalculia and visuo-spatial dyscalculia. Semantic dyscalculia refers to difficulty with memorization while in preparatory for learning. Procedural dyscalculia is difficulty with procedure in follow steps while solving a problem. Finally, visuo-spatial dyscalculia denote problem with spatial representation in concepts such as place value. It also denotes the capacity to understand reason and remember the spatial relations among objects or space. In addition to this Ideognostic dyscalculia represents difficulty with mental calculation and Practognostic dyscalculia denotes difficulty with pictorial represents be other kinds of dyscalculia which has also been survive too for disorder children.

The types of dyscalculia mentioned above in children creates problem in the domain subjectively as mathematical properties,

memory, money, anxiety, time, visual and problem solving in mathematics and so on. **Mathematical properties:** Difficulties in mathematical properties are such as measuring things, memorizing math facts, understanding place value, the distributive property, imaging mathematical shapes or number lines and trouble interpreting "twelve" as "12" or delayed in making translation. Also children experience trouble in estimating or rounding numbers up or down and trouble with sorting by size. **Memory:** Problem in the part of memory such as difficulty memorizing time tables, addition tables, trigonometric values, logarithmic concepts and phone numbers etc., **Money:** May they have trouble using money, such as counting and giving change etc., **Anxiety:** This anxiety that related to math and in part of behavior, problems may develop as a result of frustration. **Time:** Children may have difficulty with time management or following a schedule in studies. This difficulties may be arises also in the real life condition. **Visual:** Studies indicated that brain's capacity for long-term memory of pictures is limitless and 90% of the brain sensory input comes from visual sources. In the view of Ogle (2000) Linking verbal and visual images increase the student ability to store and retrieve information. **Problem solving:** Experiences difficulties with strategy based games like chess and difficulties with multi-step procedures. Also it is a condition that defines the problem arises on working with, logarithmic, trigonometric, deductive approaches and calculations in place values.

SKILLS AFFECTED BY DYSCALCULIA

Visual Skills: Trouble faced with vision such as invert numbers (i.e., 26, 62) and understanding patterns such as 14, 24, 34, 44 etc. Also it leads to confusing with symbols such as addition with multiplication (+ with X) and subtraction with division (- with÷), difficult assessing symmetry, rotating shapes mentally as with tessellations and geometry. Also they may have trouble in reading and writing some words, such as they spontaneously write 'thier' instead as 'their' and read out 'ten' on for 'net'. Basically they may have trouble in reversal of patterns, whether it may be in alphabet or in numerals.

Social Skills: Repeated fail in mathematics class can lead children to assume failure in other area too. By this children can seemed with low self esteem and this can affect children willingness to make new friends or avoid participation in extracurricular activities. Therefore the children might also avoid playing games and sports activities that involve mathematics and keeping score. **Directional Sense:** Here children may have trouble in reading from left to right. They may have trouble in searching places by reading maps or follow direction. They cannot involve in concept mapping or mind mapping some children with dyscalculia cannot picture things in their minds and also trouble in imaging three dimensional images. Also the children faces difficulties in understanding or performing place values in numbers while doing calculations. Physical Coordination: Dyscalculia can interrupt the working combination of brain and eyes. From this a children may have trouble in judging the length, breadth, height, volume and in judging distances between objects. From this children may seem clumsier than other age group. Time management: Children with dyscalculia have trouble in inability to measure quantities, including units of time. They have also face difficulty in estimating minutes, seconds etc. This can make it hard to stick to a schedule in all their activities. Flora (2013), Henderson (2012), Kaufmann, Liane and Michael Von Aster (2012) revealed that a children with dyscalculia might have a hard time estimating on their real life.

STUDIES ON DYSCALCULIA

Voutsina and Ismail (2007) provided evidence of the nature of understanding of selected concepts of single digit addition held by the young children (of primary school age) who have difficulties in mathematics are identified by a computer based standardized test as being risk of dyscalculia.

Koy and Yeo (2003), Miles and Miles (1992), Chinn and Ashcroft (1998) and Yeo (2003) pointed out that most dyslexic pupils have difficulty with long term memory for facts, working memory difficulties, sequencing difficulties and difficulties with language, including mathematical language.

Yeo (2001) reported that while many dyslexic children have difficulties only with those aspects of arithmetic that involves verbal memory; some dyslexic children have more fundamental difficulties with 'number sense'.

Hart (1981) and her team revealed that secondary school pupils have many difficulties, both procedural and conceptual, with many mathematical topics, including ratio and proportion: fraction and decimal; algebra and problems involving area and volume.

Stewart et al. (2003) have developed strategies for dealing with classes that include a significant number of children with mathematical difficulties and techniques that has used multi-sensory teaching of mathematics, involving motor activities.

BRAIN COMPATIBLE INSTRUCTIONAL STRATEGY

Teaching is an art of challenging the brain. Brain Based instructional strategy is connecting the brain research to school curriculum. Since this study deals children with dyscalculia, and the children many challenges as above discussed. We are in need using brain compatible instructional strategy for the children with dyscalculia. According to Eric Jensen (1995) Brain based instructional strategy is the engagement of strategies based on how the (individual) children brain works. Also he defines Brain based learning is application of meaningful group of principles that represent children understanding of how the brain works in the context of education.

Wolfe (2001) describes it is essential for the children to participate in the learning process as they connect the previous information to the current knowledge they obtain and they be able to retain them for future use. Erlauer (2003) and Sprenger (2002) conclude a key concept in brain-based learning is the learner wants a supportive, challenging learning environment while the educator makes the learning process easier as educational activities come to light. In the part of remedial programs this brain compatible instructional strategy plays a vital role as with its principle is suitable for problem arises by dyscalculia. Caine and Caine (2010) give the principles of brain compatible instructional strategies. Some of the strategies are as follows.

Search for meaning is innate Learning engages the entire physiology
Learning involves both focused attention and peripheral perception
Understand and remember is best when facts are emended in natural, spatial memory

STUDIES RELATED TO BRAIN COMPATIBLE INSTRUCTIONAL STRATEGY

According to Jensen (2008) brain Based Learning was related to teaching strategies and principles from an understanding of how the brain functions and learning with the brain in mind.

Demir (2011) conclude that however, student motivation come from multiple sources, the primary determining factor was the student's perception.

Jacob and Mary (2005) identified brain-based learning as a learned based instructional strategy. They have analyzed the core principles of brain-based and the instructional strategies that can be used in a learner centered education.

Kaur (2013) studies the effectiveness of brain based learning strategies on enhancement of life skills among primary school students with internal based external locus of control.

Eric Jensen (2005) said "Brain Based Education is the purposeful engagement of strategies that apply to how the brain works in the context of education.

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According to Andrea Spears and Leslie Wilson (2008) Brain Based Learning is a comprehensive approach to instructions based on how current research in neuroscience suggest our brain learns naturally.

From the above information Brain Compatible Instructional Strategy enhances the procedures that involves the function of brain while in learning, follow instruction, perception of data and so on. Here in our study, problem is related with brain function of children involving arithmetic and numerals. The contribution of this brain compatible instructional strategy while "Problem Solving" in mathematics provides a good facility as well as a supporting agent for the children with dyscalculia. Through this strategy children can easily overcome problem related to dyscalculia, while performing arithmetic and numerical calculations.

Eric Jenson (2005) Brain based Instruction in education is a purposeful engagement of strategies that apply to how the brain works in the context of education. So some of the Brain Compatible Instructional strategies are visuals, brainstorming, movement, graphic organizers, **metaphor**s, mnemonic devices, **guided** imagery and technology can be discussed and elaborated as how it is useful for learning by children with dyscalculia.

PRACTICING OF BRAIN COMPATIBLE INSTRUCTIONAL STRATERGY

Using **visual** in teaching mathematics such as math wall, word wall, sequence activities, timelines, flash light tag, facilitate discussion by writing key words or formulas and usage of overhead projector to display key points. Sprenger (2007) says a picture in your mind creates a memory you can find. According to Jenson (2008) practicing visualization can help the brain access important information and pre-expose it to a meaningful data. Visualization of a data for children with dyscalculia improves recall in problem solving when interruption occurs and during the application in new tasks. Also it provides the opportunity for children to use inductive and deductive approaches through their imaginations to overcome problems.

Mnemonics are memory devices that help learners recall larger pieces of information, especially in the form of lists like characteristics, steps, stages, parts, phases, etc. For example foe mnemonic is, on performing calculation with arithmetic operators children can taught first to do divide, then multiply, then add it finally subtracting the number. This procedure can be made as simple as BODMAS to remember and it can be taught by Bracket of Division Multiplication Addition and Subtraction. A study by Gerald R. Miller (1967) that mnemonics increased recall. He found that students who regularly used mnemonic devices increased test scores up to 77%. A metaphor is a comparison between two things that share a common characteristic. One thing is equal to another because it has this characteristic. For example the concept for volume of a cone and cylinder can be explained easily. Since volume of a cone is one-third part of volume of a cylinder $i.e., \frac{1}{3}\pi r^2 h \ \ cubic\ units = \pi r^2 h \ \ cubic\ units$

Movement: Specific types of movements can stimulate the release of body's natural motivators, maximize the children energy levels, and improve storage level and retrieval of data. Development of neuronal system will help children when ready to read. And this neuronal system developed only by the moment such as noradrenalin and dopamine. According to Jensen (2008) physical performance is probably the only known cognitive activity that uses 100 percent of the brain. Also Hannaford (2005) conclude that movement not enhances learning and memory but it also causes neutral connections to become stronger. There is variety of movements to allow the children to get up and discuss information. Some of these are stepping stones, carousel etc.

Brainstorming: The process of brainstorming can be used to activate prior knowledge since one children's idea causes other children to scan their neutral network for related ideas. Allen (2008) says when children talk about a topic, they will understand it better because their brain not only process the information but also verbally process it. Jensen (2007) says students with special needs benefit when the class works in groups of fewer than six and the teacher uses directed response questioning so that students have chances to think aloud. Brain storming can use in a classroom by probing challenging questions, using task cards and provide a challenging math problem to solve. Children learn 90% of what they say or discuss as they complete an activity. So small group discussion reinforces classroom learning, assists the brain in recalling the information, and allows children to solve problem collaboratively and explore topic in depth.

Guided imagery is a meditative process that uses visualization and imagination to bring awareness to mind-body connection. It also describes as use of one's imagination to promote mental and physical health. It can be self-directed, where the children put him into a relaxed state and create his own images, or directed by others. Directed by others includes children listen to a therapist, video or audiotape exercise that leads through a relaxation and imagery exercise. Through this a children can enhances his memory, wealth, and competencies etc.

Graphic organizers are some of the most effective visual learning strategies for children and are applied across the curriculum to enhance learning and understanding of subject matter content. Graphic organizers help in make connections and structure thinking in mathematics. In addition to helping students organize their thinking and writing process, graphic organizers can act as instructional tools. Teachers can use graphic organizers to illustrate content knowledge about a topic or section of text showing areas for improvement. Examples including, webs, concept maps and mind maps.

Generally using **technologies** in classroom that all children will benefit from his learning outcomes. Assistive technologies be used for children with dyscalculia to perform better in the classroom and it enables independent learning. These technologies are categorized as **multimedia and Multi Resources.** Multi Media includes (electronic math work sheets, Math Software-Number Race, Adapted Measuring Devices, Babakus, Computer Assisted Instruction, Microsoft power point 2010 and Kurzeweil 3000). Multi Resources are (Numicon, Cuisenaire Rods, Nuggets, Stile System, Number Shark, and Concrete Models).

DISCUSSION

This paper discuss about children with dyscalculia, different types of dyscalculia, skills affecting dyscalculia and remedies. The skills may affected are visual skills, social skills, directional sense, physical coordination and time management and that all the skills are discussed briefly as much as possible with themes. The troubles arise by dyscalculia in the children will affects the performance on studies that involve numerals and arithmetic. Also dyscalculia is a problem related to brain functions, so that there is no cure for this problem if also the age developed. Only the problems can be overcome by some remedial measures through the brain compatible instructional strategies. Since this strategy closely related to engagement of strategies based on the individual brain works. By the above discussed data about trouble with dyscalculia and the nature, principle of the brain compatible instructional strategies we conclude that brain compatible instructional is the best tool and acts as a effective remedy for the children with dyscalculia.

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