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Effectiveness of certain neuro cognitive interventions to overcome learning disabilities in mathematics at primary level

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Abstract
In this study aimed at finding out the effectiveness of certain neuro cognitive intervention strategies to overcome learning disability in Mathematics at primary level. The sample of the study consists of 30 students. The study adopted pretest posttest experimental design. The result indicated that the applied neurocognitive interventions have had an effect on improving mathematics academic performance of students (aged 9-10) with dyscalculia.

Keywords: neurocognitive, learning disability, intervention program, mathematics difficulties

1. Introduction
A learning disability is a neurological disorder happened in the developmental days of certain children. In simple terms, a learning disability results from a difference in the way a person's learning concepts in any of the subject matter with compared to their counterparts. Children with learning disabilities are as smart as or smarter than their peers. But they may have difficulty in reading, writing, spelling and reasoning, recalling and organizing information. A learning disability can't be cured or fixed; it is a lifelong issue. With the right support and intervention, however, children with learning disabilities can succeed in school and go on to successful, often distinguished careers later in life. Parents can help children with learning disabilities achieve such success by encouraging their strengths, knowing their weakness, understanding the educational system, working with professionals and learning about strategies for dealing with specific difficulties.

2. Literature Review
Checa *et al*. (2008) [15]. Conducted a study to examine Neurocognitive and Temperamental Systems of Self-Regulation and Early Adolescents' Social and Academic Outcomes. The findings of the research study showed that the efficiency system of neurocognitive network attention is highly related to mathematics achievement and related to academic excellence.
Ke (2008) [16] studied the situational use of educational computer games in a summer math program to facilitate cognitive math learning. The findings reported that computer games significantly motivate the learners in mathematics learning, but not significantly different in facilitating cognitive math's test achievement and metacognitive awareness.
Ramdass *et al*. (2008) [18]. Discussed the effect of self-correction strategy training on middle school student's self-efficacy, self- evaluation and mathematics division learning. The study concluded that students who utilize strategies in Problem solving will develop higher efficacy in solving problems in mathematics compared to those who do not utilize them.
Maccini *et al*. (2007) [17] conducted a study on Mathematical Interventions for Secondary Students with Learning Disabilities and Mathematics Difficulties. The findings of the study showed that that mathematical interventions influence mathematics outcomes for students who were affected with learning disability and mathematical difficulties.
Wolters (2004) [19] investigated how different components of achievement goal theory related to each and to student's motivation, cognitive engagement and achievement in mathematics among high school students by assessing their perceived classroom goal structures; personal goal orientations, a collection of outcomes that included persistence, procrastination, choice, their use of cognitive and metacognitive learning strategies and mathematics grade. Results indicated that mastery structure and mastery of orientation were related to adaptive outcomes in all areas and the patterns of relations for performance- approach goal structure, and for performance - approach and performance-avoidance goal orientations were less uniform across outcomes.

2.1 The Roots of Dyscalculia
A. Neurobiological Perspective
The analysis of various dyscalculic children showed that it is occurred because of neurological problem in performing arithmetic and its related calculations. The part of brain which is responsible for mathematic calculation is mainly in parietal lobe of the cerebral cortex. When this area is affected definitely such students fall prey for dyscalculia problem.
B. Genetic Causes of Dyscalculia
In human development genetic factors play a significant role in learning process. When some genetic structures are misinterpreted in gene coding, such conditions lead to

Dyscalculia among children. This is supported by the research findings of Alarcon *et al.* (1997) [2], Shalev and Gross Tsur (2001) revealed that nearly half of the siblings of dyscalculic children are dyscalculic themselves. Abedi (2010) [1]. Findings proved that a child with learning disabilities, particularly students with dyscalculia, is associated with neuropsychological features in course of their development.

3. Research Methodology

The current research employed a quasi-experimental design with control and experimental group design. Pretest and posttest were conducted for both the groups to test their achievement in mathematics. Independent variable and dependent variable are neurocognitive interventions and academic performance of students (9-10 years old) with dyscalculia.

3.1 Population and Sample

The research population consists of dyscalculia students (9-10 years old) from 20 randomly selected primary schools during the 2017-2018 academic years from one district of Tamil Nadu. Sample were selected on the basis of 1) problems in learning mathematics identified by using screening test comprises of visual perception and processing disabilities, sequential processing disabilities, abstraction disabilities, memory disabilities, and motor disabilities.

Thirty students with dyscalculia were randomly selected and divided into two groups, experimental (15) and control (15). Eventually, Neuro cognitive interventions were conducted on the experimental group and the control group with normal classroom method of teaching.

3.2. Research instrument

1. **Raven's progressive matrices IQ test**

In order to measure the abstract reasoning in mathematics among children a non-verbal test dev eloped by ravens was used. This test consists of 60 items which are intended to measure the mathematical reasoning abilities.

2. **Screening test**

This screening test is used to find out the following components in dyscalculia students. Numerical difficulty, sequential difficulty, Motor difficulty, Language difficulty, Cognition difficulty, Visual and spatial difficulty and Multiple task

3. **Mathematics achievement test**

After the screening test, dyscalculic students were assessed again by a mathematical achievement test with15 questions. This was used to identify errors made by an individual student on the basis of problems in learning mathematics based on above mentioned seven components.

3.3. Neuro Cognitive intervention

The researcher used the developed neuro cognitive instructional strategies to overcome the learning disabilities in mathematics.

1. **Multisensory approach strategies**

This strategy will help the dyscalculia students to enhance their visual, hearing and tactile function which leads to memory enhancement in solving mathematics problems. The intervention programs for the area of difficulties were spelt as Numeracy, Addition and Subtraction, Motor difficulties, Language difficulties, Visual and Spatial difficulties, and Multiple task.

2. **Visual imaginaries strategies**

This strategy is used to develop the visualization process among the dyscalculia children; thereby they visualize the concepts with the help of smart classroom technique, audio and video method.

3.4. Procedures

After the pretest, to reinforce and instruct neuro cognitive aspects, interventions were conducted in 10 sessions of 2 hours (2 sessions a week). Neuro cognitive interventions' activities mainly function on the basis of stimulus and reinforcement mechanism. This mechanism stimulates the brain to retain the mathematical concepts permanently.

3.5. Post-test Intervention program

Posttest was conducted after completing each component of intervention program simultaneously. Each component of difficulty was tested after the intervention programs with tests comprising fifteen items. The test included items on Numerical difficulty, Sequential difficulty, Language difficulty, Motor difficulty, Cognition difficulty and multiple tasks.

3.6. Statistical data analysis

The research data were analyzed and interpreted by statistical criteria of average, standard deviation and correlation analysis by making use of SPSS software.

Table 1: table showing t-value for overall control group pretest and posttest scores

Control Group	Pre test			Post test			t	level of significance
	N	Mean	SD	N	Mean	SD		
Numerical Ability	15	9.2	0.94	15	11	1.30	4.32	S
Sequential ability	15	10.06	0.70	15	10.73	0.96	2.16	S
Language ability	15	10.4	0.82	15	13.6	0.91	10.07	S
Cognition ability	15	11.53	0.74	15	14.3	1.45	6.15	S
Visual spatial ability	15	7.86	0.91	15	8.66	0.48	2.98	S
Motor ability	15	9.2	0.77	15	10.6	1.54	3.13	S
Multiple task	15	10.6	1.12	15	11.4	1.35	1.76	NS

Significant at 0.05 level.

Statistically it is clear that there is significant difference between the mean scores of pretest and posttest. This proves That the developed Instructional Strategies has a positive impact on dyslexic students

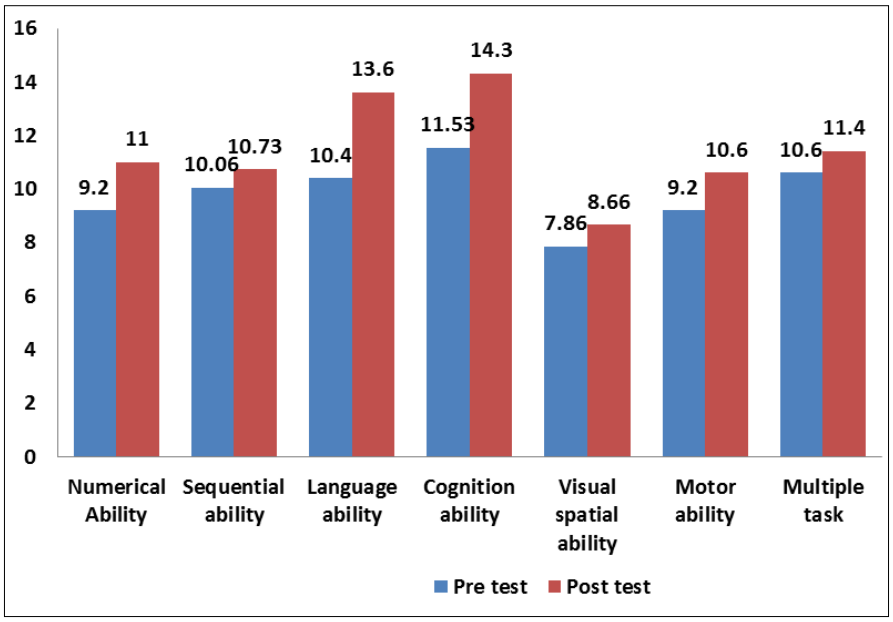

Fig 1: Showing Overall Control Group Pre Test and Post Test Scores

Table 2: Table Showing T-Value for Overall Experimental Group Pre Test and post Test Scores

Experimental Group	Pre test			Post test			t	level of significance
	N	Mean	SD	N	Mean	SD		
Numerical Ability	15	9.4	0.77	15	17.66	1.67	17.75	S
Sequential ability	15	10.06	0.96	15	17.02	1.14	18.46	S
Language ability	15	10.46	0.91	15	19.33	1.39	20.55	S
Cognition ability	15	11.46	1.30	15	22.33	1.29	22.95	S
Visual spatial ability	15	7.46	1.06	15	19.53	1.64	23.91	S
Motor ability	15	9.46	1.12	15	19.73	0.70	29.95	S
Multiple task	15	11	0.53	15	21.2	1.08	32.72	S

Significant at 0.05 level.

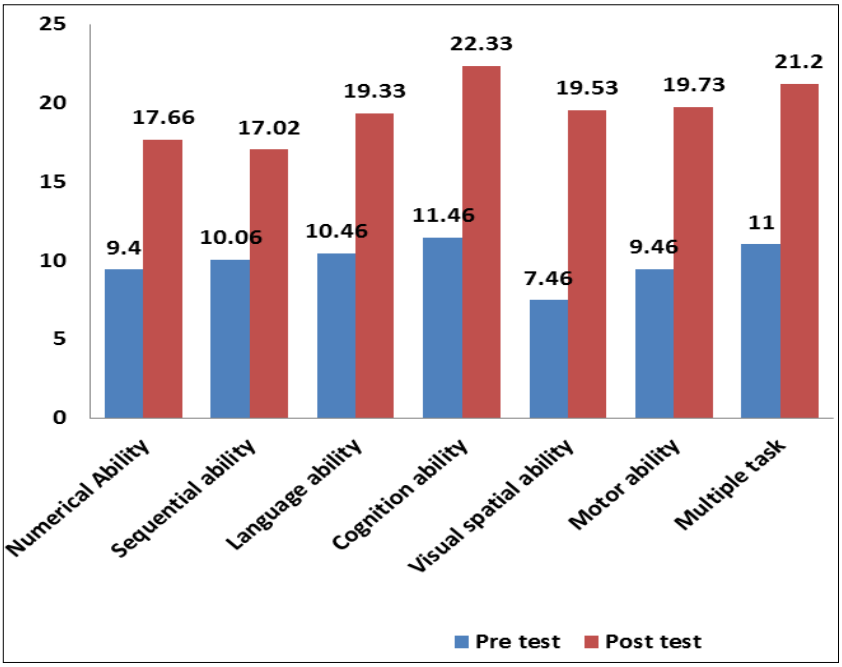

Fig 2: Showing Overall Control and Experimental Group at Post Test Level

Table 3: Table Showing t-Value For Overall Control and Experimental Group at Post Test Level

Pre-test	control			Experimental			t	level of significance
	N	Mean	SD	N	Mean	SD		
Numerical Ability	15	9.2	0,94	15	9.4	0.77	0.71	NS
Sequential ability	15	10.04	0.70	15	10.06	0.96.	0.02	NS
Language ability	15	10.46	0.82	15	10.46	0.91	0.2	NS

Cognition ability	15	11.53	0.74	15	11.46	1.30	0.18	NS
Visual spatial ability	15	7.86	0.91	15	7.46	1.06	1.78	NS
Motor ability	15	9.2	0.77	15	9.46	1.12	0.78	NS
Multiple task	15	10.6	1.12	15	11	0.53	1.33	NS

Table 4: Effect Size (D) Between Pre and posttest on Control Group

Control Group	Pre test			Post test			E.S. (d.)
	N	Mean	SD	N	Mean	SD	
Numerical Ability	15	9.2	0.94	15	11	1.30	1.58
Sequential ability	15	10.06	0.70	15	10.73	0.96	0.79
Language ability	15	10.4	0.82	15	13.6	0.91	3.69
Cognition ability	15	11.53	0.74	15	14.3	1.45	2.40
Visual spatial ability	15	7.86	0.91	15	8.66	0.48	1.09
Motor ability	15	9.2	0.77	15	10.6	1.54	1.14
Multiple task	15	10.6	1.12	15	11.4	1.35	0.64

Table 5: Effect Size (D) Between Pre and Post Test on Experimental Group

Experimental Group	Pre test			Post test			E.S. (d.)
	N	Mean	SD	N	Mean	SD	
Numerical Ability	15	9.4	0.77	15	17.66	1.67	8.69
Sequential ability	15	10.06	0.96	15	17.02	1.14	6.60
Language ability	15	10.46	0.91	15	19.33	1.39	7.55
Cognition ability	15	11.46	1.30	15	22.33	1.29	8.39
Visual spatial ability	15	7.46	1.06	15	19.53	1.64	8.74
Motor ability	15	9.46	1.12	15	19.73	0.70	10.99
Multiple task	15	11	0.53	15	21.2	1.08	11.99

4. Results and Discussion

By comparing posttest and pretest scores of experimental group, it was found that the obtained t value of experimental group at pretest, posttest of all dimensions is significant at 0.05 levels. Hence formulated hypotheses were rejected. Effect size difference between means of the pretest and posttest scores showed that all dimensions have very large effect size. Therefore, it can be concluded that neurocognitive interventions have had an effect on improving mathematics academic performance of students (aged 9-10) with dyscalculia.

The present study found that neurocognitive intervention strategies had significant effect on students having dyscalculia problem at primary level. The results are consistent with the findings of Carluccio (2005) [3], Shih (2006) [14]. and Scheuerman (2006) [12], Kaufmann, Handl & Thony (2003) [8]. Shebishy & Sasikala (2019) [13, 11]. who revealed that intervention strategies, both Instructor-oriented and technology oriented had significant effect on learning disability students. The current study also disclosed that numerical and arithmetical difficulties encountered by the learners were minimized by the intervention strategies. This result is supported by Saraswathi, Sasikala Merlin (2019) [13, 11].

These researchers have shown the efficacy of neurocognitive interventions in mathematics academic performance of children with mathematics learning disabilities. They have reported that the performance of elementary school children with mathematics learning disabilities in neuropsychological tests is drastically weaker than normal children. To explain the research findings, it can be said that children have to be proficient in a set of skills which are neurocognitive aspects such as attention, executive functions, language, visual-spatial processing and memory.

5. Conclusion

Dyscalculia is a major problem which extends from child hood to adult life to do and understand concept of mathematics. But if the same is identified at the time of primary level schooling it is easy to overcome and rectify the problem very easily. The best solution is developing and applying appropriate intervention strategies and alternative methods during the time of teaching learning process. This study reveals that cognitive intervention strategies are best method to overcome dyscalculic children in learning mathematics at the primary stage onwards. To this end, attention to neurocognitive interventions as funda mental.

Mathematics learning skills can be an effective approach in curing and improving the performance of children with mathematics learning disabilities.

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