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Effect of Cognitive Strategies in Improving Comprehension of Students with Mathematical Disability

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ABSTRACT The present study's objective was to ascertain the impact of cognitive intervention strategy on the numerical ability of the students with mathematical disability. Sample consisted of 80 third grade students with 40 in experimental and 40 in control group. Schema based strategy instruction was used to help the students to find, organize, plan and solve the problem. GLAD (Grade Level Assessment Device) was used to assess the impact of cognitive intervention. The pretest score were same for the experimental and control group. A significant difference was found in the post GLAD test score of experimental and control group. From the results of the study it can be concluded that cognitive intervention has positive impact on the numerical abilities of students with mathematical disability.

INTRODUCTION

In today's competitive world, education has become a necessity. Parents have high aspirations for children's education irrespective of their socio-economic status. Right to Education (RTE) Act is also being implemented very seriously by the Government both in urban and rural areas. Education is given utmost importance in the family and the society. Nowadays parents also understand the importance of overall development of the child, that is, physical growth, socio-emotional development, language development and cognitive development for the welfare of the child. Foundation for cognitive development of the child is laid during infancy but becomes stronger during early childhood years and primary school year. Education at primary school level becomes a burden when there are problems in learning by children. Learning becomes difficult and painful when children are having reading, writing and mathematical learning disabilities due to cognitive deficit.

Cognitive Strategies for Dyscalculia

The term 'working memory' describes the ability we have to hold in mind and mentally manipulate information over short periods of time. Working memory is often thought of as a mental workspace that we can use to store important information in the course of our mental activities. Working memory is an important factor which helps in understanding individual differences in mathematics achievement in children. Three-component model of working memory (Baddeley 1986) examine the influence of different working memory components on mathematics achievement. At the core of Baddeley's model is the central executive, which is responsible for the control, regulation, and monitoring of complex cognitive processes. The model also encompasses two subsidiary subsystems of limited capacity that are used for temporary storage of phonological information (that is, the phonological loop) and visual and spatial information (that is, the visuospatial sketchpad). These subsidiary systems are typically assessed by means of classic short-term memory tasks such as the recall of digits (that is, Digit Span) and locations (that is, Block Recall). Central executive ability is generally investigated by means of complex span tasks that require both storage and simultaneous processing of information such as the well-known Listening Span task (Daneman and Carpenter 1980) and Counting Span task (Case et al. 1982). This tripartite structure of working memory is supported by converging evidence from brain imaging, neuropsychological, and cognitive developmental studies (Baddeley 2003). A large-scale cognitive study on the working memory structure in children showed that this three-component model was confirmed in 6- to 15-year-olds (Gathercole and Alloway 2009).

Error analysis involves tabulating the errors committed by children in doing mathematics. The teacher can find the precise area where the student's level of competence in a specific skill breaks down. Besides, through error analysis, a teacher is encouraged to refrain from assigning drill activities such as worksheets, which only serve to reinforce incorrect strategies. The error analysis helps to establish the base for planning the Individual Education Plan (IEP). The errors are classified into two categories viz., Dependent errors (that is, applying wrong operations because of confusing the mathematical signs) and Independent errors (that is, confusion with zero).

Aim of the Study

To ascertain the impact of intervention on Arithmetic skills in children with mathematical learning disabilities.

METHODOLOGY

Purposive sampling method was used to select schools for the study. A list of Government primary schools in Amberpet and Malakpet Divisions was collected from Mandal Education Officers. Four schools were identified purposively from these 2 divisions which are having large population in each classroom. Sample of 80 grade 3 children with math disability were selected after screening. The sample were divided into two groups of 40 (experimental) and 40 control group.

Tool

Arithmetic learning skills were tested through Grade level assessment device for Grade-III students developed by Jayanthi (1997).

Intervention

For mathematics disabled students, Phase I of 1-20 sessions included Error analysis, Phase II from 21-40 sessions concentrated on developing conceptual Base and Phase III from 41-60 sessions included teaching Multiplication and Division through use of cognitive strategies. At the end of 10 months intervention and one month of no intervention the subjects were re-administered on the scale.

RESULTS AND DISCUSSION

This section presents the results obtained after pretesting by the empirical work done on the scores achieved before and after the intervention of this study.

Table 1 shows pre, mid and post intervention scores of Math's Experimental on Math's Achievement Test. The pre-test mean score of Math's Experimental Group is m=58.17 SD=7.8, mid test scores m=62 SD=8.1 and post-test Mean scores m=66 with S.D=8.5. The F value was 11.21 which was found to be significant at 0.01 level. These results suggest that there was a highly significant difference in Math's Experimental Group for pre, mid and post intervention scores. Therefore, it is clear that intervention given to the Experimental Group improved the arithmetic skills of children with Mathematical Disabilities. This can be seen in a continuous improvement from pre to post-test results with post-test shows the highest improvement.

The results in Table 2 shows pre-test mean score M= 58.17 and S.D. = 7.8 for the Experimental Group and Control Group mean scores of M=56.32 and S.D. =8.5. The 't' value was found to be 1.017, p<0.01 indicates that there was no significance difference during pre-test between Experimental and Control Groups. However, in

Table 1: Pre-mid and post-intervention scores on achievement score of mathematics experimental and control group

Groups	*Experimental group (M)*			*Control group (M)*		
Terms	*Pre*	*Mid*	*Post*	*Pre*	*Mid*	*Post*
Mean	58.175	62	66	56.325	56.075	56.15
SD	7.8	8.1	8.5	8.58	7.96	7.91
F-ratio		11.211			0.01	
p-value		0.000*			0.99-NS**	

*p<0.01 level of significance; **NS-Non-significant

Table 2: Mean, 't' value between experimental and control group (M) mathematics achievement test

Group	*Term*	*Mean*	*SD*	*t value*	*P value*
ExperimentalGroup (M)	Pre	58.17	7.8	1.017	0.3 NS
Control Group (M)		56.32	8.5		
Experimental Group (M)	Mid	62	8.1	3.35	0.04*
Control Group (M)		56	7.9		
Experimental Group (M)	Post	66.75	8.5	5.77	0.001**
Control Group (M)		56.16	7.9		

*$p<0.05$ level of significance, **$p<0.01$ level of significance

the mid intervention, the mean scores of Experimental Group, Mean= 52 and SD= 8.1 and mean score of Control Group was 56 with SD= 7.9. When the means scores was compared 't' value obtained was 3.35, $p<0.05$ showing significant difference between the experimental and control groups indicating the effectiveness of intervention. In case of post intervention, a mean score of Experimental Group was 66.75 (SD=8.5) and Control Group Mean was 56.16 (SD =7.9). The 't' value was 5.77 and $p<0.01$ indicating a significant difference between the experimental and control groups. The study concludes that the math experimental group which received cognitive intervention showed a remarkable improvement in Math's achievement. Hence, from Tables 1 and 2, it can be concluded that cognitive intervention strategies had significant effect in improving arithmetic skills of the selected sample (3rd Standard children who are having mathematical disabilities). The study also concluded that even with deficits in cognition, performance in math's calculations can be improved with remediation. Cai et al. (2013) investigated the cognitive processing characteristics of mathematics learning disability students. The results showed that the Mathematics learning disabled students have deficits in central executive of working memory, visual- spatial sketchpad and phonological loop. It was also found that these students are less competent in simultaneously storing and processing information due to a deficient central executive functioning. Peng et al. (2016) conducted a longitudinal study on predictors of early calculation development among young children at risk for learning difficulties. Numerical competence, processing speed, and decoding skills significantly explained the variance in calculation performance from first grade to third grade. Future research should see whether teacher's instructional approaches enhance the calculation development among the children at risk of learning difficulties.

CONCLUSION

Math gives prime importance to conceptual understanding that helps children develop logical and sequential steps while doing operations. In present study, Mastery learning and Instructional Techniques include learning skills built on the previous learning and these are intertwined in problem solving at a higher level. In intervention the children developed automaticity in processing basic fundamental skills. These results suggest that there was highly significant difference in Math's Experimental Group when compared to the Control Group. Therefore, it is clear that intervention given to the Experimental Group improved the arithmetic skills of children with Mathematical Disabilities.

RECOMMENDATIONS

Children should be taught with activities and concrete objects giving them oral instructions about the operation, but later on, it should be changed to concrete objects with written signs and instructions. Classroom teaching, concrete and usually colorful objects that can be easily manipulated by children should be used to teach math principles. Children with dyscalculia have problems in comprehending the abstract nature of mathematical operations. Hence, they need explicit examples to illustrate the principles implicit in such operations. It will help the student to comprehend the logic behind computational operations.

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