

**EFFICACY OF REMEDIAL PACKAGE IN AUGMENTING  
PRIMARY SCHOOL TEACHERS' SKILLS TO HELP  
DYSCALCULIC CHILDREN**

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## CERTIFICATE

This is to certify that this thesis entitled "Efficacy of Remedial Package in Augmenting Primary School Teachers' Skills to Help Dyscalculic Children", submitted to the Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for the award of the degree of Doctor of Philosophy in Special Education is a record of original research work done by THOTTOLI GEETHA, during the period of her study in the Department of Human Development, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, under my supervision and guidance and the thesis has not formed the award of any Degree/Diploma/Associateship/Fellowship or similar title to any candidate of any university.

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21.8.97

Signature of the Guide

## DECLARATION

I hereby declare that the matter embodied in this thesis titled, "Efficacy of Remedial Package in Augmenting Primary School Teachers' Skills to Help Dyscalculic Children", submitted to Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, is the result of investigation carried out by me in the Faculty of Home Science, Avinashilingam Deemed University, under the supervision of Dr. (Mrs.) N.JAYA, M.Sc., Ph.D. (Madras), Professor and Head, Department of Human Development, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore and it has not been submitted for the award of any Degree/Diploma/Associateship/Fellowship or similar title of any other university or institute.

  
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## I. INTRODUCTION

"The past is our foundation  
The present our material  
The future our aim and summit".

- Sri Aurobindo

Unfortunately today the focus on education is sometimes on the past, very often on the present and seldom on the future.

Development of human resources is the first step for the rapid improvement of any progressive society. Education refines sensitivities and perceptions that contribute to scientific temper, independence of mind and achievements. It is through education of its children, that a nation transmits heritage, recreates its culture, strengthens its economy and ensures its values. Hence, it is right to consider that education is the potential instrument for human resource development.

Cognising this aspect desirably, Article 45 of the Constitution provides education to all the children of the country. A variety of new challenges made it imperative to evolve new design for education and new policy directions in the context of contemporary realities and future concerns and hence the emergence of the National Policy on Education (NPE, 1986).

The National Policy envisages not only access to all children in the primary schools but also their success. This success has been further delineated as the Minimum Levels of Learning (MLL). In the National Budget, increasing allocations are being made for primary education. Primary schools are now available to about 95 per cent of the population within one kilometer of walking distance. There has been a considerable increase in the number of qualified and trained teachers. As a result, one notices considerable improvement in the educational situation of the child. However, the country is still far from the goal of Universalisation of Elementary Education (Srivastava, 1995).

The main reason attributed for the inability to achieve the goal of Universalisation of Elementary Education (UEE) is the poor retention capacity of children in the education system. Kaul (1996) lamenting over the existing situation states that there are schools in which no more than 50 of every 100 children who enroll in class I stay on till class V and there are millions of other children who do not get even a fleeting benefit of this dubious dispensation. A study quoted by Misra (1996) reveals that "an estimated 35 per cent of children who enroll in the first grade drop out before completing their primary education, the rate being higher among girls than boys". The large number of early drop outs cancels all the successes that might have been achieved in bringing the child to school.

On account of the poor nature of infrastructure, the National Policy on Education (1986) initiated the Scheme "Operation Blackboard", under which all the primary schools in the country were to be given minimal basic infrastructure in a phased manner. It is also hoped that under the Revised National Education Policy Formulation (1992), substantial improvement in the educational quality will contribute to improving the educational situation of children. One of the most significant contributions of the 20th century which shall be remembered in History would then be the global upsurge for "Universalisation of Elementary Education" (Ismail, 1996).

In India, Tamil Nadu took the pioneering step in announcing a legislation to provide compulsory enrolment and retention of children in primary schools with the focus on 6 - 12 year olds (Swaminathan, 1994). Among the important life experience of a growing child, school experiences play a very crucial role, as learning starts with primary education.

The school has the unique responsibility of transmitting knowledge and skills, develop abilities and attitudes with an environment specifically created to aid in the learning process of an individual. However, success during this process depends to a great extent, on the type of schooling provided for the child. It is evident through

studies that the measured learning abilities such as productive thinking, reasoning and planning capacity influence academic performance. Therefore, higher the learning abilities, the greater will be the academic achievement.

Academic failure, learning inefficiency, anxiety barriers, dismissals, expulsions, drop outs, reading retardation and a host of other problems are rampant on the educational scene and the percentage of failing students are on the increase. Among them may be the group of learning disabled children, who perform particularly poorly at school despite having otherwise average or above average levels of intellectual ability (Lewis et al., 1994; Murthy, 1995 and Ahuja, 1996).

The National Joint Committee for Learning Disabilities (NJCLD, 1981) defines learning disabilities as a generic term that refers to heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. Even though learning disability may occur concomitantly with other handicapping conditions (eg. cultural differences, insufficient / inappropriate instruction, psychogenic factors) it is not the direct result of these conditions or influences.

Sharma (1993) reports that one in ten school going children are learning disabled. These children have an educationally significant discrepancy between estimated intellectual potential and actual level of performance related to basic disorders in the learning processes. Specific types of learning disabilities include dysgraphia (writing disability), dyslexia (reading disability) and dyscalculia (arithmetic disability).

Children with learning disability may not be able to recognise numbers, or big letters from small, may read 12 for 24, 01 for 10, 6 for 9, saw for was, peak for keep, are slow, confused and hesitate to read, miss lines in text, has difficulty in differentiating right from left and in identifying number values in units, tens, hundreds etc.

Research on learning disabilities is in its infancy in India. Even a cursory estimate of this drawback depicts the magnitude of negligence to which such children are exposed. In the absence of proper diagnosis and remedy, most of these children go unnoticed in the guise of low achievers.

The United Nations Declaration of 1981 as "The International Year of the Disabled", and Economic and Social Commission for the Asian and Pacific Region (ESCAPE) Declaration of the Decade 1993-2002 as "The Asian Pacific Decade for the Disabled", request member countries to ensure full equality to those with disabilities along with others,

no doubt, this has caught the world's attention (Venketaraman, 1995).

Education For All (EFA) including all children with learning disabilities and handicaps as well, by the year 2000 is a global target before the world community. The Universalisation of Elementary Education is planned to be achieved by the end of the first quarter of the 21st century. The task is a challenging one as all children including the disabled have to be educated. This demands that teachers are professionally trained to cater to their specific requirements. Unfortunately, there is little awareness of these aspects in our schools and training institutions. Many children suffer due to lack of awareness on the part of the teachers and parents on disabilities.

Disabilities in reading and writing are often accompanied by disabilities in mathematics. During the first 20 years in the field of learning disabilities, there was little focus on problems with arithmetic computation and the learning of mathematical concepts. More recently however, there has been increased emphasis on these areas.

"Dyscalculia" is the most widely used term for disabilities in mathematics. In general, "Dyscalculia", means inability to calculate. Sometimes the term "Acalculia", is used to refer to complete inability to use

mathematical symbols and perform arithmetic computations. The term 'dyscalculia', is reserved for less severe problems in these areas.

Radhakrishnan (1996) considers arithmetic a universal language enabling people to think, record and communicate the elements and relationships involving quantity. It includes both verbal and written symbols that denote size, order, relationship, space, form, distance and time. Mercer and Miller (1992) observed that many students with learning problems have deficiencies in mathematics that result in practical and emotional problems.

The areas of arithmetics and mathematics include the skill and knowledge used in computing answers to written problems and a great deal more. Understanding many concepts and acquiring familiar skills such as managing money, telling time and measuring volume are included in arithmetics. Primary classes being very crucial for children, it is very important that a child develops interest in learning during this period (Ramachandran, 1996).

Researchers find that 5-15 per cent of children aged 3-15 years are as a group at high risk with social handicap and mental health problems (Mary, 1995). An important study of the National Council for Educational Research and Training (NCERT, 1995) covering 23 states and over 60,000 students expresses concern over the declining learning

levels in primary schools and it has been found that the achievements of students in arithmetics and language in class V are lower than in class IV.

Students with learning disabilities receive their instruction in general education classrooms. Many students do not have the ability to keep pace with the curriculum, the way it is structured and thereby experience a different kind of segregation, the exclusion from the basic right of education (Schumm et al., 1995). These students are perceived as being lazy, dull, mischievous and notorious in class. Rightly named as "hidden handicap", these children do not get attention or even consideration for the disability as it is not conspicuous like other disabilities involving sensory, motor or intellectual aspects. Thus, learning disabled children have remained undetected in the present educational system where automatic promotion exists (Menon, 1994).

The problem of learning disability cannot be dealt with medically, it needs to be urgently addressed only through educational remediation. Therefore, early detection of learning disabled children and their remedy is vital at the primary school level. The earlier the remediation, the lesser the damage and the greater the dividend (Mathew, 1996). Rush and Vitale (1994) also favour early prevention stating that the earlier years are the most crucial and if

the battle of essential skills is not won before the fifth grade a student can automatically be identified as at risk for school failure.

If children are given activities of their choice, they would learn several things without the help of a teacher. This requires some imagination and planning by the teachers aiming towards a better teaching learning process (Ghose, 1996). The broad view of education requires a shift from the traditional lecture to active student-centered, self-paced, self-discovery methods of learning. This shift requires a commitment to innovation and ability and opportunity to bring about change (Falchikov, 1993).

The National Policy on Education (1986) lays special emphasis on child centered approach, playway and activity based learning in place of formal methods of teaching. (Ganesan, 1995 and Narayan, 1994). The major focus therefore, should be to enable the teachers to develop proper insight with regard to the nature of learning disability, procedures to identify and diagnose the same and provision of remedial help to the learning disabled children in regular classroom (Jaya and Geetha, 1994).

As the current trend in education of the disabled children is geared towards integration, it is ideal to keep the children with scholastic backwardness in regular school

and equip the regular class teachers to identify the child's specific problem in learning. This would in turn lead to helping the child in correcting the problem without labeling him with a diagnostic tag. When "Education for All" is the United Nation's Declaration to be achieved by 2000 AD, such a preparation of regular primary teachers is a major milestone towards achieving the goal. The need of the hour is to develop and introduce remediation methods as a special support system to be practiced by teachers to bring about effective responses among children with learning difficulties in mathematics.

Against this backdrop, the investigator designed this study on "Efficacy of Remedial Package in Augmenting Primary School Teachers' Skills to Help Dyscalculic Children", with the following objectives :

- A. Sensitize primary school teachers towards children with learning disabilities
- B. Assess the academic performance of primary school children and identify dyscalculic children among the scholastically backward
- C. Evolve and implement a remedial intervention programme for dyscalculic children and
- D. Evaluate the efficacy of the remedial package developed.

As higher education becomes competitive, children with this 'hidden handicap' get nowhere into the educational stream and receive no attention to their 'hidden talents'. It is, therefore, envisaged that combined efforts of regular teachers and the parents along with persistent, well motivated approach of the student under the guidance of the remedial teacher would alone bring about a dramatic change in the existing difficulties of the learning disabled.

### Research Questions

The study is aimed at answering the following research questions :

- i. What percentage of children exhibit general backwardness in academic subjects ?
- ii. What is the proportion of children exhibiting difficulties in mathematics ?
- iii. What percentage of children with learning difficulties in mathematics manifest behaviour problems and neuropsychological difficulties ?
- iv. What are the outcomes of remedial intervention on selected dyscalculic children ?.

### Operational Definitions

#### 1. Learning disabled

Any average or above average <sup>general intelligence</sup> child having academic performance below the norm (determined by a standardised

measure of academic achievement) and displays substantially greater number of error responses in academic subjects than their peers.

## 2. 'Dyscalculic' children

Mathematical disability referred to as dyscalculia is concerned with specific arithmetic computational deficits faced by children in addition, subtraction, multiplication and division or to specific deficits related to concepts such as spatial relation, shape and size discrimination, one to one correspondence and problem solving.

## II. REVIEW OF LITERATURE

The literature pertaining to the present investigation has been reviewed under the following heads :

- A. Learning Disability Among Primary School Children-  
Emerging Concepts and Trends
  - B. Learning Disability with Special Reference to  
Dyscalculia
  - C. Arithmetic Competence Deficits and its Impact
  - D. Remediation of Dyscalculic Children - Means and  
Methods and
  - E. Teachers' Role-Tasks in Remediation
- 
- A. Learning Disability Among Primary School Children  
Emerging Concepts and Trends

School experiences constitute a major social influence on behaviour (Berk, 1994 and Ghose, 1996). For children, schooling occupies a high proportion of working hours during much of their growing years. As a result, this system is called upon to provide a variety of experiences to meet the growth needs and to enhance growth partnership between home and the school (Gokaran, 1989; Ujjwalarani and Kumari, 1994 and Rao and Parthasarathy, 1995).

The Department of Social Welfare and UNICEF (1994) report that over 3.5 million children of school age (6-14 years) are out of school. They are neither enrolled or dropped out. About 19 per cent children enrolled in class I

drop out before they complete five years of primary school, while 40 per cent drop out before class VIII (Child Asia, 1993).

A child quits school not on account of one reason, but because of a constellation of reasons (Pangotra, 1986; Singh, 1986; Cairns et al., 1989 and Barrett and Trevitt, 1991). Poor achievement and lack of interest are major reasons for dropping out. Studies have shown that more than half the children in class IV and class V fail to meet basic requirements of literacy and numeracy (Patyal, 1980 and Newman, 1989 and Bhagat, 1993).

Projecting the rural scenario of primary education as it prevails, Acharya (1988), Newman (1989) and Sohoni (1990) indicate that the National Education Policy (1986) did not refer to the vast bulk of rural primary schools, where 77 first graders out of 100 enrolled, drop out before they reach class VIII where 40 per cent of the buildings are of temporary quality; 40 per cent of schools have no black boards; 59 per cent have no drinking water and 35 per cent function with only a single teacher.

Krishnamurthy (1993) and Rani and Bhadramani (1993) report that of the 100 million children attending primary classes, 50 per cent of them achieve only 30 per cent scores. On the other hand, some children with normal IQ and

adequate adaptive function nevertheless have difficulty in learning to read, write or do arithmetics (Hayes, 1995).

Analysing the infrastructure of the primary schools and the poor quality performance of the children, Brenam (1982) and Rush and Vitale (1994) recommend that the first task of development in schools must be to ensure that children with special education needs are discovered as early as possible. The most vital intervention should begin between the ages of 7 and 8 years and for this the teachers should become aware of early signs of emerging difficulties and be skilled in resolving them at a stage where the children are amenable to ordinary classroom approaches (Lernor et al., 1981; Peer, 1996).

Adelman (1992), Rush and Vitale (1994) emphasize the need to identify factors that lead students to become at risk for school failure. Absenteeism, academic failure and early school departure are links in a long chain of interconnected problems. The NIPCCD (1994) concurs that dropping out is a progression of factors that begin at primary level up to the students final decision to drop out.

Elia et al. (1993) refer to American Psychiatric Association (1987) that lists academic under achievement as characteristic of most children with attention deficit hyperactivity disorder (ADHD) and school failure.

Matsuura et al. (1993) investigated emotional and behavioural problems among primary school children using Rutter's questionnaire in Japan (N=2638), China (N=2432) and Korea (N=1975). The results indicated higher prevalence of deviance among boys and among those children with poor school achievement.

Pandey and Advani (1995) and Weldon (1996) observed that even mildly dyslexic children or those with specific learning difficulties tend to have low self-esteem and its effect spreads through the social and academic world. Among the other associated conditions, Lefrancois (1983), Epstein and Cullinan (1984), Bruck (1986), Bender (1987) and Stevenson et al. (1993), explain that if learning problems lead to behaviour problems, hyperactivity is likely to emerge.

Classroom behaviour is the outcome of a complex set of factors operating on students at different levels (Esser et al., 1990; Menon, 1995 and Bayrd, 1996). Inadequate housing facilities and abnormal family size, disturbed family situation may hinder pupils' performance. Over population and environmental pollution may increase behavioural disorders among individuals. In addition, performance in the examination emphasized as success parameter, is one of the major reasons for undesirable behaviour patterns among students.

One of the major obstacles in creating an effective classroom environment, is the behavioural problem child, who cannot adjust to the socially acceptable norms of behaviour and consequently disrupts his own academic progress, the learning efforts of his classmates and inter-personal relations (George and Sananda Raj, 1983; Sinha, 1988; McIntosh et al., 1993 and Menon, 1995).

In a study on socio-metric status and behaviour of 179 children aged 8-12 years, including 36 children with learning disability, Nabuzoka and Smith (1993) nominated the Learning Disabled (L.D.) children as shy, rejected, seeking help and as victims of bullying significantly more than non-learning disabled children. Greshan (1982), Dudley - Marling (1985), Larry (1989) and Sharma (1993) also have similar view on the poor social status of the L.D.

Prasad's (1982) study with primary school children showed that poor expressive language development and poor visual perceptual development as primary factors led to learning difficulties. Sinha (1988) further adds that children enter school with behaviour problems that are not conducive to optimum learning.

Efforts continue to explore the causes of learning disabilities. Disturbances in the brains' information processing system occur prenatally, during birth or in the early years. An expectant mother's poor diet or use of

drugs, alcohol, or cigarettes may restrict the blood supply and reduce oxygen to the foetal brain. Loss of oxygen can also result from a difficult delivery (Shields, 1989). Researches have found a link between specific learning problems and low birth weight, resulting from insufficient prenatal development of portions of the brain or foetal hypoximia (The Child's Rights Bulletin, 1996).

Cognising the fact that the world disabled population would be well over 600 million by the end of this century (40 % being school age children), Mckay (1994), Sethia et al. (1994) and Hayes (1995) highlight early recognition and intervention to help children with learning difficulty to overcome feelings of lowered self-esteem, self-hood and stress and to feel valued and integrated with the school system and the family (Rutter, 1985; Kirpalini, 1989).

Milton (1993) contends that corporal punishment had only a negative effect on children's attitude to schooling though meant to induce academic progress among children (Rani and Bhadramani, 1993; Rao and Parthasarathy, 1996).

Wolff (1989) and Venugopal (1994) report studies relating home environment and intellectual competence. They have shown that parents' educational level and the mother's tested intelligence are strongly related to the children's

tested abilities from the age of 18 months onwards. However, the variety of stimulating experiences made an independent contribution (Desai, 1989; Indra, 1990; Kajjari and Khadi, 1994; and MacKey, 1996).

UNICEF (1988), Grolnick and Slowiaczek (1994); Pandey and Advani (1995) and the World Bank (1995) reiterate that the family is the most important channel of assistance to the child. However today parents face the problem of rearing their children to face an extremely competitive world with knowledge. Anantharaman and Parthasarathy (1992), Desai (1993) and Pillowalla (1993) exhort that quite a few parents are involved and concerned about their children and play a positive role.

Balachandran (1993) states that parents willingly carry half the burden of educating the child and the problems with most underachievers are directly linked to lack of concentration. Cognising the dependence of young children on the immediate environment, Subramanyam (1983), Gokaran (1989), Grotberg (1995) and Mackey (1996) emphasize the role of the home, the neighbourhood and the school to meet their growth needs and to provide the transfer of cultural values, information and skills.

Research concerning the L.D. students' spontaneous use of language in natural and contrived settings by Bryan et al. (1981), Dudley-Marling (1985) and Scarborough (1990)

demonstrate that children with learning disabilities differ from their peers in "what they say and how they say it". They have shorter utterances (Donahue et al., 1982), provide less information (Knight-Arest, 1984) and request information less often when compared to normally achieving children.

Problems related to directionality, mirror writing, poor auditory discrimination, number order, clumsiness and difficulty in understanding instructions are some of the activities depicting specific disabilities (Ramaa, 1992; Ahuja, 1996). Bamman (1989), Farr (1989) and Bishop and Adams (1990) and predict that a child who has a specific reading language impairment in the preschool is at risk for specific reading disability in the later years.

Cognitive processing deficits are associated with learning disability. Sethia et al. (1994) list them as impairments related to short term memory, long term memory, sequential memory, working memory, recall and recognition as quite common.

A comparative study with normally achieving students by Parmer et al. (1994) indicate that both students with mental retardation and those with learning disabilities lag considerably behind their average achieving peers. To Rao (1988) three mandatory characteristics by which L.D. can be

identified include 'average' or 'above average intelligence', 'adequate sensory acuity' and 'achievement considerably less than their composite IQ', 'age' and 'educational opportunity'.

Another area of motor behaviour which may signal a learning problem is co-ordination problem, synchronizing large muscles, fine motor tasks in writing, printing, drawing, copying and tracing (Lovitt, 1989) and handedness (Arnold and Askew, 1993).

Reports of Wong (1985) and Pressley et al. (1989) reveal that L.D. frequently lack specific or general problem solving ability, they do not process information or apply knowledge effectively, experience difficulty in selecting and deploying task appropriate strategies and lack self-regulation processes.

Khurana (1988), Sharma (1993) and Ramaa (1997) list the characteristics of the L.D. as one who pays attention to everything that goes<sup>on</sup> around him, cannot assign priorities to tasks for completion and is indiscriminate-a characteristic of immaturity. Responses and behaviour of these children though not abnormal, are often more appropriate to much younger children. They also lack many of the basic skills usually acquired in preschool years, the foundations necessary to academic learning. Hyperactive behaviour may be

exhibited in instructional settings by a short attention span, restlessness and exaggerated behaviour (Stevenson et al., 1993).

Mohan and Gulati (1986) and Sumangala (1995) observed correlation between academic achievement and intelligence. The environmental and psychological factors play a significant role in the child's academic achievement. It is also felt that what is true about preventing disability equally holds good in promoting development. One needs to act early enough since the foundation of growth and development through the years of school age, youth and adult life is laid in early childhood have not been ruled out by (Ganapathy and Singh, 1981 and Diamond et al., 1994).

If early years suffer relative neglect as they often do, it will not be easy to make up later for the lost human potential (Kaul, 1986). Sinha (1991) and Narayan (1994) contend that by making primary education child oriented, the system might turn to be a joyful, inventive and satisfying learning activity rather than a system of rote and cheerless authoritarian instruction.

#### B. Learning Disability with Special Reference to Dyscalculia

Learning disability is a fast expanding field, though much of it remains unexplored. The debate on learning disability till date relates to differing opinions as to

what is really meant by the term 'learning disability' in terms of degree, nature of disability and identification procedures among other factors.

Following paragraphs reflect learning disabilities as explained in the educational sphere :

Learning disabilities irrespective of either physical, mental or learning conditions are universal across all ages, socio-economic levels and races with the individual facing mild or severe learning problem (Ramanujam, 1995).

Various definitions on learning disability are in vogue, According to Heward and Orlansky (1988), Shields (1989) and Rourke and DelDetto (1994) the term 'learning disability' refers to children with significant learning problems that cannot be explained by mental retardation, sensory impairment, emotional disturbance or lack of opportunity to learn.

According to Sarangi (1989) any average or above average child having academic performance below the norm is labelled as learning disabled. Ramaa (1992) refers to learning disability as the child's limited ability in learning.

Thomas et al. (1987) and Adams (1990) observe that students with learning disabilities display substantially greater number of error responses in certain academic

subjects than their non-handicapped peers. While sources of backwardness are many, Menon and Koshy (1991) perceive two broad distinctions between one group of children - slow learners (IQ < 45 to 50) who by nature have limited intellectual endowment and the other group 'underachievers' (IQ - 75 and above), whose achievements are expressed by causes other than low mental ability.

Alexander (1993) and Bhatia (1996) remark that there are a substantial number of children delayed or retarded in learning to talk, in language acquisition or have great difficulty in learning to read, spell, write or calculate arithmetic problems. However, not all children with these problems have a learning disability per se.

Hallahan (1992) and Parmar et al. (1994) indicate that students with mental retardation and those with learning disabilities fall considerably behind their average peers, the latter having IQ scores from slightly below average to average with discrepancies in performance between two or more academic areas.

Harris and Liebert (1987) and Rao (1988) are of view that the term learning disability is used when a child's school achievement is well below expectations, given the child's IQ score, family background and physical and emotional health are good.

Narayan (1994) noticed that dyslexia or dyscalculia, conditions that are purely academic oriented do not get detected in many individuals and they struggle a lot. This is because no survey on L.D. children has been done due to probably the inconspicuous and misunderstood nature of the disability.

According to Witt et al. (1988), dyscalculia is a term that was originally used in medicine to indicate the virtual loss of mathematical ability after head trauma and was borrowed by some educators to describe basic arithmetic learning disorders. As contended by Podder (1996) the loss of arithmetic ability to learn numbers and number relationships is 'dyscalculia'.

Differentiating the terms 'arithmetics' and 'mathematics' Lewis et al. (1989) states that 'arithmetics' is primarily concerned with computation - addition, subtraction multiplication, division and algorithms related to these operations. 'Mathematics' includes computation, problem solving, estimation, approximation, prediction, application of concepts as in reading graphs, charts and tables.

Mercer (1983) considers arithmetics a universal language enabling people to think, record and communicate the elements and relationships involving quantity. It includes both verbal and written symbols that denote size,

order, relationship space, form, distance and time (Gearheart and Gearheart, 1989; Mercer and Miller, 1992). Daily living requires the application of mathematic skills, for eg., planning and monitoring time, computing percentages, making estimations, measuring textile purchase, computing scores, playing games etc. In school settings, problems in mathematics often result in school failure leading to high levels of anxiety. Further, successful functioning in the adult world requires a variety of problem solving skills that demands skills more than computation (Koscinski and Gast, 1993; Kulak, 1993).

Gakhar (1983) and Berk (1994) are of the view that mathematical reasoning like reading builds on a foundation of informally acquired knowledge. Research conducted by Woodward and Haward (1994) indicate that one of distinguishable feature of low achievers is their incapacity to use a range of representation systems (eg. - drawing) when confronted with novel problems.

Batchelor et al. (1990) investigated neuropsychological factors as predictors of 1,189 L.D. students' (aged 9-16 years) performance on visual and verbal arithmetic performance. Results suggest that students' arithmetic performance varied as a function of neuropsychological deficits and mode of stimulus problem presentation.

Koscinski and Gast (1993) recommend mastery of basic facts in mathematics as the stepping stone to further achievements. Traditionally too, the efficient and automatic retrieval of the basic facts from memory was the mathematical goal (Fleischner et al., 1982). The prevalence of disability in arithmetics projected by Kosc (1974) is as much as six per cent of the school age population. Haward and Orlansky (1986) report of 5 to 30 per cent of the school age population with disabilities in arithmetics.

Kosc (1974) traces hereditary or congenital affliction of the brain substrate in mathematical function, this disorder clearly distinguished from other forms of disturbed mathematical abilities. According to Prasad (1982), Joseph (1985) and Chalam (1996), children hailing from socially and educationally disadvantaged groups fail to achieve a minimum level of learning in mathematics and language. Lack of sufficient motivational factors for children at home and selective deficits in processes unique to calculation are quoted as reasons (Desai, 1985).

In economically deprived sections of society, the levels of medical and social pathology are high with profound effects on <sup>the</sup> child. Brief hospital admissions if repeated, can lead to educational failure especially in mathematics (Wolff, 1989).

Studies by Kirby and Becker (1988) demonstrate that the greatest number of arithmetic errors are due to the use of incorrect strategies or procedures. These incorrect procedures are characterized by the child selecting the wrong operation such as addition instead of subtraction or taking the wrong numbers away in subtraction. Other errors particularly when numbers larger than 10 are involved are due to conceptual difficulties regarding numbers (Resnick, 1983 and Russel and Gunsberg, 1984).

Deficiencies in mathematics among L.D. students emerge in the early years and continue throughout secondary school (Gakhar, 1986). Cawley and Miller (1989) report that the mathematical knowledge of students with learning disabilities tends to progress approximately one year for every two years of school attendance.

Mathematics has its own vocabulary, uses common words with a special meaning, employs complex concepts and involves string of relationships and making of generalizations thereby leading to more reading problems in mathematics than in any other subject content (Bond and Tucker, 1979).

As for gender issue in mathematics achievement, Harris and Liebert (1987) observe that in elementary schools girls do about as well in mathematics as boys. In high school, boys outdo girls by a considerable margin. The girls are

more likely than boys to react to difficulties by feeling incompetent and giving up, whereas boys are more likely to react in a mastery oriented way and work harder (Singh et al., 1994).

Eccler (1989) states that girls consistently had more confidence in their English ability than in mathematic skills. Parents of girls think that their children have to work harder in mathematics than parents of boys do, when teachers' think both groups can work equally hard. Problems in mathematics effect less confidence on the part of the poor achievers.

Share et al. (1988) investigated factors associated with reading disability and specific arithmetic disability in a longitudinal study of over 900 children assessed from age 3-13 years in NewZealand. Evidences revealed reverse patterns of strengths and weaknesses with regard to verbal and non-verbal skills, among boys but noticeably absent for girls.

Rourke (1993) summarizes the findings of the study focused on two groups of children aged (9-14 years and 7-8 years) with learning disabilities who exhibited equally impaired levels of arithmetic achievement but with different pattern of neuropsychological assets and deficits.

Sethia et al. (1994) conclude that the L.D. children despite being slow, possess the ability and motivation to

perform the task accurately, but are hampered by high cognitive load which in turn requires slow and sustained effort. Numerous studies of Kirby and Becker (1988); Bhatia (1996) and Ramaa (1997) support the position that students with disabilities can be taught to improve their mathematical performance.

Loveland et al. (1990) compared 14 non-disabled control children with 13 L.D. impaired in reading and arithmetic skills and 12 children with learning disabilities in arithmetic but not reading. The results revealed that the L.D. had problems with social communication skills, the nature of the problem varying with the type of learning disability.

Mercer and Miller (1992) reveal that many students with deficiencies in mathematics exhibit characteristics that predispose them to math disabilities (eg., problems in memory, language, reading, reasoning and metacognition). Their learning difficulties are often compounded by ineffective instruction. Shields (1989), Kelly et al. (1990), Carmine (1991) and Babu (1996) believe that poor or traditional instruction is a primary cause for learning problems of many students in mathematics.

McIntosh et al. (1993) suggest effective integration of students with learning disabilities into the general education classroom. The L.D. children are capable of

remarkable things. When trusted, they respond warmly with an understanding that is purely based on love which by itself proves to be a source of strength to draw from (Indra, 1990).

### C. Arithmetic Competence Deficits and Its Impact

Learning of mathematical concepts is highly logical and abstract. A mathematical concept is a mental construct acquired through abstracting a common response to the set of apparently different stimulus interaction.

Concept acquisition involves the process of associating, understanding, based on real experiences and stimuli of the words (Subramanyam, 1986). Hills (1993) Greenleaf et al. (1994). attribute difficulties in acquiring arithmetic competence to various influences both internal and external to the learner.

The results of a study by Light and Defries (1995) on assessment of genetic and environment etiologies leading to reading and mathematics deficits among 148 identical and 111 fraternal twin pairs aged 8 to 20 years suggest that about 20 per cent of the problem in reading deficits was due to genetic factors that influenced performance. Genetic and shared environmental influences appear to contribute almost equally to the observed covariance between reading and mathematics scores.

Approaching the problem from an empirical standpoint, Rourke (1993) and Rourke and DelDetto (1996) have identified two neuropsychologically distinct subtypes of arithmetic dysfunction. The first subtype occurred concomitantly with reading and spelling disorders. These children demonstrated intact visual, spatial and tactile perceptual skills. However, children in this group were deficient in their general, verbal and auditory perceptual abilities. The second sub-type was found to display normal achievement in areas other than arithmetic. Although this group demonstrated normal verbal and auditory perceptual skills, they were deficient on both visual, spatial and tactile perceptual measures (Batchelor et al., 1990).

Cawley et al. (1979) and Lovitt (1989) enumerated several factors leading to deficits in arithmetic as

- \* Correlated failures - mathematics related to reading - children with difficulty in reading having problems in maths. Handwriting problems or difficulty in drawing simple shapes can negatively affect performance in maths. Difficulty in comprehending time, space, direction and quantity affect math abilities.
- \* Instructional failure - inappropriate instruction, incorrect or too limited exposure to develop the skill being taught.

- \* Shifted from one skill to another before reading competency.
- \* Tendency of the teacher to over correct, faulty and incorrect assessment of student performance.
- \* Faulty and incomplete assessment of students performance
- \* Individual failure - includes attentional deficits, problems of encoding memory, organisation and general disability in mathematics or dyscalculia.

Arithmetic achievement is correlated with a number of "non-intellective" variables including attitude, anxiety, interest, personality and teacher factors (Sumangala, 1995). At the same time, these variables themselves necessarily interact with intelligence, verbal and spatial abilities. Normally intelligence is considered basic to success in mathematics, though its relative contribution depends upon individuals investigated and criterion measures employed.

Swedish studies on the psychological and social background of children have been based on cognitive learning theory. Faulty perceptions of concrete events, representations of objects or events or abstractness were traced to be the factors associated with under achievement in maths (Magne, 1978).

Hitch and McAuley (1991) and Case et al. (1992) establish that students with learning disabilities demonstrated poor general mathematics achievement and were less adept at solving word problems than average or high achieving students. Most of the mistakes were not due to conceptual errors, instead executed the wrong algorithm and did not complete all the steps necessary to solve the problem (Kirby and Becker, 1988).

Mathematical disabilities in students include difficulties with psychomotor speed (Fleischner et al., 1987 and Kosinski and Gast, 1993), visual or auditory perceptual deficits (Lambardo and Drabman, 1985 and Hitch and McAuley, 1991), memory deficits (Bhatia, 1996), difficulties in developing automaticity by shifting from reconstructive (counting) to direct revival of strategies (Fleischner et al., 1987; Woodward and Haward, 1994).

Second and Vth graders with mild disabilities were monitored in reading and mathematics immediately before and after a summer vacation and six weeks into the following school year using Curriculum Based Measurement Probes by Allinder and Eicher (1994). The selected sample regressed significantly in both areas following the summer break. However, they regained proficiency in reading, but were performing at the same level in mathematics at the recoupment measurement time.

Seven, III grade children aged (8.5 to 9.0 years) with developmental dyscalculia examined by Shalve and Gross - Tsur (1993) attending mainstream classes had no academic progress. The authors suggest that the indicators for medical or neurological assessment be broadened to include children, not improving academically despite appropriate professional intervention.

Analysis of "think - aloud" protocols by Case et al. (1992) revealed that L.D. students had more trouble than their normally achieving peers in identifying the needed information, understanding the problem and in organising an efficient approach involved in problem solving.

Considering children with spatial difficulties but intact language abilities, Geary et al. (1987) are of the opinion that they might have difficulty keeping track of the object presented on the non-verbal problems, contributing to performance delays. However, the difficulties may become less important for calculation as children learn basic number facts.

Children with language difficulties but intact spatial abilities may perform at a normal level on non-verbal calculation problems but not on verbal calculation problems. In contrast, children with both language and spatial

difficulties might perform below normal (Jordan et al., 1995).

Mathematics educators often stress on factors that interact with the learners' cognitive abilities as complexity of the subject matter, insufficient mastery of pre-requisite skills, motivational factors and inadequate instruction (Cawley et al., 1978).

Though structural learning is considered superior, Kirby and Becker (1988) suggest three cognitive factors responsible for children's learning problems in simple arithmetic as encoding of numbers, efficiency of operation execution and strategies for carrying out the operations.

In most individuals, the right hemisphere predominates for spatial and holistic processing, while the left hemisphere is specialized for analytic and logical aspects of both verbal and numerical functions (Joshua, 1996). Problem solving and other complex forms of thought are believed to require fluency and integration of hemisphere functions (Jimenez, 1992; Kumar, 1995) characterised the roles of right and left hemisphere in arithmetic performance. Their respective roles as one or the other side of the brain is more influential during performance of arithmetic tasks.

Geary et al. (1995) identified three sub-types of early mathematical disabilities, two of which involved selected verbal processes. This classification scheme extended the earlier sub-typing work. The first sub-type was characterized by difficulties in the representation and retrieval of arithmetic facts in semantic memory, the impairment associated with dysfunction involving posterior regions of the left hemisphere of the brain (Warrington, 1982). Children of this category, had specific weakness in learning and in automatizing basic arithmetic facts even after extensive drill and practice in school.

The second sub-type involved difficulties with arithmetic procedures such as using counting strategies to solve calculation problems (Geary et al., 1987). Performance characteristics of procedural deficits included the use of developmentally immature arithmetic procedures, delays in acquiring basic procedural concepts and frequent errors in executing arithmetic procedures. Children with procedural deficits appeared to have general rather than specific difficulties with the acquisition of basic number concept. The third sub-type though not associated with verbal abilities is characterised by deficits in the spatial representation and interpretation of numerical information. The Visio - spatial sub-type involved dysfunction of the

posterior regions of the right hemisphere of the brain (Venketaraman, 1996) and the children may have difficulty reading arithmetic signs.

Aiken (1972) proposed that mathematics itself is a specialized language. Mathematical language differs from ordinary language, thereby posing second language learning dilemma for children (Kumar, 1985 and Mercer and Miller, 1992). Children with language deficits may fail to solve word problems correctly eventhough they have competencies in calculations (Jitendra and Hoff, 1996).

Bhatia (1996) suggested that the same language difficulties that interfere with developing skill in reading also affect arithmetic performance, difficulties with arithmetic symbols or vocabulary and the language to organise and guide computational steps.

The importance of rich and meaningful vocabulary, knowledge in developing concepts is widely accepted by classroom teachers. Monroe and Panchyshyn (1995) justify difficulties with mathematics contending maths with more concept per word, per sentence and per paragraph than any other area. Schiller and Rossano (1988) consider it particularly crucial to emphasize vocabulary instruction in mathematical content area. Calculation provides a foundation for later mathematical learning and it's difficulties can

erode children's confidence in their mathematical abilities (Scary, 1990; Parmer and Cawley, 1991).

Jordan et al. (1995) reveal that children with different cognitive pattern may have different instructional needs in acquiring calculation skills. The use of verbal and non-verbal calculation tasks in educational assessments may prove to be helpful in characterizing young children's mathematical strengths and weaknesses.

In a related study among preschool children, Jordan et al. (1995) found that the non-verbal education task format is less sensitive to socio-economic variation than the verbal task formats. Children of low and middle income families showed similar levels of performance on the non-verbal calculation task performing well below standard level. In contrast, children from low income families performed much worse than middle income children on story problems and number facts problems, because the former received less conventional verbal input at home (Kirk and Elkins, 1975). A follow up study one year later, showed that many of these difficulties persisted after formal instruction in the first grade (Jordan et al., 1995).

To sum up, it is apt to quote the expressions of Srinivasan (1994) that the "earlier the people are made to realise that mathematics is the "King of all Arts" and

"Queen of all Sciences" and the earlier mathematics is considered and accepted as a creative subject of higher applicability, the better will be the quality of individual and social life".

#### D. Remediation of Dyscalculic Children - Means and Methods

The major aim in diagnosing the disabled child is to determine the best remediation programme. Hence, the larger concept of assessment is a must to identify the problem and to determine the most beneficial types of intervention for the child with disabilities (Ramanujam, 1995).

Depending on the severity of the problem, remediation involves one (or more) of the following three hierarchical levels.

- \* Level A - focuses on age appropriate life tasks (basic knowledge, skills and interests)
- \* Level B - includes missing prerequisites for learning
- \* Level C - Concerned with factors interfering with learning (disabilities, negative motivation and interfering behaviour)

In the past, majority of the programming for students with learning difficulties focused on language and reading, though currently large number of students with learning disabilities are receiving remediation in mathematics (Heward and Orlansky, 1988).

Assisting students with learning disabilities to learn mathematics more effectively requires a two step approach.

- a. consideration of the disabilities that may contribute to difficulties in learning and
- b. review of approaches, methods or strategies that appear to be valuable circumventing these disabilities (Starr, 1962 and Sewell, 1986).

Factors such as quantity taught, pacing, (fatigue and attention span) rate and mode of presentation (concrete objects, pictures or symbols) readiness or drill (sufficient understanding of the concept for repeated practice) level of interest and difficulty and lastly application in real life situations must be considered in developing remediation (Reisman and Kauffman, 1980; Kelly et al., 1990 and Vaidyanathan, 1995).

Prakash (1996) is of the view that the concepts taught in mathematics are superfluous, having no direct bearing on the children's day to day life. As a consequence, the ground reality is that a large number of them not only find it difficult to master the subject, but struggle to cope with it.

As for teachers' efforts, Baker and Zigmond (1990) observed that undifferentiated large group instruction was the norm with few accommodations made for students with

individual differences. Jenkins et al. (1994) and Jaikumar (1997) consider grouping and supplementary instructions as the most enduring means of addressing ability differences, since no teacher can deny the importance and usefulness of individual guidance in learning. Kishore (1984) aims for mastery learning procedure - a special form of guidance in learning which allows a student to learn at his own rate, providing continuous opportunity to check his learning.

For students with mathematical difficulties, Bond and Tucker (1979) and Jegathambal (1996) suggest an accurate command of all the technical symbols used as an important prerequisite without systematic instruction. Slow progress is made in acquiring sufficient skill to understand and manipulate symbols, abbreviations and numerals.

An attempt has been made in Table 1 to compile the studies on various remedial intervention methods used for children with learning difficulties in mathematics.

Table 1: Remedial Intervention Methods for Dyscalculic Children

Method	Procedure	Sample Size	Author
Questions and answers in verbal problem solving	Questions used in seeking correct responses		Zweng et al. (1980) Fantasia (1981) Robertshaw (1981) Nazum and Morzola (1987)
Manipulative aids such as abacus, counting rods and paper clips	Positive effects in overcoming subtraction problems		Lovitt et al. (1974)
Demonstration and Permanent modelling (D & PM)	Teach addition, subtraction and multiplication		Blackenship (1978) Sugai and Smith (1987) Meyer et al. (1992)
A Battery of Piagetian tasks	None advanced to concrete operation stage due to delay in transition  Aquisition of reading skills was not dependent on the stages of operational development	Two - nine year old boys with normal IQ, language and reading ability	Sake and Shabeen (1981)
Competency Based Instructional (CBI) Programme	Hierarchical order of specific concepts, attainment of one leading to next	1st and 2nd grades	Joshi (1983)

Breaking into specific goals, terminal objectives and specification of activities	Leon and Pepe (1983) Goldman (1989)
Strategy instruction and self instruct	Helpful in learning a new skill.
Write and write and say	Used this method in mathematical problem solving
Verbalization for subtraction	Verbalisation for subtraction led to higher self-efficacy and skillful performance
True/False Reaction Time (RT)	Presented simple addition problems using time/false Reaction Time Tasks (RT) LD children required more time, had deficit in self monitoring and relied on counting strategy
Constant Time Delay method (CTD)	Provides systematic introduction of teaching; assistance in teaching multiplication facts
	LD 90 children aged 11 years 2 months to 16 years and 2 months grade 6-8
	77 Normal 46 LD from II, III and IV grade
	2 boys, 3 girls

Lambardo and Drabman (1985)

Schumk and Cox (1986)

Geary et al. (1987)

Gast et al. (1988)

Steven and Schuster (1988)  
Koscinski and

<p>Learner Response Model - A Piagetian perspective</p>	<p>Teacher as facilitator provides a thorough basis for understanding space, number, seriation and classification</p>	<p>Gast (1993) Gearheart and Gearheart (1989)</p>
<p>Token reinforces for correct response</p>	<p>Used for a structured set of mathematics problem in a two part experiment. Sample achieved 90 % correct response against 34 % correct response initially</p> <p>In the second part of the study, 100 % correct response was achieved for multiplication and division</p>	<p>Pavchinski et al. (1989)</p>
<p>Use of concrete materials, pictures and symbols for multiplication</p>	<p>Flash cards and multiplication charts used helped. Cause nario' rods materials and arithmetic blocks</p>	<p>Kurland (1990) Koscincski and Gast (1993)</p>
<p>Worksheets with Self Monitoring Checklists (SMC)</p>	<p>Included numeric device, 90 per cent level maintained 1-7 weeks after follow-up</p>	<p>Brown and Frank (1990)</p>
<p></p>	<p>2 groups of 3 students each</p>	<p></p>

Strategy choice and Information Processing Model (IPM)	Assessed the two methods in terms of differences among sample L.D. No change group opted for frequent use of immature computational strategy and poor strategy choice	23 Normal 29 LD in maths I & II graders	Scary (1990)
Self paced computer based pattern recognition tasks	Inferential skills in problem solving and response to error examined. L.D. scored significantly lower than normal achievers	33 Normal 69 LD	Shafir et al. (1990)
Mediated transfer procedure and colour mediation procedure	Involved the association of each numeral with a colour. Number facts were rapidly learnt.		Van-Houeten and Rolider (1990)
Reinforcement, games self instruction and calculators	Acquisition of facts such as addition, subtraction and multiplication		Bakken and Scruggs (1991)
Extended remediation Learning sequences served as guides for remediation	Learning process elaborate on transition from concrete to symbolic mode of doing arithmetics	Nine-second graders	Lopez (1991)

Intervention	Description	Author(s) and Year
Token Reinforcement Cognitive Behaviour Modification (CBM) and Direct Instruction	Comparative study revealed significant differential gain between treatments and direct instructions. Groups to be equally effective through TR & CBM were superior to direct instruction	Ross and Braden (1991)
Simple self regulated strategy	Used in solving simple word problems	Case et al. (1992)
Concrete Semi-concrete Abstract (CSA) teaching sequence	CSA sequence was an effective intervention requiring 3 to 7 lessons using manipulative devices/ objects. Transfer of learning to abstract level made possible	Mercer and Miller (1992) Miller and Mercer (1993)
Modelling	Tasks requiring perceptual skills with or without model were used	Meyer et al. (1992)
Application of concepts to real life situations and mockshop	Results showed that children lacked understanding of place value, were unable to transfer it back to real life situations	Sutherland (1993)

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Various remedial intervention methods tried out among dyscalculic children reveals the extent of

research that has been effectively implemented in this specific area of mathematics.

According to Woodward and Howard (1994), errors though unavoidable elements in learning can be controlled and eventually eliminated through well-designed instruction, appropriate and immediate feedback, step by step instruction and efficient scheduling of newer difficult items.

Simple techniques suggested by Reisman and Kauffman (1980) and Brown and Frank (1990) include assigning fewer problems, minimising or eliminating copying from the text book or blackboard, creative use of visual cueing (eg., colouring the steps), encouraging the use of finger tracing and using auditory cueing to reinforce visual input. Bartel (1982) recommends that teachers become familiar with the use of discovery method in teaching mathematics and the potential for flexibility in instructional approaches in planning.

It seems likely that major benefits would accrue from modifying current instructional practices to better match individual differences not only in developmental capability but also in motivation. The literature documented no doubt reveal that early diagnosis and remedial classes are a must with an understanding of the role of family, school, study skills, students' self-confidence identification and encouragement of talent. The new focus should be "catch them young" to prevent the developmental discrepancy and

help the at risk category (Gopalakrishnan, 1992; Raghavan, 1996).

To sum up, as rightly pointed out by Narayanan (1994) and Silver and Hagin (1990) thoughtful consideration of organisational patterns in intervention models inevitably leads to the conclusion that there is no single structure or model that can be regarded as suitable for every child in the vast heterogeneous population of learning disorders. Though efforts have begun, a lot more needs to be done in this area in India.

Finding a learning disabled is easy according to Barsch (1992), but Bateman (1992) is of the idea that the difficult part is overcoming it. The key he says is the daily curriculum planned by the teachers. The final product of our endeavour must be a compact curriculum capsule, rich in simplicity and yet profound in complexity, which can be comfortably manned by a teacher.

It appears that one of the major challenges in remediation is to assure that a nurturing, self enhancing, positive learning environment is maintained. Stimulation projects that enhance the learning process to a great extent be introduced. Making the education informal and interesting, is the only way to encourage creativity among the learning disabled and enable them to overcome their problems.

### E. Teacher's Role-Tasks in Remediation

Teaching demands a range of skills and roles. The combination of technical, organisational and interpersonal roles mean that teachers have to be exceptional people (Aludiapillai, 1993; Rao, 1994 and Sexena, 1994).

To quote Sri Aurobindo, "A good teacher is always a help in the pupils' pursuit of accomplishment and perfection". The teachers come in to uplift the pupils effort, knowledge and skills. A teacher's instruction, example and influence are the three instruments of good teacher orientation. According to Bras (1980), Rajaiah (1980), Appasamy (1996) and Joshua (1996) the attitude of the teacher will make a world of difference to a child's progress.

Singh (1986), Shamsuddin (1991) and Jayakumar (1997) proclaim that teacher education has been widened to include not only some professional skills, but also professional attitudes and values. The reasons put forth by Jangira (1990) for teachers not being able to meet the pedagogy of individual needs in the classroom are large class size, multi-grade teaching, heavy curriculum load, poor physical facilities and constraints of the system. Twenty million more primary teachers would be required in developing regions if the goal of Universal Primary Education is to be met by the year 2000 (ICCW, 1994).

The work of teachers is being acknowledged as one requiring cognitive processing. Teaching is not filling up of empty pails, but it is lighting of a fire. Teaching should lead to problem solving (Gopal, 1995) and the role of teacher is not being an instructor but be a facilitator (Bhasin, 1985; Gonsalvez, 1994 and Gupta, 1996).

World Bank (1995) and Narayanan (1997) remark that teacher's knowledge is strongly and consistently related to student performance. Teachers with a wide repertoire of teaching skills, are more effective than those with limited repertoire. The most effective strategy is ensuring that teachers have adequate subject knowledge and use instructional materials effectively (Singhal, 1987; Rao, 1996 and Sarojini Devi, 1997).

Falchikov (1993) and Muthukumaran (1995) envisage active student - centered, self-paced, self-discovery methods in education with a commitment to innovation and change on the part of the teacher. The National Policy on Education (1986) has also emphasised adoption of activity based process of learning at the primary stage (Chopra, 1991).

Bhasin (1985), Baksh (1996) and Emmanuel (1996) remark that the teaching-learning transactions will be impeded unless teachers understand the uniqueness of individual students and the general characteristics of children as learners (Mitchell, 1993).

Several studies on underachievers have been conducted. These studies assess classroom advancement and do not attempt to identify the causative factors of these problems (John, 1995; Malavika, 1995). An attempt to identify these factors is essential for planning proper remedial programmes to such children and to create congenial classroom environment. Though remediation of some of these children require specialised services, teachers have a major role to play in the management of most of these children (Kishore, 1984; Singhal, 1990). The major focus therefore should be to enable the teachers develop proper insight on the nature of learning disability (Jaya and Geetha, 1994). They must also try to match teaching strategies to pupils learning styles and their multi-dimensional personality (MacMay and Boyle, 1994).

Santhanam (1992) and Philip (1996) indicate that scholastic backwardness can be identified for appropriate referral by a sensitized teacher of the mainstream school through standardized yet informal assessment tool.

Ahuja (1995) pinpoints addressing learning disabilities through educational reforms. Gautam (1991), Khan (1995) and Rao (1997) consider that teacher's role is to inspire students for learning and act as a guide to impart certain skills, attitudes and competencies.

Teachers must know programmes best suited in terms of effective learning (Bhatia, 1996). Gearheart and Gearheart

(1989) state that teachers of L.D. recognise disabilities, assess them and provide remedial activities. Clegg (1972) and Katz (1993) observe that all children who find the learning process difficult need stable, affectionate, relationship with their teacher since the disability emerges due to anxieties, mental conflicts or deprivation during early childhood.

Daswani (1990) observes that if a teacher uses computer like the early teaching machines for tedious drill and practice, optimal use of this expensive technology will not be made. On the other hand, if such programmes are successful, they lower the drop out rate by 80 per cent and save teachers' time upto 90 per cent per pupil enabling them to attend to the special needs of the individual learners.

Concerned with those who learn no more than what is in the prescribed text, Swaminathan (1994) and Kannayan (1997) opine that authorities who shape the curriculum and set standards for schools must pay attention to this serious drawback and devise ways appropriate to prepare the students better.

The teacher education scenario needs a thorough overhaul, deserving its due priority on the national agenda (Rajput, 1996). The implication of quality teaching for all according to Jangira (1990) and Gonsalvez (1994) is to

ensure optimum learning by all children in the classroom despite the wide range of abilities due to interactive factors within the child, school, home and the community. This is possible when individual needs including special needs are met in the heterogeneous class.

With the advent of the education of the handicapped children gaining importance, various educational facilities are being experimented all over the world. The trend today is integrated education, leading to normalization. The philosophy behind this movement is that education provided in the least restrictive environment for the handicapped would minimize specialized provisions for community integration (Narayanan and Menon, 1989).

The National Council for Teacher Education, (NCTE, 1990) and Appasamy (1996) propose that teachers and schools should be prepared in a way that all children are able to learn to their fullest potential. Azad (1990) and Sacheendran (1996) foresee co-ordination of various agencies, Governmental and non-Governmental organisations discover ways and means to improve the methods of imparting special education. Another issue that special education has to address towards 2000 A.D. is the application of technology. Therefore special education should gradually prepare itself for admitting the innovations in science and technology (Mani, 1986; Gupta, 1996). Implementing videodisc technology draws a dramatic change in the teachers role from

being an explainer to a manager of technology (Gersten and Kelly, 1992).

As Rao (1995) has rightly observed "to improve the quality of cognitive and academic achievement in primary education the quality of teachers and instructional facilities should be improved". Akinaso (1993) and Kothari (1997) feel that investment in teacher training and appropriate instructional facilities would be worth while and teachers have to change as the world is changing, for the children are far more alert, than they used to be (Fernandez, 1992; Pillowalla, 1993 and Kannappan, 1995).

The Teachers Education Resource Pack developed by UNICEF is bound to hold the children in schools arresting high drop out rate bringing the goal of "Education for All" within reach in developing countries in a reasonable time frame (Jangira, 1991). The major challenge ahead lies in sustaining Universalisation of Primary Education (UPE) movement alive amongst the teaching community and the general public - till every child in the state is enrolled in primary schools and completes at least five grades with minimum levels of learning. If the movement meets this challenge, it would be the precursor of similar movements in other states as well (Govt. of India, 1993). The idea that we are educating the leaders of tomorrow demands rapid and effective training of teachers.

### III. METHODOLOGY

The methodology for the present investigation on "Efficacy of Remedial Package in Augmenting Primary School Teachers' Skills to Help Dyscalculic Children", involved the following steps :

- A. Sensitizing Primary School Teachers on Learning Disabilities Among Children
- B. Identifying Dyscalculic Primary School Children
- C. Evolving Remedial Programme and Package for Dyscalculic Primary School Children and
- D. Evaluating the Efficacy of Remedial Package

Figure 1 : Reflects the research design in a nutshell.

- A. Sensitizing Primary School Teachers on Learning Disabilities Among Children

This phase included :

1. Getting to know teachers' awareness on learning disability
2. Organising sensitization programme for school teachers on learning disabilities and
3. Conducting an orientation programme for selected teachers

1. Getting to know teachers' awareness on learning disability

A survey among the local school teachers was found essential to assess their awareness on this relatively new dimension "Learning Disability".

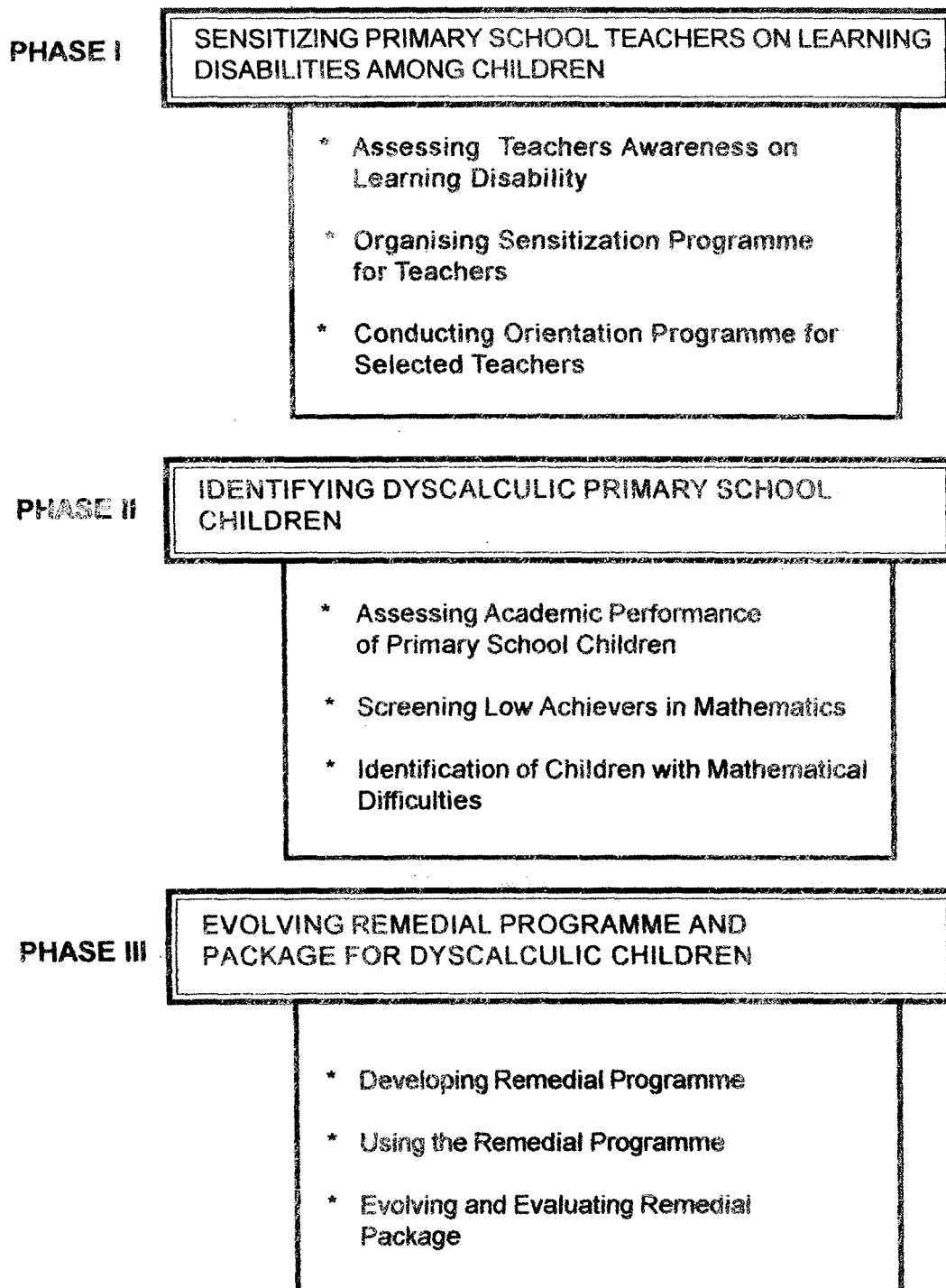


Figure - 1  
Design of the Study

This aspect of the study comprised the following steps.

**a. Selection of teachers**

A list of Matriculation schools in Coimbatore Revenue District was obtained from the Directorate of Matriculation Schools, Ramanathapuram, Coimbatore. Out of 102 Matriculation Schools in the district, 30 schools located within the city comprised the sample unit for the present study.

The correspondents/principals/heads of selected schools were explained the purpose of the study. Ensuring their co-operation, 150 teachers handling classes I to V were selected adopting the purposive sampling method.

**b. Preparation of a questionnaire**

A questionnaire was prepared to elicit information on teacher's background viz., age, educational qualification, experience, training programmes attended and their awareness of the concept, types, causes, characteristics, identification, assessment and educational requirements for children with learning disabilities.

As stated by Kothari (1996) in a pilot study, the replica and rehearsal of the main survey brings to light the weaknesses in the tool. Hence the questionnaire prepared was pretested for its suitability among 10 school teachers.

Appendix I contains the finalised questionnaire used for data collection.

c. Collection of teachers' responses on issues related to learning disability

The selected teachers were explained the purpose of the study. The questionnaires were then distributed and collected from the teachers for further analysis.

2. Organising sensitization programme for school teachers on learning disabilities

The responses of selected teachers to the questionnaire brought to light the need to educate and inform them on the concept of learning disability. Almost 80 per cent of the teachers were found to be quite ignorant of its prevalence, its meaning and its implications. This finding necessitated organising a one day sensitization programme on "Dyslexia Among Primary School Children".

A list of primary schools (Aided/Unaided/Private/and Matriculation) obtained from the Office of the Chief Educational Officer, Coimbatore was used. Permission was also sought for deputation of teachers for the programme.

An invitation informing the schools of the theme, guest speakers, date, time and venue along with a brief write up on the concept of learning disabilities (Dyslexia) among young children and the need for equipping the teachers on this concept was despatched to the head of institutions

three weeks in advance for their perusal and for circulation among the staff (Appendix II).

The sensitization programme attended by 130 participants included primary teachers (47) secondary grade teachers (53), principals/correspondents (18), special educators, specialists and university teachers (12) (Plate I).

Appendix III gives the details of the programme, topics discussed, resource persons invited and the questionnaire used in assessing the teacher's awareness on learning disabilities prior to the sensitization programme.

### 3. Conducting an orientation programme for selected teachers

Implementing this programme involved the following tasks :

#### a. Planning for an orientation programme

An orientation programme on "Identification and Education of Learning Disabled Children", was planned for five days in the Department of Human Development. Appendix IV gives an overview of the programme organised.

Invitations were sent to all the 30 Matriculation schools selected for the study and through personal visits, efforts were made to enroll as many teachers as possible to participate in the programme. Nineteen primary school



PLATE I

SENSITIZATION PROGRAMME FOR TEACHERS

teachers attended the five day programme organised in collaboration with Madras Dyslexia Association, Madras.

The major focus of the programme was on discussing and clarifying concept and educational issues related to learning disabilities among school going children.

**b. Evolving instructional materials on learning disabilities**

As teachers were found less competent on the issues related to learning disability and had limited access to reading materials efforts were made by the investigator to develop "Instructional Materials" aimed at providing the teachers an understanding of learning disabilities in a comprehensive manner. This involved :

**i. Developing and refining the instructional materials**

Related literature on learning disabilities from various sources like books, journals, magazines and manuals from libraries of various universities and institutions, namely (Madras Dyslexia Association, Madras, Alpha to Omega Learning Centre, Madras and National Institute for the Mentally Handicapped (NIMH) Hyderabad aided in the preparation of the instructional materials.

**ii. Validating content of the prepared materials**

The literature collected was scrutinized and thoroughly analysed to make the presentation of materials simple, clear and precise. In the process, the need for suitable, easy to

comprehend instructional materials was realised. Taking into cognizance this aspect, the following materials were prepared:

- \* Leaflet - Concept of learning disability
- \* Booklet - Specific learning disabilities -  
- Terminology and identifiable errors
- \* Pamphlet - Causes of learning disabilities
- \* Flip book - Problems of the learning disabled
- \* Folders - Characteristics of learning disabled children and  
- Teaching methods for specific learning disabilities

A checklist on selected parameters for evaluation viz., clarity, flow of thought, handiness, informativeness and simplicity was prepared (Appendix V) to check the adequacy and appropriateness of the developed instructional materials. The checklists were distributed to five experts each in the fields of Education (2) Human Development/ Special Education (2) and Psychology (1). As per their recommendations, necessary modifications were incorporated. The final manuscripts thus prepared were distributed to the participating teachers in the programme for use. Instructional material prepared as part of this study are included in the remedial package.

### c. Conducting and assessing the programme

The main aim in organising the orientation programme was to introduce primary school teachers to the concept of learning disability among young children and to make them operationally effective in their classrooms and publicize

the fact that most children irrespective of the degree of severity of learning disability can be remediated and be helped.

Extensive use of the instructional materials developed was a salient feature of the programme. Dissemination of information during the programme was made through talks by experts, group discussions and individual assignments (Plate II).

Evaluation is defined as systematic effort to determine the worth of an intentional effort, whether it is an educational enterprise, a social action programme or some intervention effort (Wolff, 1989).

Evaluation of the orientation programme was done by assessing knowledge acquired by the teachers on learning disabilities before and after their participation in the five days programme.

#### **B. Identifying Dyscalculic Primary School Children**

This part of the study probed into the following aspects :

1. Assessing academic performance of primary school children,
2. Screening low achievers in mathematics and
3. Identification of children with mathematical difficulties (dyscalculics).



PLATE II

ORIENTATION PROGRAMME IN ACTION

## 1. Assessing academic performance of primary school children

In order to know the scholastic performance of primary school children in their learning environment, an overview of their academic achievement for an academic year was found necessary.

Five matriculation schools that had evinced keen interest in the conduct of the present investigation were considered for the collection of data. From the records maintained in the schools, the marks of students from classes I to V during the academic year (1994-95) were recorded.

Among the five schools selected, three were co-educational and one each had boys only and the other exclusively girls. For uniformity, only four major subject areas viz., English, Language, Mathematics and Science were considered and the average marks in five tests were obtained to analyse the general academic performance of students.

## 2. Screening low achievers in mathematics

This feature of the study involved :

### a. Confirming disability in mathematics

Based on teachers' opinion and the achievement of students in mathematics from classes I to V in four consecutive tests (I midterm, quarterly, II midterm and half yearly) for the academic year 1995-96, students scoring less

than 40 per cent on an average were identified. Thus a total of 115 students in the age range 6 to 11 years were pinned down as low achievers in mathematics from the five matriculation schools considered.

The present investigation necessitated the use of the following tools in order to confirm the disability in mathematics among the 115 low achievers in mathematics.

**i. Raven's Coloured Progressive Matrices (RCPM)**

The Coloured Progressive Matrices developed by Raven (1965) is used satisfactorily with people who for any reason have difficulties in perception. Rao (1988) and Ramaa (1993) report that RCPM is internally consistent and homogeneous for young children.

This test is a non-verbal, untimed power test for children under 11 years. The RCPM consists of 36 coloured multiple choice matrices (3 sets, A, AB, B each with 12 problems). Each subset of RCPM is designed to measure different aspects of general ability ie., set A "the apprehension of discrete figures as spatially related wholes" and set B "both apprehension of analogous change in spatially and logically related figures". The problems in different sets are arranged in such a way to assess the cognitive processes of children.

Limited data exist, however, on the differential performance characteristics of students classified as

learning disabled. As Parmar et al. (1994) contends that the learning disabled group have IQ scores in the range of normal ability on Raven's. Hence, to assess the intellectual ability of the selected low achievers in Mathematics (N=115) Raven's Coloured Progressive Matrices test was administered.

**ii. Arithmetic diagnostic test for primary school children**

The above test developed and standardised by Ramaa (1994) diagnosis specific difficulties in arithmetics encountered by primary school children. The test covers three major areas viz., number concept, arithmetic process operations (addition, subtraction, multiplication and division) and arithmetic reasoning (assessed at different levels through word problems and other types of problems dealing with the judicious application of the fundamental arithmetic operations in solving them) Appendix VI.

Since it is a diagnostic test, it includes sums that represent each type and subtype of tasks that fall under each of the three major areas. Each subtype of the task is represented by two items in the case of arithmetic process and reasoning. This helps in thorough diagnosis of the difficulties faced by the children in dealing with particular subtype of arithmetic task. The sub-items and items are arranged in order of increasing difficulty level within the different sections of sums as well as between the sections.

iii. Behavioural checklist for screening the learning disabled (BCSLD)

Research on L.D. children has identified a variety of attentional deficits (Ramaa, 1992 and NCERT, 1997). These children exhibit behavioural characteristics which make them disruptive in the classroom and at home (Rao, 1988). Hence, the tool developed and standardised by Swarup and Mehta (1991) was used to assess the behavioural characteristics of the selected children.

The behavioural checklist consists of 30 items - positive and negative to be filled by the teacher. The eight areas assessed using the BCSLD include : deficits in visual processing, auditory processing, motor co-ordination cognitive domain, language, memory, preservation tendencies and disorders in affective domain (Appendix VII).

b. Collection and analysis of data

The above aspect involved :

**Step 1 : Administration of intelligence test**

All the selected 115 children from classes I to V were administered the Raven's Progressive Matrices Test. The test was administered individually and scoring was done as per instructions in the manual. On the basis of scores obtained on this test, selected children were classified into five grades.

## Grade

- I or "intellectually superior", if his/her score lies at or/above the 95th percentile for people of his/her age group.
- II "definitely above average" in intellectual capacity, if his/her score lies at or above the 75th percentile.
- III "definitely average" if his/her score is greater than the median or 50th percentile.
- III-, if his/her score is less than the median.
- IV "definitely below average" in intellectual capacity, if his/her score lies at or below the 25th percentile.
- IV-, if his/her score lies at or below the 10th percentile and
- V "intellectually defective", if his/her score lies at or below the 5th percentile for his/her age group.

In the above classification, a slight modification was done to suit the present study. Children whose percentile points fell in between 25th and 10th percentile were also considered as children with average intelligence, since some of the non-dyscalculic children had also scored below the 25th percentile.

## Step 2 :

Administration of arithmetic diagnostic test.

This test was administered to all selected 115 children in groups of five in two sessions of 60 minutes duration each. For children in classes I and II only number concept, addition and subtraction sums were given in the first session and for those in classes III, IV and V number concept, addition and subtraction sums were given in the

first session and multiplication and division sums were presented in the second session.

To find out the strengths and weaknesses of the children with reference to different types of arithmetic tasks, their performance was qualitatively analysed in terms of the tasks that they were capable of doing and those not successful.

**Step 3 :**

Administration of the behavioural checklist for screening the learning disabled.

The behaviour checklist was given to the class teachers of selected children with guidance to fill in for the individual student and it was collected back after one week.

For the negative items in the checklist the weightage given was as follows : Yes-2, No-0 and? 1. For the positive items Yes-0, No-2 and? -1. The maximum obtainable score is 60.

**Step 4 :**

**Administration of personal data schedule for pupils**

This schedule(Appendix VIII) was sent to parents through their wards with a request to fill up the required information. After two days, the forms were collected by the investigator from the class teacher.

### 3. Identification of children with mathematics disabilities

Among the 115 children from classes I to V earlier identified as low achievers in Mathematics and screened for mathematical performance, 63 children were short listed as probable dyscalculics on the basis of various tests administered.

Among the 63 children identified, 27 children were eliminated on grounds of subnormal intelligence, underage and absence of any associated behavioural problems. Finally only 36 children were found to be having arithmetic disabilities.

Further, an attempt was made to establish difficulty in neuropsychological areas among the 18 identified dyscalculic children (experimental group) using the Diagnostic Test for Learning Disability standardised and developed by Swarup and Mehta (1992), (Appendix IX).

From the school records, consultation with the class teacher and observations by the investigator, the identified children (36) were found to be normal in visual and auditory performance, were provided with the required schooling and were encouraged by parents in their educational pursuits. Thus these children fulfilled all the criteria required to identify them as children with arithmetic disabilities (dyscalculic) for the purpose of the present investigation.

C. Evolving Remedial Programme and Package for Dyscalculic Primary School Children

This aspect of the study involved :

1. Framing remedial programme for identified children
2. Using the developed remedial programme and
3. Evolving remedial package for children with mathematical disabilities

1. Framing remedial programme for identified children

To integrate and implement remedial programme for the selected children with mathematical disabilities, they had to be grouped based on age, class and level of difficulty.

Among the 36 children identified, only 18 children (Experimental group) were considered for remediation on the basis of accessibility and co-operation extended by the schools. The remediation took place in two groups as under :

Group A - Nine children 5 girls and 4 boys in the age group 6-8 years who had scored less than 30 per cent in the pretest and were observed to have made maximum errors in counting, addition, subtraction and writing numerals in words and numbers.

Group B - Nine children of 8-10 years (5 girls and 4 boys) 40 per cent in the pretest with errors in verbal problems, subtraction, multiplication and division.

The remaining 18 children served as control group.

On identifying the areas of difficulty in the various mathematical concepts learnt by the children in the classroom, an attempt was made to use various teaching aids while introducing multiple intervention strategies.

The remedial programme was developed incorporating multi-sensory approach to inculcate the required skills with the following objectives.

- \* Teach mathematical concepts identified as difficult
- \* Provide continuous exercises in the conceptual area until mastery.

## 2. Using the remedial programme developed

Teachers handling mathematics from the respective schools were oriented towards using and implementing the developed programme. The investigator co-ordinated in working with the teachers for effective implementation of the programme.

Since concentration was laid only on the acquisition of particular computation skills, a minimum of 20 sittings and maximum of 30 sittings of 90 minutes duration for remediation was found adequate for each child.

To help the students acquire practice and mastery of the various skills for increasing their rate of computation "time bound probes" were administered during remediation to enable them to gain adequate skill and confidence with the computational facts (Plate III).

In order to evaluate the acquisition of basic skills taught during remediation, a post-test using the same diagnostic tool as in pre-test was administered.

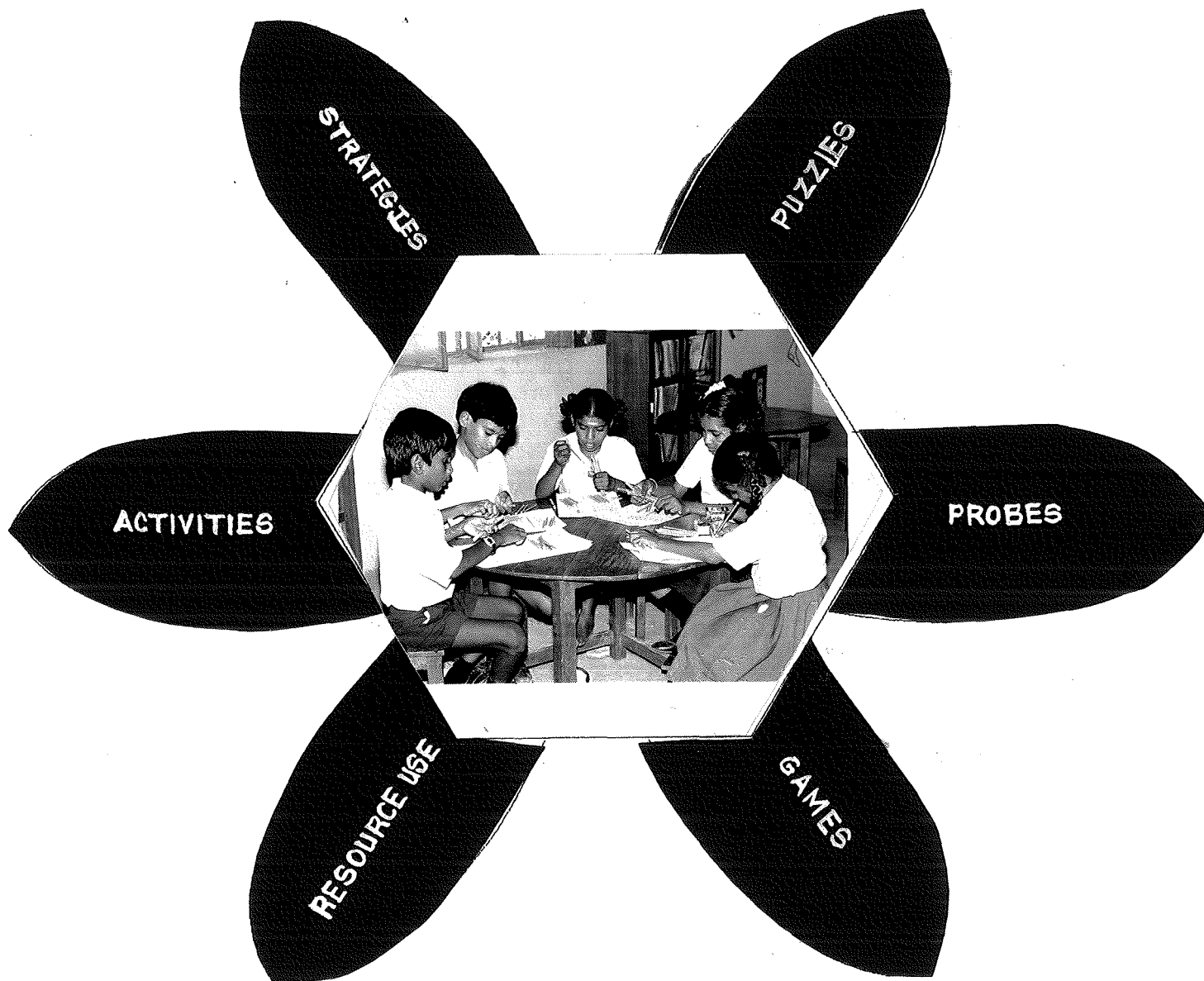


PLATE III  
REMEDIAL INTERVENTION IN OPERATION

### 3. Evolving remedial package for children with mathematical disabilities (dyscalculics)

The investigator's experiences of working with children with mathematical disabilities resulted in the preparation of a remedial package for primary school teachers for use with children having difficulties in mathematical computation.

It was observed that students with deficiencies in mathematics had social and emotional problems. In school settings, mathematics problems often resulted in school failures that led to high levels of anxiety. Bartel (1982) and Kulak (1993) state that students with mathematics deficiencies are as disabled as individuals with reading problems, as daily living requires the application of mathematical skills.

The fact that most of the students go in for special mathematics instruction pins down the importance of providing effective instruction for students with mathematical difficulties. It has been observed by Radhakrishnan (1996) that difficulties with numerical relationship can begin at an early age.

The challenge therefore lies in identifying the skill deficits and in improving instruction for these students using the remedial package.

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In this study, the remedial programme was developed on undertaking a thorough analysis of the existing curriculum in the primary schools. The main components in the package included concept of learning disabilities, information on number instruction, uses of manipulative aids and resource materials (Plate IV) specific strategies in mathematics instruction, project activities and games (Appendix X).

The major input in the remedial programme was adoption of multi-sensory approach wherein the basic concepts of addition, multiplication, subtraction and division were taught to the selected group.

#### D. Evaluating the Efficacy of Remedial Package

The remedial package developed was then evaluated by distributing the same to ten primary school teachers handling mathematics two from each of the five schools selected. A checklist was evolved to test the efficacy of the same (Appendix XI).

Data thus obtained in the conduct of the various aspects of this investigation were analysed and discussed in Chapter IV.



PLATE IV

MANIPULATIVE AIDS AND RESOURCE MATERIALS USED

#### IV. RESULTS AND DISCUSSION

The findings of the study on "Efficacy of Remedial Package in Augmenting Primary School Teachers' Skills To Help Dyscalculic Children", are discussed under the following major heads :

A. Awareness of Primary School Teachers on Learning Disabilities Among Children

B. Identifying Dyscalculic Primary School Children

C. Remedial Intervention for Dyscalculic Children and

D. Efficacy of Remedial Package for Dyscalculic Children

A. Awareness of Primary School Teachers on Learning Disabilities Among Children

This aspect of the study discusses :

1. General profile of selected teachers
2. Teachers' awareness of learning disabilities among children
3. Evaluation of sensitization programme for school teachers on learning disability and
4. Outcomes of orientation organised for school teachers

1. General profile of selected teachers

Hundred and fifty primary school teachers (women) from 30 Matriculation schools within Coimbatore city were selected for the present investigation. Questionnaires distributed to the selected teachers brought forth information presented below :

The general information on primary school teachers included age, educational qualification, teaching experience, number of classes handled, students strength and training programmes attended by them are indicated in Table 2 given below :

**Table 2 : Profile of Selected Primary School Teachers**

Aspects	Teacher's stating (N=150)	
	Number	Percentage
<b>Age (in years)</b>		
20 - 30	69	46.0
31 - 40	64	42.6
41 - 50 and above	17	11.4
<b>Educational qualification</b>		
Graduation with B.Ed. and M.Ed.	97	64.6
Post Graduation with B.Ed. and M.Ed.	43	28.7
Diploma	10	6.7
<b>Teaching experience (in years)</b>		
2 - 4	79	52.7
4 - 8	71	47.3
<b>Number of classes handled</b>		
1 - 2	34	22.7
2 - 4	62	41.4
4 - 6	54	35.9
<b>Students strength per class</b>		
10 - 30	28	18.7
31 - 60	107	71.3
61 - 70	15	10.0
<b>Programmes attended</b>		
Subject related seminars	25	16.7
Child development seminars	3	2.0
Montessori training programme	2	1.3
Seminar on slow learners	1	0.7
Preschool education	1	0.7
Nil	118	78.7

Forty six and 43 per cent of the selected teachers were in the age range of 20 - 30 years and 31 - 40 years

respectively. Those above 40 years were 11 per cent. Among the teachers, 65 per cent were graduates followed by 29 per cent post graduates.

It is the experience that adds to the efficiency of the teachers. In this study, 53 per cent had 2-4 years of teaching experience followed by 47 per cent with 4-8 years of experience in teaching primary school children.

The number of classes handled by a single teacher ranged from one to six. Two to four classes were handled by 41 per cent of the teachers. Almost 36 per cent of the teachers handled 4-6 classes reflecting the heavy work load on a single teacher at the primary school level.

Information on students' strength in the classes revealed that 19 per cent of the teachers had less than 30 students per class, 71 per cent had 31-60 students and 10 per cent had a strength of almost 70 students in their classes.

Opportunities for the primary school teachers to attend enriching programmes were found to be rather very limited in that only two per cent of the teachers had attended seminars on child development followed by less than two per cent attending Montessori training programme. Seventeen per cent of the teachers attended individual subject related seminars in English, Science, Mathematics and Poetry. Seventy nine per cent of them had no exposure to any such programmes. This reveals the dire need for organising in-service

training programmes for these teachers to equip them with the latest developments in the field of education of young children.

## 2. Teachers' awareness of learning disabilities among children

Awareness of selected teachers on learning disabilities among school children as elicited from their responses are presented below :

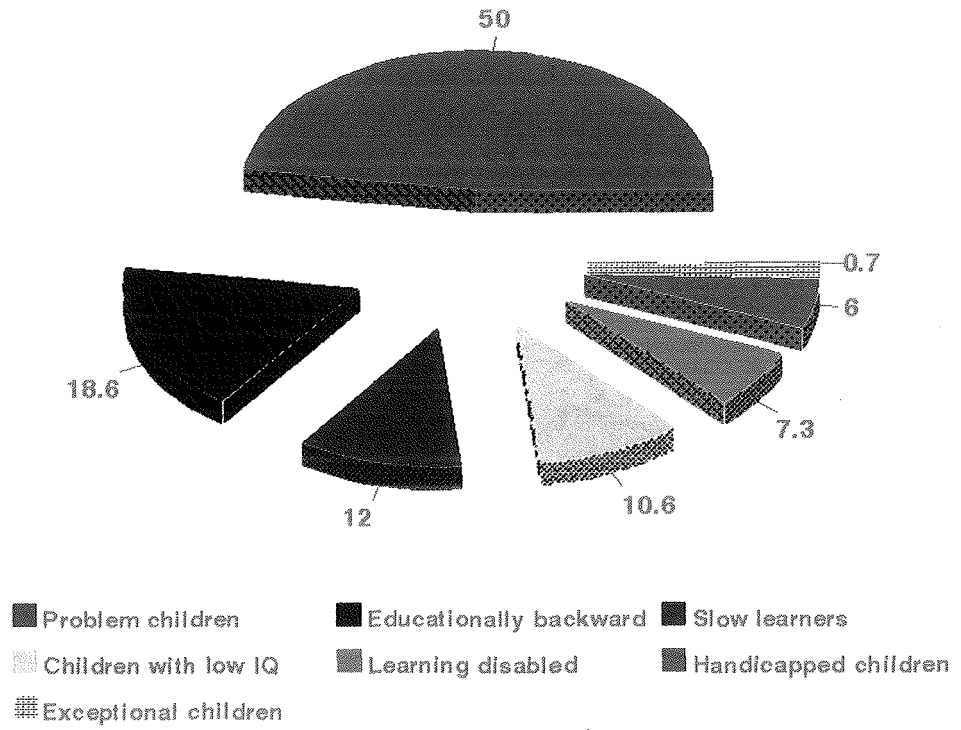
### a. Learning disability - concept

Table 3 and Figure 2 provide perceptions of the selected teachers' terminology of learning disability.

Table 3 : Learning Disability as Perceived by Selected Teachers

Perceptions	Teachers stating	
	Number	Percentage
Problem children	75	50.0
Educationally backward children	28	18.6
Slow learners	18	12.0
Children with low IQ	16	10.6
Learning disabled	11	7.3
Handicapped children	9	6.0
Exceptional children	1	0.7

Among the various terminologies used in referring to children with learning problems, 50 per cent of the teachers



**Figure 2**  
**Learning Disability as Perceived by**  
**Selected Teachers**

perceived them as 'problem children' in their classrooms, while 19 per cent referred them as 'educationally backward' and 12 per cent as 'slow learners'. Nearly 11 per cent of the teachers presumed them to be children with low IQ.

With no basic training inputs in this emerging field, only seven per cent teachers branded them as children with learning disabilities though no assessment was done for the diagnosis of the problem. Six per cent of the teachers viewed them as handicapped children and less than one per cent referred them as 'exceptional children'.

The teachers' perception of the L.D. had been low, because they had no exposure or training regarding learning disability and its related issues.

#### **b. Specific learning disabilities**

Mirco-level researches conducted have identified specific learning disabilities as that of reading, writing and arithmetic disability (Sarangi, 1989).

Selected teachers were able to categorize these children as those with writing difficulties (19.3 per cent), reading (18 per cent) and with arithmetic difficulties (13 per cent). It was evident that the teachers lacked wholesome concept of the categories of learning disabilities.

This finding brings out the need to incorporate a module on children with learning disabilities into

curriculum at all levels of the teacher training programme. Perhaps, the need to orient the teacher trainees cannot be undermined anymore.

### c. Causes

Table 4 depicts the awareness of teachers in relation to causes of learning disability among school children.

**Table 4 : Causes of Learning Disability as Viewed by Teachers**

Causes	Teachers stating (N=150)	
	Number	Percentage
Poor teaching in school	54	36.0
Lack of early stimulation	39	26.0
Lack of awareness on causes	14	9.3
Discouragement by parents	9	6.0

One of the major reasons assigned by 36 per cent of teachers as the cause leading to learning disability was poor coaching (inadequate instruction) prevailing in schools with respect to individual learners. This is in accordance with Taylor and Sternberg (1989) and Devi (1996) who are also of the view that environmental situations outside the child in the form of inappropriate instruction and reinforcement are the causes for learning disability.

Fernandez (1992) considered decreased parental and environmental stimulation as the factors for increased risk

of learning disabilities. In the present investigation, only 26 per cent of the teachers attributed lack of early stimulation as a factor responsible for learning disabilities.

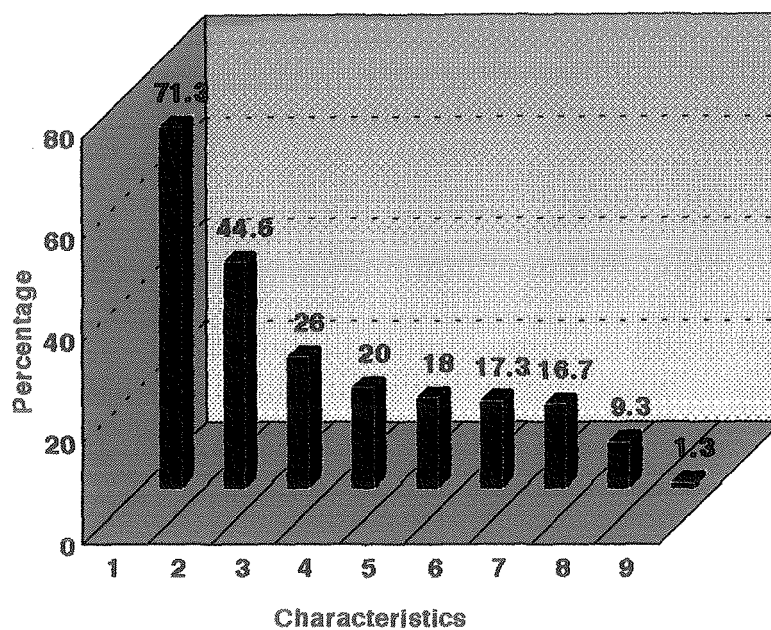
Lack of awareness on causes among teachers (9 %) and discouragement of children by parents in case of academic failure (6 %) were also some of the causes stated by the teachers.

#### d. Characteristics

The characteristics of L.D. children in relation to the problems experienced by the teachers in the classroom are listed in Table 5 and given in Figure 3.

Table 5 : Characteristics of Learning Disabled as Perceived by Teachers

Characteristics	Teachers stating (N=150)	
	Number	Percentage
Behavioural problems	107	71.3
Lack of concentration	67	44.6
Lack of memory	39	26.0
Distractability	30	20.0
Language problems	27	18.0
Social withdrawal	26	17.3
Poor self-concept	25	16.7
Academic failure	14	9.3
Dependency behaviour	2	1.3



- |                            |                           |
|----------------------------|---------------------------|
| 1. - Behaviour problems    | 6. - Social withdrawal    |
| 2. - Lack of concentration | 7. - Poor self concept    |
| 3. - Lack of memory        | 8. - Academic failure     |
| 4. - Distractability       | 9. - Dependency behaviour |
| 5. - Language problems     |                           |

**Figure 3**  
**Characteristics of Learning Disabled as Perceived by Teachers**

As Alexander et al. (1993) considered behavioural difficulties in youngsters with learning problems as a significant concern, majority of the selected teachers (71 per cent) highlighted the associated behavioural problems among the L.D. children as a significant characteristic, followed by 45 per cent stating lack of concentration. The other characteristics mentioned included lack of memory (26 %), distractability (20 %), language problems (18 %), social withdrawal (17 %), poor self concept (16 %), academic failure (9 %) and dependency (1 %).

The responses of the teachers pin down the fact that in order to determine the degree of learning disability among the primary school children, there arises a need to orient the in-service teachers on the nature and characteristics of L.D. children.

#### e. Tools for identification

From the listed options in the questionnaire, 66 per cent of the teachers felt that informal classroom tests and observation could be easily adopted for identification of L.D. children. In the words of Taylor (1989) observation is an important tool to detect student problems at an early stage. It was encouraging to note that 63 per cent of the teachers favoured use of checklist for identification.

Since children with learning disabilities have observable behaviour problems, 46 per cent and 28 per cent of the teachers expressed that behavioural assessment and

study of home environment respectively could also be used to identify children with learning problems. Medical examination for identification of children with learning difficulties was reported by few teachers (6 %).

**f. Teaching considerations**

Table 6 depicts teachers' awareness of teaching considerations for the L.D..

**Table 6 : Teaching Considerations for the Learning Disabled**

Teaching considerations	Teachers stating (N=150)	
	Number	Percentage
Goals setting	56	37.3
Individual variations	43	28.6
Mainstreaming	40	26.7
Special educational needs	38	25.3
Referral support	34	22.7
Personal skills	22	14.6
Teaching procedures	9	6.0

Goal setting for an individual learner as an important pre-requisite in the teaching process was considered important by 37 per cent of the selected teachers. Only 29 per cent of them were aware of the individual variation in the degree of learning to be considered as an important factor in planning individual educational plans for the L.D. children.

On the other hand, 27 per cent of the teachers had been aware of the possibilities of integrating mild L.D. with normal children. While 25 per cent teachers considered special educational needs as basis for their curriculum planning, use of referral support available for L.D. was mentioned by 23 per cent. Apparently only 15 per cent had understood the need for being equipped with skills for communication. Verbal explanation followed by demonstration were the teaching procedures mentioned by a few teachers (6 %).

The low awareness of teachers on learning disabilities among school children reflects the urgent need to build in and to equip them with the required knowledge, since they are responsible for the education and management of children they are also in a position to remediate children with learning disabilities and contribute towards "Education for All".

Obviously, it is realised that regular classroom teachers are inadequately prepared to educate and mainstream children with learning disabilities. As NCERT (1995) reports, it is important that teachers, administrators and related service personnel, who are fundamental for improvement of school performance of the children, be trained. Therefore, effective school reform must include provisions to enable practicing teachers to review and

refine their professional skills in the area of learning disability.

### 3. Evaluation of sensitization programme for school teachers on learning disability

A sensitization programme organised on learning disability attended by 130 participants, included secondary grade teachers (53) primary teachers (47), principals and correspondents (18) and special educators, specialists and university teachers (12).

Among the participants, a majority of 38 per cent belonged to the age group 21 - 30 years and 33 per cent to 31 - 40 years. In the age group 41 - 50 years, there were 19 participants and only nine per cent were 51 years and above. An analysis of their qualification revealed that there were 29 per cent female and five per cent male graduates, while among the post graduate category there were 19 per cent females and 14 per cent male participants.

All the participants knew about the programme only from the invitations despatched to the heads of institutions and for almost 70 per cent of the participants, it was their first programme on this concept. Less than one per cent made a mention of their participation in selected in-service training programmes, National Council for Educational Research and Training (NCERT) and State Council for Educational Research and Training (SCERT) workshops relating

to educational procedures and those organised by UNESCO for primary school teachers.

Among the participating teachers, 97 per cent were definite about the prevalence of learning disabilities among the children.

The various categories of specific learning difficulties observed among children by the teachers are enlisted in Table 7 and Figure 4.

Table 7 : Learning Difficulties Observed Among Children by Teachers

Specific area	Teachers stating	
	Number	Percentage
Writing	102	78.4
Arithmetic	98	75.3
Reading	96	73.8
Spelling	93	71.5

Poor handwriting was a persistent problem observed by 78 per cent of the participating teachers followed by difficulties in arithmetic (75 %), reading (74 %) and spelling (72 %). Though no specific tools had been used by the teachers for identification, they were able to spot out 1176 (boys) and 1269 (girls) with learning difficulties.

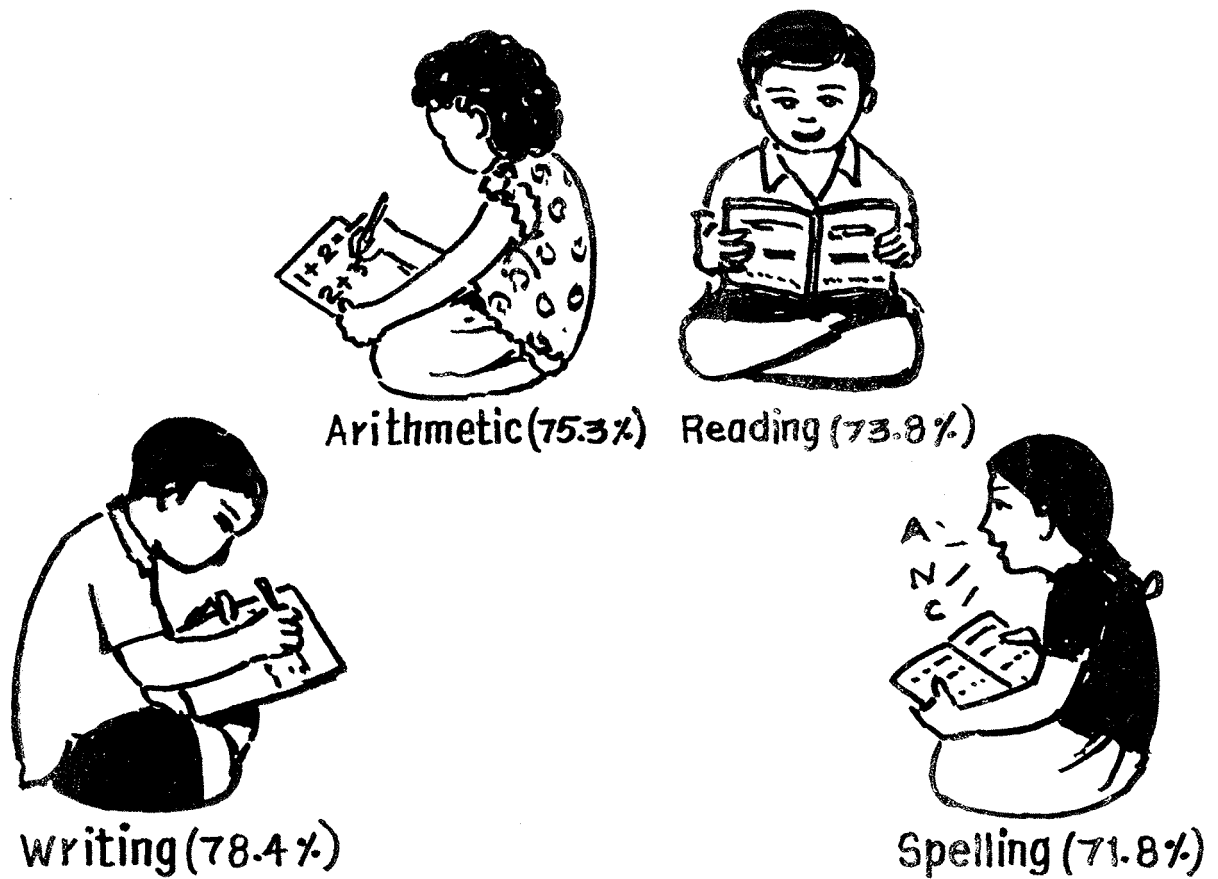


Figure.4.

**LEARNING DIFFICULTIES AMONG CHILDREN  
AS OBSERVED BY TEACHERS**

Some of the very common errors committed by young children in writing as well as in spelling as perceived by the participants are focused in Table 8.

**Table 8 : Specific Writing and Spelling Difficulties  
Observed Among Children by Teachers**

Difficulties	Teachers stating	
	Numbers	Percentage
Spelling errors	81	62.3
Confusion of letters	25	19.2
Illegible writing	20	15.3
Omission of letters	13	14.7
Short attention span	8	6.1
Slow writing	7	5.3

Among the various writing and spelling difficulties experienced by children, 62 per cent stated errors in spelling. Less than 20 per cent observed children getting confused with alphabets, omitted letters and had very poor handwriting. Short attention span among the children was also stated to be the reason that led to difficulties in writing and spelling as opined by six per cent of teachers. Slow writing among children was noticed by five per cent of the teachers.

Reading difficulties observed among the children are highlighted in Table 9.

Table 9 : Difficulties in Reading Among Children

Difficulties	Teachers stating	
	Number	Percentage
Mispronunciation	77	59.2
Slow in reading	25	19.2
Grammar comprehension	11	8.4
Fast reading without comprehension	9	6.9
Omission of words	5	3.8
Fear of reading	4	3.0

In the perception of teachers, prominent reading difficulty among children included mispronunciation of words (59 %) and slow reading (19 %) less than 10 per cent of the teachers stated problems in comprehending grammar and fast reading without comprehension of facts as learning difficulties experienced by the students.

Less than five per cent of teachers indicated difficulty in omission of words and fear of reading among children.

Learning problems in mathematic have traditionally received less attention than those in other academic areas eventhough children do experience a wide range of difficulties in the same.

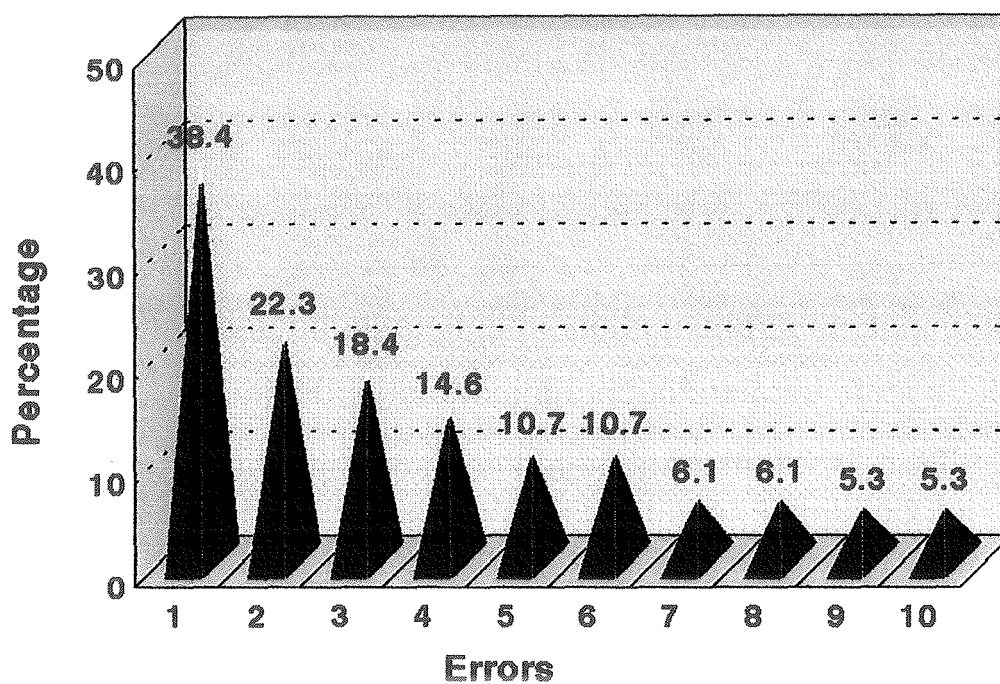
Table 10 and Figure 5 reflect reasons behind the errors made by the children in mathematics.

Table 10 : Reasons for Errors in Mathematics

Reasons	Teachers stating	
	Number	Percentage
Carelessness	50	38.4
Poor understanding of concepts	29	22.3
Poor number concept	24	18.4
Difficulties in division	19	14.6
Difficulty in memorising tables	14	10.7
Poor concentration	14	10.7
Errors in symbols	8	6.1
Misplacing digits	8	6.1
Forgetting formulas	7	5.3
Errors in fundamental operations	7	5.3

Little more than one third of the teachers (38 %) attributed errors in arithmetic to carelessness among young children. Poor understanding of the basic concepts and their differentiation including that of number concept stood next in the list, having been noticed by 22 per cent and 18 per cent of teachers.

Difficulty in doing division sums in memorising tables, poor concentration, errors in use of symbols, place value



1. Carelessness
2. Poor understanding of concepts
3. Poor number concepts
4. Difficulties in division
5. Memorising tables
6. Poor concentration
7. Errors in symbols
8. Misplacing digits
9. Forgets formulae
10. Errors in fundamental operations

**Figure 5**  
**Reasons for Errors in Mathematics as**  
**Perceived by Teachers**

and in working with fundamental operations and formulas were reported by less than 15 per cent teachers.

Some of the common methods adopted by the teachers in helping children with learning difficulties are indicated in the Table 11 below.

**Table 11 : Methods Adopted by Teachers in Helping Children with Learning Difficulties**

Methods	Teachers stating	
	Number	Percentage
Motivation	99	76.0
Special attention	95	73.0
Extra coaching	86	66.1
Parental involvement	51	39.2
Use of teaching aids	50	38.4
Recognition of abilities	49	37.6

It was encouraging to note that though none of the teachers had any formal training in helping children with learning difficulties, almost 76 per cent of them had adopted the techniques of motivating these children to learn better and improve. Amidst their heavy work load, 73 per cent of the teachers were able to render special attention and 66 per cent were even able to spend a few extra hours to coach and guide the children in their problem areas.

Request for parental involvement in helping the child at home, use of teaching aids and identifying the children's abilities were some of the methods adopted by less than 40 per cent of teachers. Though the number practicing is less, these methods tend to have a far reaching impact on the minds of the children to cope with their difficulties.

#### 4. Outcomes of orientation organised for school teachers

Nineteen teachers participated in the orientation programme of five days duration. Initial and final assessment of knowledge (in terms of knowledge scores) were taken to assess the impact of the orientation programme. Paired 't' test was applied to test the difference between the pre and post mean knowledge scores and the outcomes are presented below :

##### a. Concept of learning disability

Table 12 depicts pre and post-test knowledge scores of teachers assessed for learning disability concept, categories and causes for learning disability among children.

Table 12: Knowledge Scores of Teachers on the Concept and Causes of Learning Disability

Concept	Pre-test		Post-test		Difference in mean + S.D.	Paired 't', value
	Percentage (N=19)	Knowledge scores mean + S.D.	Percentage (N=19)	Knowledge scores mean + S.D.		
Terminology - Learning disability	26.3	0.26+0.44	100.0	1+0	0.74+0.45	6.76**
Mean percentage	26.3		100.0			
<b>Specific learning disabilities</b>						
Reading disability	47.3		100.0			
Writing disability	15.7	0.21+0.52	100.0	1+1.41	0.79+0.74	4.48**
Arithmetic disability	-		100.0			
Mean percentage	21.0		100.0			
<b>Causes</b>						
Poor teaching in school	52.7		94.7			5.37**
Lack of awareness among parents and teachers	52.7		100.0			
Heredity	-	0.26+0.55		0.89+1.57	0.63+0.51	5.37**
Illness of mother during pregnancy	-		78.2			
Mean percentage	26.3		89.4			

\*\* P &lt; 0.01

Prior to the orientation programme, the teachers referred the children as "handicapped", "exceptional", "problem children" and "children with low IQ". Pre-test data further revealed that the terminology "learning disability" had been referred to by only 26 per cent of the teachers. After the orientation all the teachers revealed a better understanding of this terminology. Significant difference at one per cent level between pre and post mean knowledge scores on concept of learning disability is an encouraging positive outcome.

As for specific learning disabilities, it was quite surprising to note that none of the teachers in the group were aware of arithmetic disability among school children, while reading and writing disability were known to 47 and 16 per cent teachers respectively.

On the contrary, after the training, all the teachers had comprehended well the three different types of learning disabilities, the difference between pre and post mean knowledge score being significant at one per cent level. This finding forecasts an immediate need to orient all the teachers on specific learning disabilities, so that children with such problems can be given timely and appropriate help.

Prior to the orientation programme, 53 per cent of the teachers opined poor teaching (inadequate instruction) and lack of awareness among parents and teachers as factors leading to learning disabilities against 95 per cent and the difference was significant statistically after the orientation. Apparently this orientation programme had offered an opportunity for about 81 per cent of the teachers to gain knowledge on the significance of hereditary factors and illness of the mother during pregnancy, as contributive sources to learning disabilities.

#### Characteristics

Table 13 lists manifestations of learning disabilities reported by teachers at pre and post training levels.

Table 13: Knowledge Scores of Teachers on the Characteristics of Learning Disabled

Characteristics	Pre-test		Post-test		Difference in mean + S.D.	Paired 't' value
	Percentage (N=19)	Knowledge scores mean + S.D.	Percentage (N=19)	Knowledge scores mean + S.D.		
Lack of concentration	42.1		100.0			
Language problems	42.1		84.2			
Motor problems	36.8		100.0			
Poor self - concept	31.5		100.0			
Social withdrawal	31.5	0.81+0.15	89.4	0.92+3.07	0.74+1.28	2.51*
Memory problems	26.3		94.7			
Over dependency	5.26		94.7			
Disruptive behaviour	5.26		84.2			
Academic learning difficulty	-		100.0			
Impulsivity	-		94.7			
Distractability	-		84.2			
Difficulty in following oral directions	-		84.2			
Mean percentage	18.4		92.5			

\* P < 0.05

The characteristics of the learning disabled listed by the teachers included lack of concentration and language problems (42 %), motor problems (37 %), poor self-concept and social-withdrawal (32 %) and memory problems (26 %). Over dependency and disruptive behaviour were mentioned by very few teachers (5 %). None of the teachers were aware of the distinguishing features like repeated academic failure due to learning difficulties in the areas of reading, writing and arithmetic, impulsivity, distractability and difficulty in following oral directions prior to their participation in the orientation programme. The percentage of teachers pointing to the above characteristics increased significantly after the orientation programme.

In the pre-test, teachers mentioning the various characteristics ranged from five to 42 per cent as against 84 to 100 per cent in the post-test. In the orientation programme, the teachers (84 to 100 %) obviously had good focus on the last four characteristics in Table viz., academic learning difficulty (100 %), impulsivity (95 %), distractability (84 %) and difficulty in following oral directions about which they were totally ignorant initially. Majority of the teachers gaining perception of the characteristics and its associated problems as indicators for the learning disability of the child appears to be a favourable outcome of the orientation programme and was proved statistically too.

#### c. Tools for identification

Table 14 shows teachers' comprehension of the tools used for identification of children with learning disabilities.

Table 14: Knowledge Scores of Teachers on Tools for Identification of Learning Disabled

Tools	Pre-test		Post-test		Difference in mean $\pm$ S.D.	Paired 't' value
	Percentage (N=19)	Knowledge scores mean $\pm$ S.D.	Percentage (N=19)	Knowledge scores mean $\pm$ S.D.		
Formal/informal assessment tools	57.8	100.0				
Behavioural assessment	42.1	0.42 $\pm$ 0.64	94.7	0.96 $\pm$ 1.37	0.54 $\pm$ 0.50	4.69**
Checklists	26.3		94.7			
Mean percentage	42.1		95.5			

\*\* P < 0.01

It was quite encouraging to note that in the pre-test level, 58 per cent teachers were aware of both formal and informal assessment tools such as classroom tests and observation, followed by 42 and 26 per cent of the teachers comprehending the use of behavioural assessment and checklist respectively for identification of learning difficulties.

A substantial and significant increase in both the number stating and knowledge scores related to tools used were recorded in the responses of teachers in post-test level depicting greater understanding of the same on the part of the teachers.

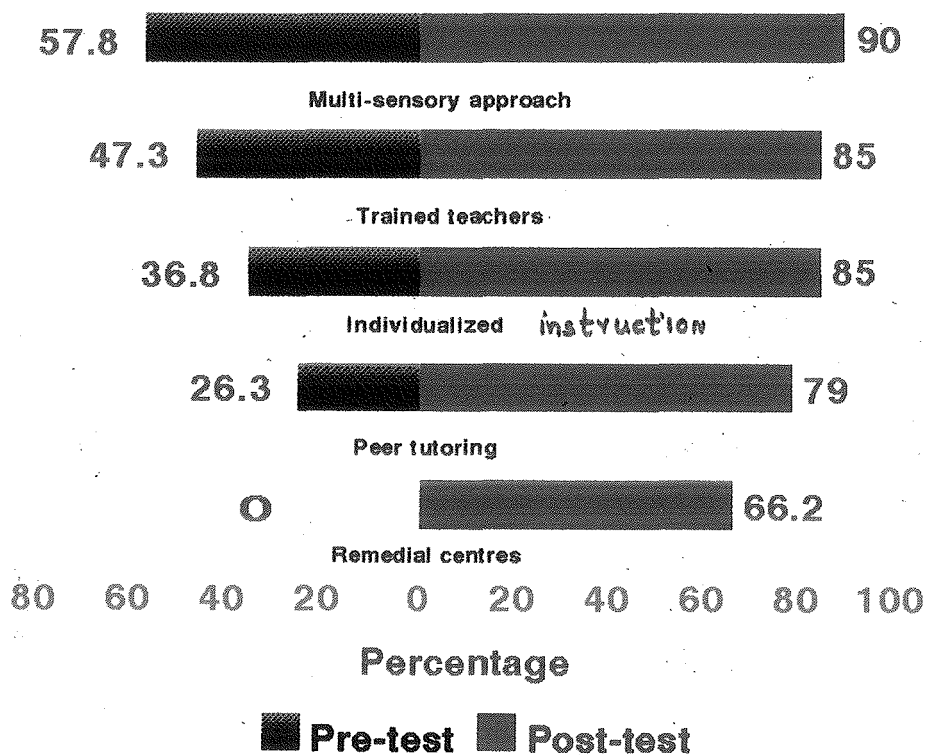
#### Remedial methods

Teachers' awareness on the remedial options for L.D. children in a classroom situation under pre and post-test condition is projected in Table 15 and Figure 6.

Table 15: Knowledge Scores of Teachers on Remedial Methods for Learning Disabled

Concept	Pre-test		Post-test		Difference in mean $\pm$ S.D.	Paired 't' value
	Percentage (N=19)	Knowledge scores mean $\pm$ S.D.	Percentage (N=19)	Knowledge scores mean $\pm$ S.D.		
Multisensory approach	57.8	90.0				
Trained special teacher	47.3	85.0				
Individualized instruction	36.8	0.33 $\pm$ 0.70	85.0	0.81 $\pm$ 1.64	0.48 $\pm$ 0.83	2.51*
Peer tutoring	26.3		79.0			
Remedial centres/units	0		66.2			
Mean percentage	33.6		81.0			

\*  $P < 0.05$



**Figure 6**  
**Knowledge Scores of Teachers on Remedial**  
**Methods for Learning Disabled**

As for remedial options for the L.D., 58 per cent of the teachers were aware of the multi-sensory approaches in teaching followed by coaching by specially trained teachers (47 %). Individualised instruction (37 %) and peer tutoring (26 %) were also stated. It was rather surprising to note that none of the teachers knew about the functioning of the remedial centres for L.D. children in the metropolis prior to their participation in the programme. It was quite encouraging to observe that the orientation programme had enabled the teachers to acquire information on the programmes and functioning of the remedial training centres both within the state and outside.

Remedial services in terms of individualized instruction, peer tutoring and functioning of dyslexic training centers had a limited spread among the teachers in the pre-test (0 - 58 %), while the post-test brought forth as much as 66 to 90 per cent and the difference in scores was significant at five per cent level.

## B. Identifying Dyscalculic Primary School Children

The second phase of the study involving identification of dyscalculic primary school children included the following steps :

1. Academic achievement of primary school children
2. Low achievers in mathematics - an overview
3. Identification of dyscalculic children and
4. Dyscalculic children - their distribution

### 1. Academic achievement of primary school children

As a prelude to the identification of dyscalculic primary school children the investigator made an attempt to assess the overall academic performance of primary school children (1442) in four major subject areas of English, Language, Mathematics and Science over a period of one academic year.

Chi-square test was applied to find the association between academic scores in various subjects and gender. The analysis revealed significant association between academic scores and gender at 1 % level for English, Science and Mathematics only ( $x^2 = 40.15, 53.19, 17.48$ ).

Table 16 depicts the performance of children in mathematics in relation to other subjects.

Table 16 : Performance of Children in Mathematics in Relation to Other Subjects

Subject	Sex	Score	Group sample in subjects	Group sample in Maths	CR
English	Girls -	Below 40	53	66	1.238
		40-80	508	480	1.433
		Above 80	244	259	0.807
	Boys -	Below 40	71	77	0.525
		40-80	441	398	2.541*
		Above 80	125	162	2.481*
Language	Girls -	Below 40	127	66	4.680**
		40-80	472	480	0.406
		Above 80	206	259	2.914**
	Boys -	Below-40	77	77	0.000
		40-80	366	398	1.830
		Above 80	194	162	1.998*
Science	Girls -	Below-40	61	66	0.462
		40-80	503	480	1.176
		Above 80	241	259	0.969
	Boys -	Below-40	99	77	1.786
		40-80	388	398	0.576
		Above 80	150	162	0.782

\* P < 0.05

\*\* P < 0.01

A proportion test (P test) was applied to find out whether the proportion of girls and boys who had secured below 40 in English, Language and Science were the same. The test revealed significant difference at 1 % level in the case of language only among girls.

Eventhough the selected group of children showed poor performance in language predominating other subjects, performance in Mathematics was considered because there is a strong evidence cited by Crealock and Kronick (1993) that students with learning disabilities are usually first identified because of their reading problems, the correlation between reading and mathematics being high for many students since both are languages - one primarily qualitative and the other quantitative.

## **2. Low achievers in mathematics - an overview**

Low achievers in mathematics were identified by the teachers on the basis of their class performance and also by an assessment of their marks scored in the three tests (viz., first mid-term, quarterly and half-yearly). Thus from the selected five schools a total of 115 children were identified to be poor achievers in mathematics.

The family background details of the selected children are discussed below :

### **a. Low achievers - class-wise and sex-wise**

The class-wise and sex-wise distribution of low achievers in mathematics is given in Table 17.

Table 17 : Distribution of Selected Children Class and Sex-  
Wise

Class	Distribution of children (N=115)				
	Boys		Girls		Total
	Number	Percentage	Number	Percentage	Percentage
I	14	12.2	1	0.9	13.1
II	12	10.4	4	3.5	13.9
III	22	19.1	5	4.3	23.4
IV	26	22.6	2	1.7	24.3
V	13	11.3	16	14.0	25.3

An increasing trend was observed in the percentage of low achievers in mathematics class-wise. Among the selected children, only 13 per cent were in class I while almost 25 per cent were identified at class V. This brings out the fact that the higher the class, greater is the number of primary school children with difficulties in mathematics.

Sex-wise distribution of low achievers in mathematics revealed a majority of 87 children out of 115, were boys and only 28 were girls.

b. Educational qualification

Table 18 depicts educational qualification of the parents of selected children.

Table 18 : Educational Qualification of Parents

Educational qualification	Distribution of parents			
	Father		Mother	
	Number	Percentage	Number	Percentage
Primary education	10	8.7	17	14.8
Secondary education	70	60.9	72	62.6
Higher secondary	16	13.9	15	13.0
Graduates	13	11.3	9	7.8
Post graduates	2	1.7	0	0
Others (Diploma-Certificate course)	4	3.5	2	1.7

A majority of almost 60 per cent of both parents were educated only upto the secondary level. Around 14 per cent of the parents were either graduates or had completed their higher secondary grade level. Less than four per cent of the parents were diploma holders in computer education, technical education or textile technology. It was noticed that only two per cent of the fathers were post graduates.

A significantly greater number of low achievers in mathematics had fathers at low professional level, low income and lower educational levels. This was also true of children whose mothers had lower levels of education (Nair,

1981). This finding relates well with the observations of Grolnick and Slowiaczek (1994) that parental education has positive effect on childrens' achievement in mathematics.

**c. Occupational status**

Considering the occupational status it was noticed that low achievers' mothers, to a large extent, were housewives (90 %), while the remaining were engaged as either teachers, agents, or in business owning a beauty parlour or a laundry.

Seventy three per cent of the fathers of low achievers were engaged in business/trades such as cotton, gold smithry, workshops etc. Around 22 per cent of them were in other occupations like salesman, telephone operators, document writer, compositor, driver, time keepers, commission agents, dhobi etc. A few among the fathers were teachers (4 %) or held professional jobs (2 %).

**d. Family income**

Table 19 reveals the total family income per month.

Table 19 : Total Family Income Per Month\*

Income range	Distribution of families (N=115)	
	Number	Percentage
Low income group (Rs. 1,250 - 2,650)	65	56.5
Middle income group (Rs. 2,650 - 4,450)	37	32.2
High income group (Rs. 4,450 and above)	13	11.3

\*(HUDCO, 1994)

The analysis revealed that a majority of 57 per cent of children were from low income group, while 32 per cent were from middle income and 11 per cent were earning a monthly income of above Rs. 4,450/- to a maximum of Rs. 15,000/- and thus belonged to the high income group.

In addition to the income of parents, education, ordinal position and occupation of mothers were the demographic factors that affected academic performance significantly (Desai, 1990).

### 3. Identification of dyscalculic children

Identification of dyscalculic children among the 115 identified low achievers in mathematics involved diagnosis in the following areas :

a. Assessment of performance in mathematics

Table 20 presents the average marks obtained by selected children in mathematics in four consecutive tests.

Table 20 : Performance of Selected Children in Mathematics

Marks range	Distribution of children (N=115)	
	Number	Percentage
0 - 10	6	5.2
11 - 20	44	38.2
21 - 30	48	41.7
31 - 40	17	14.8

Marks in mathematics from four tests (1st mid-term, quarterly, II mid-term and half yearly exam) were considered to arrive at the average score obtained by these selected children.

An average of less than 30 marks in mathematics had been scored by 42 per cent children, while 15 per cent scored an average of less than 40 per cent marks.

A totally discouraging performance was observed among 38 per cent children who had scored less than 20 marks. Five per cent of them had scored even less than 10 marks on an average. This group of children were probably children with

difficulties in mathematics requiring assistance through appropriate remediation.

b. Intelligence test

The scores obtained by the selected children in different grades on the Raven's Progressive Coloured Matrices is presented in Table 21.

Table 21 : Grade-Wise Classification of Children on Intelligence Test

Grade	Classification	Distribution of children (N=115)	
		Number	Percentage
I	Intellectually superior	-	-
II	Definitely above average	4	3.5
III	Average	39	33.9
IV	Definitely below average	47	40.8
V	Intellectually defective	25	21.7

Since the selected group of children included poor achievers in mathematics, it was not surprising to observe that none of them belonged to Grade I classified as 'intellectually superior' (95th percentile points). Only four per cent of children belonged to Grade II, classified as "above average" in intelligence, their percentile score being 75th percentile point.

Thirty four per cent of children belonged to "average intelligence" group. In Grade IV category "definitely below average" in intelligence, 41 per cent children were grouped. Thus children with average and above average intelligence and with failure in basic arithmetic skills, in the Arithmetic Diagnostic Test administered were assumed to be dyscalculics.

**c. Behaviour problems**

Sharma (1993) and Yasodhara (1996) contend that undiagnosed learning problems lead to explosive outbursts of frustration among young children and dyscalculic children might manifest behaviour problems.

Behaviour problems among the selected children were recorded using behavioural checklist for screening the L.D. developed by Swarup and Mehta (1992). Table 22 reveals the number of children with and without behaviour problems among the 115 low achievers in mathematics.

**Table 22 : Prevalence of Behaviour Problems Among Selected Children**

Criteria	Distribution of children (N=115)	
	Number	Percentage
Children :		
With behaviour problems	94	81.7
Without behaviour problems	21	18.3

The behavioural assessment made by the class teachers revealed that a majority of 82 per cent of the selected low achievers exhibited behaviour problems as per the norm. Obviously 18 per cent of children had no behaviour problems. Probably the children with behaviour problem may manifest learning difficulties.

**d. Responses of children while doing arithmetic test**

Arithmetic diagnostic test for primary school children developed and standardised by Ramaa (1994) was administered to all the low achievers in mathematics. The responses of these children towards the test are given in Table 23 and Figure 7.

**Table 23 : Responses of Children Towards Arithmetic Diagnostic Test**

Responses	Children (N=115)	
	Number	Percentage
1. Failure in basic arithmetic skills	63	54.6
2. Inconsistent responses	22	19.1
3. Difficulty in higher order tasks	20	17.4
4. Incomplete without obvious reason	6	5.2
5. Failure to perform lower order tasks (though capable of higher order ones)	4	3.5

A large number of 63 children (55 %) had problems in basic arithmetic skills and were most likely to be dyscalculics, therefore these children were short listed for

1. Failure in basic skills
2. Inconsistent response
3. Difficulty in higher order tasks
4. Incomplete without obvious reason
5. Failure to perform lower order tasks

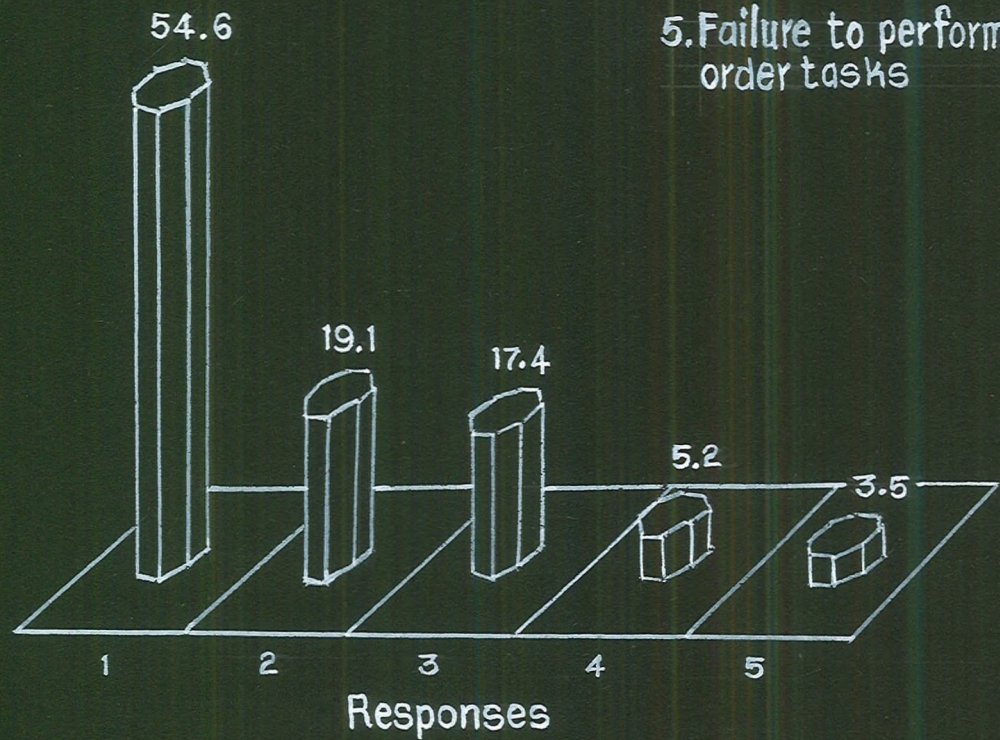


Figure 7

RESPONSES OF CHILDREN FOR ARITHMETIC  
DIAGNOSTIC TEST

further assessment and diagnosis. Inconsistent responses were observed among 19 per cent of children and 17 per cent of them had difficulty in higher order mathematics tasks. Few children (6 %) showed incomplete responses and failure to perform lower order tasks even though capable of handling higher order ones. Thus the children's strengths and weaknesses in solving problems in various concept areas in mathematics could be identified.

This analysis shows a direction to think that children with difficulty in basic arithmetic skills tend to continue with their problems though they get promoted to higher classes with marks for a minimum pass based on their performance over the academic year.

e. Confirming dyscalculia among children

The process of identification of probable dyscalculics involved a step-wise diagnosis. Table 24 below gives a glimpse of the diagnostic criteria followed to confirm dyscalculia among the 63 selected children.

**Table 24 : Identification of Dyscalculic Children**

Criteria	Number of children (N=115)	
	Eliminated	Retained
Arithmetic diagnostic test	52	63
Subnormal intelligence	18	45
Underage	2	43
Children without behaviour problems	7	36

Out of 63 children identified as probable dyscalculics on the basis of their difficulty in doing basic arithmetic skills, a total of 27 children were eliminated since they were under age, had subnormal intelligence and had no behaviour problems.

Thus the exclusion procedure followed led to the final number 36 confirmed as dyscalculics.

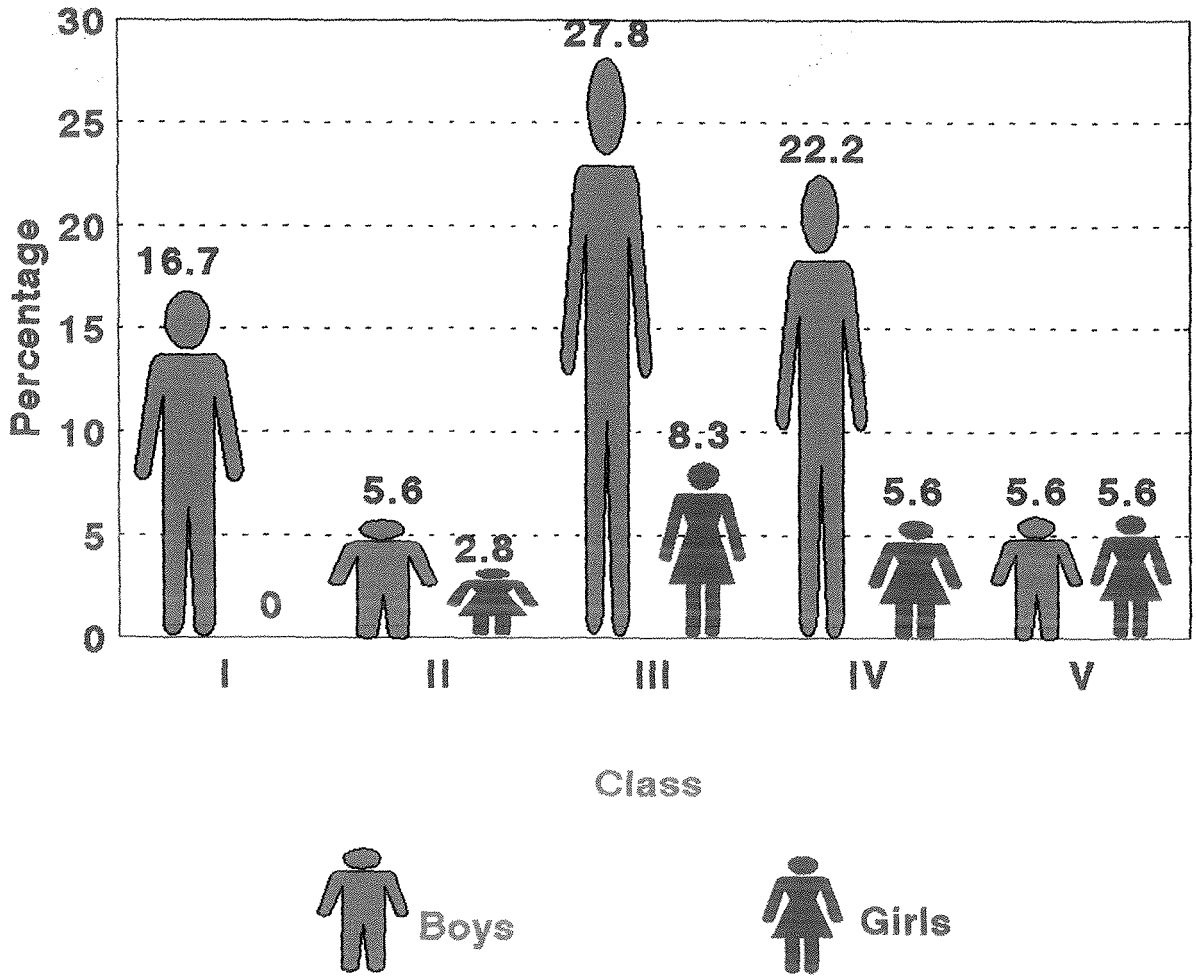
**f. Dyscalculic children - their distribution**

On confirming dyscalculia among selected children, an attempt was made to trace their class and sex as in Table 25 and Figure 8.

**Table 25 : Dyscalculics Class and Sex-Wise Distribution**

Class	Distribution of children (N=36)				
	Boys		Girls		Total
	Number	Percentage	Number	Percentage	
I	6	16.7	0	0	16.7
II	2	5.6	1	2.8	8.4
III	10	27.8	3	8.3	36.1
IV	8	22.2	2	5.6	27.8
V	2	5.6	2	5.6	11.3

Out of the 36 identified dyscalculics, a majority of 78 per cent were boys and the remaining 22 per cent were girls. Class-wise, 36 per cent were from class III followed by class IV (28 %) class I (17 %) class V (11 %) and class II (8 %).



**Figure 8**  
**Class and sex wise distribution of**  
**dyscalculic children**

Though an increasing trend of poor achievers was observed grade-wise in mathematics performance in the ascending order, the number of dyscalculics grade wise did not reveal a similar trend.

g. Deficits among dyscalculics

Table 26 depicts some of the behavioural deficits exhibited by the identified dyscalculic children.

**Table 26 : Deficits Exhibited by Dyscalculics in Selected Areas**

Problem areas	Distribution of children	
	Number	Percentage
Deficits in		
Memory	36	100
Auditory processing	34	94.0
Cognitive domain	34	94.0
Language	34	94.0
Affective domain	31	86.1
Preservation	29	80.0
Visual processing	27	75.0
Motivation	26	72.2
Motor co-ordination	24	66.7
Reading	23	63.9

Problems related to memory was a significant characteristic stated by the teachers among all the dyscalculics, identified, followed by deficits in cognitive domain, auditory processing and poor language (94 %). Above 70 per cent of the identified children had deficits in affective domain (86 %) preservation (80 %) visual processing (75 %) and poor motivation (72 per cent).

Kousalaya (1992) associated behavioural difficulties in youngsters with learning problems as a significant concern. True to this finding, all children in the present study also exhibited associated behavioural problems characteristic of L.D. children.

#### **h. Type of errors committed**

An analysis of arithmetic errors committed by the identified dyscalculic children on the Arithmetic Diagnostic Test is revealed in Table 27.

Table 27: Arithmetic Errors Committed by Identified Dyscalculics

Types	Example	Distribution of children (N=36)	
		Number	Percentage
Cannot perform multiplication	$7 \times 3 = ?$	20	55.5
Random response	$23+14 = 90$	19	52.5
Writing the numbers said	Six hundred seventy as 60070	15	41.6
Wrong operation	Adding in between subtraction	14	38.9
Understands concept but cannot do it in written symbolic form	Problem solving	14	38.9
Reading digitwise	1006 as one, zero, zero six	13	36.1
Spelling errors	hundred-hundder	10	27.8
Lack the knowledge of carryover	$87 + 44 = 1211$	8	22.2
Reverses two place numbers	14 becomes 40	7	19.4
Subtracting lower numbers from higher numbers irrespective of the place	$72 - 45 = 33$	6	16.6
Reversing the digits	21 becomes 12	6	16.6
	61 becomes 16	4	11.1
Rotation of numbers	2 - 7	1	2.8
Counting by fingers		1	2.8
Cannot subtract		1	2.8

Almost a little above 50 per cent of children had difficulty in committing multiplication tables to memory and also attempted in random responses. The other category of errors included writing the numbers mentioned (42 %), wrong operation and errors in verbal problem solving, difficulty with written symbolic form (39 %), reading digit wise (36 %) and spelling errors (28 %).

Less than three per cent of the sample committed errors related to rotation of numbers and counting by fingers in problem solving. The overall performance of these children that finally emerged out of the analysis of errors committed was that a majority of dyscalculics did face difficulty in understanding and remembering the rules that govern different mathematical operations.

This finding supports the conclusion drawn by Ramaa (1992) that dyscalculics at the primary level have the above mentioned types of errors. Crealock and Kronick (1993) found that L.D. youngsters do not readily use organised strategies that facilitate memorization and recall. These students have difficulty in mathematics because they fail to use cognitive strategies in computation or problem solving. This report also confirms the above observation.

i. Performance of dyscalculic children on diagnostic test of learning disability

An analysis of the strengths and weaknesses in the various neuropsychological process areas among dyscalculics selected for remediation is shown in Table 28.

Table 28 : Strengths and Weaknesses of Dyscalculics in the Neuropsychological Process Areas

Areas	Number of children scoring (N=18)		
	(Maximum score = 10)		
	Below 4	4 - 8	8 and above
Memory	11	5	-
Expressive language	9	4	-
Receptive language	6	8	2
Cognitive abilities	5	10	1
Eye hand co-ordination	3	11	2
Position in space	2	9	5
Figure ground perception	2	12	2
Auditory perceptions	2	14	-
Spatial relations	1	14	1
Figure consistency	-	10	6

As for the performance of dyscalculics in the individual neuropsychological areas, it was noticed that they had severe problems in the areas of memory (11) expressive language (9), receptive language (6) and cognitive abilities (5) The abilities of the dyscalculic

children in the areas of figure ground perception, figure consistency, position in space and in eye hand co-ordination were relatively good.

j. Prevalence ratio

Ramaa (1994) identified 15 dyscalculic children out of 251 cases, thus establishing a prevalence of dyscalculia to an extent of six per cent in the population studied. The present investigation reveals the percentage of dyscalculics to be 2.5 per cent among a total of 1442 children. Such an alarming proportion calls for immediate efforts on the part of educators to overcome the situation which might take bigger dimensions, if left unattended.

These findings typify the need for orientation to equip the primary school teachers to handle children with difficulties in learning especially in mathematics. Kavanagh and Truss (1988) and Radhakrishnan (1996) contend that problems in mathematics achievement may be directly related to faulty instruction and uninteresting classroom environment. Thus it is recommended that teachers need to undergo courses in individualized remedial mathematics teaching to gain in-depth focus on dyscalculia and its related features among children.

Children who fail in primary grades or those not able to cope with basic subject such as mathematics might drop out. While all our efforts are being taken to establish 'Education for All', 31 per cent dyscalculics cannot be

neglected and allowed to miss their education. Hence it is imperative that primary school teachers are trained in the multiple perspectives of learning disabilities and be equipped to help young children gain proper foundation.

### C. Remedial Intervention for Dyscalculic Children

This aspect of the study had two basic objectives :

- a. To plan remedial programme for the dyscalculic children grouped A and B.
- b. To study the effectiveness of the remedial programme in improving the accuracy of solving mathematical problems with minimum errors.

#### a. Remedial Intervention

The remedial programme for the selected experimental group children (18) grouped A and B for the convenience of remediation was implemented using sample programmes given in Appendix X . Remediation was offered to the groups by the teachers who had offered to be the resource teachers along with the investigator in implementing the programme in the respective schools.

The basic five modalities considered in planning and implementing the remedial programme involved

- The present mode in which the students were shown the pictures or pictorial activity sheets
- The construct mode in which the manipulative resource materials were used (stacked, arranged, sorted, grouped, etc.)

- The oral mode in which oral discussions/oral instructions/communication took place
- The graphic symbolic mode in which written or oral symbols were used
- The identity mode in which non-verbal response by actual use of working on print was done.

With these input and output options, a variety of instructor - learner interactions were planned allowing the teachers to select alternative learning combinations for students. These multiple options enabled to circumvent difficulties among these children in other areas such as reading and writing that may impede mathematical performance.

In order to make the treatment uniform to all dyscalculics no extra intervention was provided in terms of extra coaching at home or in schools excepting the remedial intervention.

#### b. Evaluation

The effectiveness of the remedial programme was done by evaluating the students' scores on the Arithmetic Diagnostic Test implemented.

Table 29 depicts the percentage scores of the two groups (experimental and control) in the pre and post-test.

Table 29 : Performance of Selected Children on Arithmetic Diagnostic Test

Group		Mean	Standard deviation	't' value
Control	Pre-test	17.42	6.9	12.51**
	Post-test	33.12	7.32	
Experimental	Pre-test	33.21	14.69	9.28**
	Post-test	64.37	11.81	

\*\* P < 0.01

Paired 't' test applied to find out the difference between the control group (pre and post-test) scores and experimental group (pre and post-test) scores revealed significant difference in their performance in Arithmetic Diagnostic Test. Obviously after the remedial intervention, the performance of the experimental group improved with a mean value 33.16 against the control group mean 15.70 on the Arithmetic Diagnostic Test.

#### D. Efficacy of Remedial Package for Dyscalculic Children

Working with the teachers in the schools in providing remedial intervention for dyscalculic children brought to light that the teachers do not possess the required knowledge and skill in managing children with learning difficulties in mathematics in the classroom. Seemingly the literature available in this area is also limited in India. Hence, there is a need to enrich and expand the scope and availability of such materials. Therefore an attempt was

made by the investigator in developing a remedial package for children with difficulties in arithmetics-an additional supplement to the already available literature in India.

The package developed was distributed to ten primary school teachers (including resource teachers who had helped in remediation) to obtain their views on the efficacy of the package for use by teachers in classroom interventions.

A checklist was provided to get teachers' opinion on the use of the package. Table 30 depicts the opinion of the teachers on the package.

**Table 30 : Teachers' Views on the Efficacy of the Remedial Package**

Aspects	Percentage of teachers stating (N=10) 100
Remedial programme largely applicable	100
Manipulative resource materials provide imaginative learning	100
Mathematical skills can be improved	98
Simple method in concept learning useful	99
Games provide interesting learning situations	97
Adequate computation skills can be taught	95
Objectives of remedial teaching achieved	89
Instructional materials on the concept is informative	85
Parents and teachers can use the package without orientation	85

It was quite encouraging to note that all the teachers expressed that the remedial intervention spelt out in detail was largely applicable in classroom intervention and the supplementation on manipulative resource materials could provide imaginative learning experiences for the learner.

Above 95 per cent of teachers felt that by using the package mathematical skills among children could be improved, easy to learn methods could be utilised, games in the package provided interesting learning situations and impart adequate computation skills.

The selected teachers, on examining remedial package, also felt that the objectives of remedial teaching were clear (89 %), instructional materials on the concept were informative (85 %) and that both teachers and parents could successfully use the package on their own (85 %).

#### **Developing a Training Module for Primary School Teachers**

A major challenge before today's classroom teachers is to deal with L.D. children in regular classroom situations. To meet this challenge effectively, the teachers need to have a thorough understanding of the nature of learning disabilities. As a follow up to the present investigative research, it is advocated that the teachers need to be sensitized on learning disabilities through inclusion of modules in the teacher training-cum-orientation programmes.

Based on the findings of the present study, an attempt has been made by the investigator to develop the following training module for the primary school teachers in the area of learning disabilities with special focus on dyscalculia.

#### TRAINING MODULE FOR PRIMARY SCHOOL TEACHERS

Module I		Rationale
Unit I	-	Concept, - Definition and Types of Learning Disabilities.
Unit II	-	Causes, Characteristics and Problems of Learning Disabilities
Module II		Curriculum
Unit I	-	Key Components in the Identification of Dyscalculic Children.
Unit II	-	An Analysis of the Common Errors Committed by Dyscalculic Children.
Unit III	-	Examining the Nature of Behavioural Problems Among Dyscalculic Children.
Module III		Strategies and Techniques for Remediation
Unit I	-	Primary School Mathematics Curriculum. Teachers attitude and Pedagogical Approach
Unit II	-	Teaching Techniques Through Use of Remedial Package for Dyscalculic Children.
Unit III	-	"Integrated Approach" - a Teaching Strategy.

Incorporation of the above stated module in future training programmes will equip the primary school teachers with the knowledge and skills that would inturn enable children to achieve a strong foundation in mathematics. This module can also be used by agencies and institutions interested in teacher training to organise orientation and refresher training.

It is hoped that Researchers, Educators, Parents, Allied Health Personnel, Media Representatives and the General Public can together create a powerful team in meeting the needs of this category of L.D. viz., the dyscalculic children. They can work creating a net-work as analysers, guidance counsellors and awareness promoters through multipronged approaches. Perhaps the next decade will have greater cheer for these children with better learning environment.

## V. SUMMARY AND CONCLUSION

The school is the first and perhaps the most formative formal training ground for any child. Today, while the primary education system in India has expanded into one of the largest in the world, the country also has the dubious distinction of having the world's largest number of out of school children (22 % of the global total). Learning disability of a child might be one of the reasons for drop outs.

Learning disabilities are the most crucial factors in the context of educational profile and achievements. To reduce drop out rate, attention has been directed towards students with learning disabilities by allied health personnel, scientists, educationalists, media representatives and the general public. This interest has helped to foster an environment in which the understanding of learning disabilities has improved dramatically.

The primary school teachers play a pivotal role in the education of L.D. children. The current trend in education of the disabled children is geared towards integration. It is, therefore, vital to remediate these children with difficulties in academic subjects by equipping the regular teachers to identify each child's specific problems in learning and correcting them desirably.

Against this backdrop, the investigator designed this study on "Efficacy of Remedial Package in Augmenting Primary School Teachers' Skills to Help Dyscalculic Children". The objectives of the study were to :

1. sensitize primary school teachers towards children with learning disabilities,
2. identify dyscalculics among primary school children,
3. evolve and implement a remedial intervention programme for dyscalculic children and
4. evaluate the efficacy of the remedial package developed.

This research exercise was implemented in four phases. The first phase focused on awareness promotion and training of primary school teachers on learning disabilities, which led to the organisation of a five day orientation programme for selected teachers on "Identification and Education of Learning Disabled Children".

The second phase laid emphasis on identifying dyscalculic primary school children from selected five matriculation schools based on their achievement scores and teachers' opinion on their overall performance in mathematics. This phase also involved the use of various assessment tools to adjudge children's IQ, behaviour problems, arithmetic abilities and neuropsychological process areas among the selected children.

The third phase of the study was exclusively devoted to the preparation of a remedial intervention programme in mathematics which was implemented for selected experimental group namely dyscalculic children (18) with their teachers as resource personnel.

The fourth and the last phase of the research involved the development of remedial package for dyscalculic children for regular use by school teachers in their remedial intervention.

Queries among teachers revealed a majority of (46 %) were in the age range of 20-30 years; education wise the group consisted of graduates (65 %) and post graduates (29 %). As for teaching experience, 53 per cent had 2-4 years followed by 47 per cent with 4-8 years of experience in teaching primary school children. Two to four classes were handled by 41 per cent of the teachers and 36 per cent handled 4-6 classes.

Opportunities for primary school teachers to attend special programmes were found to be very limited. A majority (79 %) had no exposure to any sort of in-service training programmes.

The findings of the present study are summarized below:

- A. Sensitizing Primary School Teachers on Learning Disabilities Among Children
1. Among the various terminologies used in referring to the children with learning difficulties, 50 per cent of the teachers perceived them as 'problem children', 19 per cent as 'educationally backward' and 12 per cent as 'slow learners'. Seven per cent had branded them as 'children with learning disabilities' arbitrarily.
  2. Poor teaching (inadequate instruction) in the school (30 %) followed by lack of early stimulation (26 %) were the causes of learning disabilities as reported by the teachers.
  3. Goal setting for an individual L.D. was a pre-requisite considered important by 37 per cent of the teachers. Individual variation in the degree of learning as a vital factor in making education plans was mentioned by 29 per cent teachers.
  4. Amidst heavy load, 73 per cent of the teachers were able to render special attention and 66 per cent were even able to spend two to three hours a week to guide the children with difficulties in learning.
  5. Participation in the orientation programme enabled 19 teachers to acquire adequate knowledge of the terminology to refer to the children with learning disability. There was a significant difference at one per cent level between the pre and post mean scores of teachers on their concept of learning disability.

6. Special remedial services in terms of individualized instruction, peer tutoring and the existence of dyslexic remedial training centres had limited awareness among teachers at the pre-training level (58%), while the post-training scores brought forth as much as 90 per cent of the teachers becoming familiar with the above issues. The difference in knowledge scores was significant at five per cent level.
- B. Identifying Dyscalculic Primary School Children**
7. Academic performance of 1442 primary school children in four major areas of English, Language, Mathematics and Science over a period of one academic year was assessed. Analysis revealed 20 per cent of low achievers in mathematics, the percentage being more than 25 in classes III, IV and V.
  8. The children exhibiting general backwardness in academic subjects were observed to be 47 per cent. The proportion of children exhibiting difficulties in mathematics was 10 per cent of the selected group.
  9. Proportion test (p-test) applied to find out the proportion of girls and boys securing a score of less than 40 in English, Language, Science and Mathematics revealed significant difference at 1 % level only in the case of Language among girls.
  10. Among 115 identified as low achievers in mathematics, only 13 per cent were from class I and 25 per cent were

in class V. The higher the class, greater was the number of primary school children with difficulties in mathematics. Boys (87) with difficulties in mathematics outnumbered girls (28).

11. A significantly greater number of low achieving children in mathematics had parents at low professional level, low income and low educational levels.
12. Performance of low achievers on Raven's Progressive Matrices revealed that only 34 per cent of these children belonged to 'average intelligence' category, while 41 per cent were grouped under "below average intelligence" category .
13. Eighty two per cent of the selected low achievers (115) exhibited behaviour problems.
14. Problems related to memory (100) was a significant characteristic stated by the teachers among all the dyscalculics, followed by deficits in cognitive domain, auditory processing and poor language (94%).
15. The percentage of children exhibiting behaviour problems among the selected low achievers in mathematics was 87 per cent which is true to the observation that children with learning difficulties do exhibit associated behaviour problems.
16. Arithmetic diagnostic test administered to the low achievers in mathematics revealed that almost 55 per cent had problems in basic arithmetic skills, 19 per

cent made inconsistent responses while 17 per cent of them had difficulty in performing higher order tasks.

17. Out of 63 children identified as probable dyscalculics, a total of 27 children were eliminated, on the grounds of being subnormal in intelligence, underage and normal in their behaviour. Finally, only 36 children were confirmed "dyscalculics".
18. An analysis of arithmetic errors committed by the dyscalculics revealed that a little above 50 per cent of the children had difficulty to bring multiplication tables to memory. Writing the numbers mentioned (42 %), wrong operation and problem solving difficulties (each 39 %), reading digit-wise (36 %), spelling errors and difficulty with written symbols (28 %) were observed.
19. The diagnostic test of learning disability to assess neuropsychological problem areas revealed severe problems in the areas of expressive language, cognitive abilities, receptive language and memory among dyscalculics.

#### C. Remedial Intervention for Dyscalculic Children

20. The effectiveness of the remedial programme through Arithmetic Diagnostic Test revealed significant difference among the control and experimental group, the latter achieving higher mean scores.
21. Paired 't' test applied to find out the difference in control and experimental groups (pre and post-test

scores) revealed significant difference at 1 % level. Obviously after the remedial intervention, the performance of experimental groups was higher with a mean value (64.37) against the control group mean (33.12) on the arithmetic diagnostic test.

**D. Efficacy of Remedial Package Developed for Dyscalculic Children**

22. Perusal of the remedial package by the teachers reflected that it was suitable for use in classroom intervention and the manipulative resource materials supplemented could provide imaginative experiences in teaching and learning mathematics. The games introduced and sample sheets on mathematical "probes" were largely appreciated by the teachers.

The investigator has suggested a training module to be considered by teacher training and other related institutes.

**Recommendations**

Based on the findings of this study, the following recommendations emerge :

- \* Concerted efforts be made at the National and State levels to subject the primary school curriculum to scientific scrutiny and effect necessary changes in the perspectives, content and methodologies to make it appropriate and developmentally sound for the primary school children.

- \* Primary school children can learn effectively only from concrete situations. Hence, the primary school teachers' training must be so tailored as to expose them to learn and adopt teaching that facilitates first hand experiences.
- \* Longitudinal studies on remedial intervention strategy and their effect are needed not only to make them effective for students with learning disabilities but also for all students at risk for failure and lack basic knowledge and skills in mathematics.
- \* The training on learning disability must be systematically implemented on war footing, as the sooner it is implemented for all Primary School Teachers, the better it would be for the future of primary education and the progress of the nation.
- \* One of the immediate tasks for policy makers, administrators and researchers in Special Education Programmes is to create a framework which clarifies and delineates relevant and standard terminology relating to learning disabilities.
- \* While the focus of this research was on the general education teachers' planning for students with learning disabilities, a future challenge is to develop successful remedial intervention strategies for secondary teachers so that they can meet the needs of students as a whole and yet provide with the specific instruction needed by students with learning disabilities.

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# **APPENDICES**

APPENDIX - I

AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN  
(DEEMED UNIVERSITY), COIMBATORE - 641 043.

QUESTIONNAIRE TO ELICIT INFORMATION ON THE AWARENESS OF PRIMARY SCHOOL  
TEACHERS ON LEARNING DISABILITIES AMONG CHILDREN

Date :

A. GENERAL INFORMATION

1. Name of the teacher :
2. Sex : Male/Female
3. Age in years :
4. Name of the school :
5. Medium of instruction :
6. Educational qualification :
7. Years of teaching experience :
8. Class particulars :

---

Classes handled at present	Subjects taught	No. of students in the class			
		Boys	Age group	Girls	Age group

---

- 
9. Special seminars/workshops/training programmes attended since past five years

---

S.No.	Programme	Year	Organiser	Place	Duration (No. of days)
-------	-----------	------	-----------	-------	---------------------------

---

B. SPECIFIC INFORMATION ON LEARNING DISABILITY

1. Fill up the following :

1. In a classroom, children differ in the rate of -----
2. Primary school teachers must have ----- to present academic tasks to learning disabled children
3. The learning disabled child will have ----- intelligence.
4. Learning disabled children demonstrate ----- problems for both visual and auditory stimuli.
5. A ----- centre is a must for teaching severe learning disabled children.
6. ----- is the first phase to the whole process of remediation of learning disability.
7. The goal for behavioural change decided for the learning disabled should proceed from simple to -----
8. The curriculum, programme designed, the materials used and the specific techniques, for the learning disabled should be based on the child's ----- needs.

II. Answer the following stating Yes/No :

1. Slow learners are learning disabled children
2. Learning disability may be a condition created by poor teaching
3. Learning disabled children have behavioural problems
4. Mild learning disabled children cannot be integrated with normal children
5. Checklist cannot be used in schools for identifying possible learning disabled children
6. Children with learning disability are described as exceptional children
7. In a classroom, informal assessment tools can be used to identify learning disabled children
8. Behavioural problems among learning disabled children cannot be treated

III. Tick the correct answer among the following

1. One of the following methods used in confirming learning disability is
  - a. Medical examination
  - b. Study of home environment
  - c. Behavioural assessment
2. The learning disability of a child can be obvious in the areas of
  - a. Reading
  - b. Writing
  - c. Arithmetic
3. Medication works well with
  - a. Hyperactive learning disabled children
  - b. Passive children
  - c. Socially withdrawn children
4. A method in teaching learning disabled children is
  - a. Verbal explanation followed by demonstration
  - b. Demonstration followed by verbal explanation
  - c. Verbal explanation and demonstration together
5. For effective teaching, learning disabled children should be grouped on the basis of
  - a. I.Q.
  - b. Age
  - c. Educational needs
6. Sensory approach used for teaching learning disabled children is
  - a. Auditory
  - b. Visual
  - c. Auditory, visual, tactile and kinesthetic
7. Dyslexic child faces difficulties in
  - a. Reading and
  - b. Arithmetic
  - c. Writing
8. In case of learning disability, the child has to be
  - a. Neglected
  - b. Removed from school
  - c. Referred for support

IV. List your answers for the following :

1. Learning disability categories include
  - a.
  - b.
  - c.
2. Possibilities for integrating learning disabled children
  - a.
  - b.
3. Characteristics of learning disabled children
  - a.
  - b.
4. Environmental disadvantages leading to learning disability
  - a.
  - b.
5. The problems faced by the learning disabled in the classroom
  - a.
  - b.
6. The remedial methods/programmes used for teaching learning disabled children
  - a.
  - b.
  - c.
7. Identification of a learning disabled child can be done by
  - a.
  - b.
  - c.
8. Common psychological problems faced by learning disabled children
  - a.
  - b.
  - c.

APPENDIX II

AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN  
(DEEMED UNIVERSITY), COIMBATORE - 641 043.

Dear Sir/Madam,

Date :

The Department of Human Development, Faculty of Home Science, Avinashilingam Deemed University, Coimbatore is organising a one day "Sensitization Programme on Learning Disabilities Among Children", for teachers, parents, professionals and others interested in this emerging problem.

We plan to have an open discussion focussing on concept, strategies and needs of children with learning disabilities. We hope to emerge with concrete ideas/insights to enable the Learning Disabled in Primary School System to cope up with their problems and to reconcile with positively. You may be in a position to contribute ideas and suggestions.

As an individual interested in the area of Primary School Education, your participation will go a long way ensuring its success. We therefore invite you to participate in the event. You may confirm your participation. Primary school teachers may also be deputed for the same.

With warm regards,

Yours sincerely,

APPENDIX III

DEPARTMENT OF HUMAN DEVELOPMENT, FACULTY OF HOME SCIENCE,  
AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION  
FOR WOMEN (DEEMED UNIVERSITY), COIMBATORE - 641 043.

CORDIALLY INVITES YOU FOR A "SENSITIZATION PROGRAMME ON  
LEARNING DISABILITIES AMONG CHILDREN"

at 9.30 a.m. on 7th October, 1994

Special Lectures

- \* Concept and Strategies of Learning Disabilities

by

Mrs. Vasanthi Soundarajan  
M.A., M.Ed. D.Th.Sp. Ed. (USA)  
Principal  
HAL School for Special Education  
Bangalore

- \* Slow Learner and his Educational Needs

by

Miss. Shanthi Gnanavolivu  
M.A., Sp.Ed. (Denmark)  
Principal, Marthomas Special School  
Bangalore.

Presidential Address :

Dr. (Mrs.) Lakshmi Santa Rajagopal  
Vice-Chancellor  
Avinashilingam Deemed University  
Coimbatore.

Venue : Thiruchitrambalam Auditorium

APPENDIX - IV

AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN  
(DEEMED UNIVERSITY)  
COIMBATORE - 641 043.

ORIENTATION PROGRAMME ON IDENTIFICATION AND EDUCATION OF LEARNING  
DISABLED CHILDREN

Venue : Department of Human Development

PROGRAMME

12.12.'94 (Monday)

9.30 a.m. : Registration

10.00 a.m. : Importance of Primary School Years of the Child

Dr. (Tmt.) N.JAYAPOORANI  
Lecturer  
Department of Human Development  
Avinashilingam Deemed University,

11.30 a.m. : Role of Primary School Teachers in the Education of  
the Child

Mrs. S.Meera, M.Ed., M.Phil.,  
Lecturer  
Faculty of Education  
Avinashilingam Deemed University,

2.00 p.m. : Group discussion on Psychology of Children During  
Childhood Years

3.15 p.m. : Common Problems Among School Children - A  
Psychological Perspective

Dr. V.Ganesan  
Reader  
Department of Psychology  
Bharathiar University  
Coimbatore.

13.12.'94 (Tuesday)

9.30 a.m. : Concept and Etiology of Learning Disability

Mrs. T.Geetha, M.Sc., M.Phil., D.H.Ed.,  
Lecturer  
Special Education  
Avinashilingam Deemed University,

11.30 a.m. : Characteristics and Problems of the Learning Disabled

Miss. A.Madhumathi  
M.Phil. Scholar

14.12.'94 (Wednesday)

9.30 a.m. : Specific Learning Disabilities

Mrs. Lakshmi Radhakrishnan  
Madras Dyslexia Association  
Madras.

11.30 a.m. : Identification and Assessment of Learning Disabled Children in Classroom Situation

Mrs. Lakshmi Radhakrishnan  
Chairperson - Training Programmes  
Madras.

2.00 p.m. : Group Work on Development of Checklist for Identification of Learning Disabled in Classroom

3.15 p.m. : Presentation and Discussion of Report

15.12.'94 (Thursday)

9.30 a.m. : Remedial Programmes for Specific Learning Disabilities

Mrs. Lakshmi Radhakrishnan  
Chairperson - Training Programmes  
Madras Dyslexia Association  
Madras.

11.30 a.m. : Group Discussion on Development of Remedial Programmes for Specific Cases of Learning Disabilities

2.00 p.m. : Work on Planning of Remedial Programmes Specifically for the Learning Disabled Children

3.15 p.m. : Presentation and Discussion of Reports

16.12.'94 (Friday)

9.30 a.m. : Educational Approaches for the Learning Disabled

Mrs. Prema Rao  
Correspondent  
Vivekalaya English Medium School  
Coimbatore.

11.30 a.m. : Experiences in Handling Learning Disabled Children

Mrs. Nalini Shanmugam  
Principal  
Vivekalaya English Medium School  
Coimbatore.

2.00 p.m. : Overview of Orientation Programme and Valedictory Address

Dr. (Tmt.) N.Jaya  
Professor and Head  
Department of Human Development  
Avinashilingam Deemed University,  
Coimbatore.

CHECKLIST TO EVALUATE INSTRUCTIONAL MATERIALS DEVELOPED

-----  
Reading Material

Parameters

-----  
Clear Handy Under- Logical Interesting Informative Simple  
print standable flow  
-----

1. Leaflet -  
  Concept of  
  learning  
  disability
  2. Booklet -  
  Do you know  
  Specific learning  
  disabilities :  
  Terminology and  
  identifiable  
  errors
  3. Pamphlet -  
  Causes of learning  
  difficulties
  4. Flip book -  
  Problems of learning  
  disabled
  5. Folder -  
  Characteristics of  
  learning disabled  
  children
  6. Folder -  
  Teaching methods  
  for specific learning  
  disabilities
-

APPENDIX - VII  
BEHAVIOURAL CHECKLIST FOR SCREENING  
THE LEARNING DISABLED

Dr. Smriti Swarup,  
Mrs. Dharmistha H. Mehta,  
Department of Special Education,  
S.N.D.T. Women's University,  
Juhu Road,  
Bombay - 400 049.

For Examiner's use only

Code No.
Score :

Teacher \_\_\_\_\_

Student \_\_\_\_\_

Name \_\_\_\_\_

Name \_\_\_\_\_

Qualifications \_\_\_\_\_

Class \_\_\_\_\_

Teaching Experience \_\_\_\_\_

Age \_\_\_\_\_

School \_\_\_\_\_

## Instructions to fill in the checklist

In a class, there are some students who learn well, some who do not, despite their having a normal intelligence. This is a problem that hammers the minds of teachers. The Behavioural Checklist for Screening the learning Disabled consists of a list of behaviours that are probable causes of learning problem faced by the children, leading to their under achievement.

On the basis of your experience with the child in question, mark the behavior given in the check list, that you have encountered while working with her/his in its appropriate column i.e. Yes/No ?. Mark 'Yes' when you observe a behaviour which occurs frequently. Mark 'No' if the particular behaviour does not occur at all. Mark '?' when you think that the behaviour in question is neither so frequent that it can be put under 'Yes' nor totally absent to be categorised as 'No'.

		Yes	No	?
1.	Has problems in reading.			
2.	Has problems in oral work.			
3.	Has problems in written work.			
4.	Has a poor self image.			
5.	Poor motivation e.g. no desire to learn a new task.			
6.	Perseveration - cannot stop an activity even after it is over & proceed to the next.			
7.	Clumsy - dropping and bumping into things			
8.	Always asking for help.			
9.	Difficulty in discriminating right from left & vice versa.			
10.	Low frustration tolerance - quick to lose interest when gets no success.			
11.	Completes work even when too much material is written on one sheet.			

		Yes	No	?
12.	Reversals of letters e.g. 'b' as 'd' etc.			
13.	Forgets easily - has a poor memory.			
14.	Makes no attempt to understand what is taught because he does not comprehend.			
15.	Always needs individual instructions.			
16.	Has difficulty in copying from the board.			
17.	Generally, has difficulty in the comprehension of the content.			
18.	Hyperactive - cannot sit in one place for more than two minutes.			
19.	Is able to attend in noisy room.			
20.	Has difficulty in giving answers in his own words.			
21.	Shows lack of reasoning in the answers given .			
22.	Meaningless preoccupation with certain behaviours e.g. shaking hands, feet etc.			
23.	Has frequent mood swings - sad, angry, happy etc.			
24.	Uneven or jerky movements of eyes.			
25.	Asks for words/sentences to be repeated often.			
26.	Attends quickly, purposively to verbal stimuli.			
27.	Is able to identify most of the letter sounds.			
28.	Exhibits tension, anxiety when attending to speech.			
29.	Comprehends a series of instructions given together.			
30.	Unable to grasp the central idea of the content.			

APPENDIX - VIII

PUPILS PERSONAL DATA SCHEDULE

Name :  
Class :  
School :  
Father's education level :  
Father's occupation :  
Mother's education level :  
Mother's occupation :  
Total family income :  
Number of children : Male :  
Birth order of the child : Female

APPENDIX X

The page features a grid of mathematical problems and icons. The problems are:  $12 + 10$ ,  $100 - 99$ ,  $2 + 3$ ,  $10 \times 54$ ,  $9 \times 9$ ,  $4 \times 57$ ,  $3 \times 9$ ,  $6 \times 6$ ,  $70 - 50$ ,  $9 - 3$ ,  $10 - 0$ ,  $54 + 34 =$ , and  $6 \times 9$ . The icons include: a box, an ice cream cone, a bird, a pear, a leaf, a candy, a sun, a cross, a deer, a cherry, a pencil, and a nut.

**REMEDIAL PACKAGE  
FOR DYSCALCULIC CHILDREN  
GUIDELINES FOR TEACHERS AND PARENTS**

## **CONTENTS**

**I. Learning Disability - Basic Concepts**

**II. Making Mathematics Teaching Simple**

**III. Principles in Remediation**

**IV. Remedial Intervention**

**V. Guidelines for Teachers and Parents**

## I. LEARNING DISABILITY - BASIC CONCEPTS

Specific learning disabilities have been recognized in some countries for much of the 20th century, in other countries only in the latter half of the century as in our country and yet not at all in other places. Even where they have been recognized, the amount of help available varies from no services to their universal provision. As our world becomes more complex, the knowledge base increases and the concepts more abstract and increasing number of people will experience difficulty and be assumed to have a learning disability.

Our challenge will be to alter teaching and parenting approaches so that the child's potential contribution is acknowledged. The concept of learning disabilities, characteristics, causes, problems, teaching strategies are detailed in the form of brochures and enclosed.

## II. MAKING MATHEMATICS TEACHING SIMPLE

Specific learning disabilities call for focussed instruction and guidance. One of the prominent learning disability relates to mathematics that is inevitably needed in everyday life.

Teachers play a key role in teaching mathematics to suit the development level and comprehensive ability of the children. Following pages describe teaching mathematics in a simple and clearcut manner.

Children at all levels in the primary school seem to present a wide range of number abilities and interests. In a typical class one may find children who have a sizable amount of mathematical knowledge and readiness for new work. Others in the same class have a vague, inaccurate mathematical background, a lack of ability to make normal progress.

Children today are no longer merely trying to memorize symbols, they are learning at a very early age the meaning of numbers by making practical use of available resources at their home and school situations and learning to think quantitatively. Mathematics has come to have such important place in our modern life that children need to understand it as a means for effective living.

### Readiness for number instruction

Readiness in mathematics, like readiness in any other fundamental learning process means that the child is ready to learn a new concept with meaning. It is now recognized that readiness in mathematics is a function not only of mental maturity and innergrowth but also of previous experiences, methods of learning, interests, attitude and purposes.

PIAGET (1965) describes several concepts basic to understanding numbers :

#### a. Classification

It is the process of understanding relationship such as likeness and differences - classifying objects according to colour, size, shape, function and so on.

Eg : a group of buttons / grouped according to colour, shape, size, etc.

#### b. Ordering and seriation

This is important for sequencing numbers. The teacher might display objects in a certain order and ask the child to arrange identical objects in the same order, or sequencing straws by length. Seriation

involves ordering items on the basis of change in a property such as length, size or colour.

Eg : teacher places small buttons in a tray one at a time and child places the same number of large buttons in the same manner - concept - does each tray have the same number of buttons ?

**c. Conservation**

Conservation means that the quantity of an object or the number of objects in a set remains constant regardless of partial arrangement.

Eg : pouring known volume of water into a tall thin tumbler and a low wide tumbler.

**Readiness for facts and concepts - at a higher level**

Once formal arithmetic instruction begins, the students must master operations and basic established principles. Operations include addition, subtraction, multiplication and division. Basic principles are less familiar. Alley and Deshler (1979) list the principles important for the learning disabled :

- a. **Commutative property of addition** : No matter what order the same numbers are combined in, the sum remains constant :

$$\begin{aligned} a + b &= b + a \\ 3 + 4 &= 4 + 3 \end{aligned}$$

- b. **Commutative property of multiplication** : Regardless of the order of the numbers being multiplied, the product remains constant :

- c. **Associative property of addition and multiplication** : Regardless of grouping arrangements, the sum or product is unchanged :

Addition :

$$\begin{aligned} (a + b) + c &= a + (b + c) \\ (4 + 3) + 2 &= 4 + (3 + 2) \end{aligned}$$

Multiplication :

$$\begin{aligned} (a + b) \times c &= a \times (b \times c) \\ (5 \times 4) \times 3 &= 5 \times (4 \times 3) \end{aligned}$$

- d. **Distributive property of multiplication over addition**: This rule relates the two operations

$$\begin{aligned} a (b + c) &= (a \times b) + (a \times c) \\ 5 (4 + 3) &= (5 \times 4) + (5 \times 3) \end{aligned}$$

- e. **Inverse operations** : These principles relate to operations that are opposite in their effects. The following equations demonstrate inverse operations.

*Addition and subtraction :*

$$\begin{array}{l} a + b = c \quad 5 + 4 = 9 \\ c - a = b \quad 9 - 5 = 4 \\ c - b = a \quad 9 - 4 = 5 \end{array}$$

*Multiplication and division :*

$$\begin{array}{l} a \times b = c \quad 9 \times 3 = 27 \\ c \div a = b \quad 27 \div 9 = 3 \\ c \div b = a \quad 27 \div 3 = 9 \end{array}$$

These several concepts help in basic understanding of numerical computations.

#### **Learning Difficulties in Mathematics - Common Errors**

It is quite common to observe children with difficulties in mathematics-to forget number facts, have difficulty in figuring out symbols and equations or rules in problem solving. They easily become overwhelmed by a number of problems on a page. It is also seen that these children do their sums in a rote fashion rather than recognize the many possible approaches leading to the same outcome. At times, the children may have difficulty understanding questions that are arranged horizontally rather than vertically.

Table below illustrates briefly some of the difficulties experienced by children in mathematics.

### Common Learning Difficulties in Mathematics

Conceptual areas	Learning difficulty
<b>PERCEPTUAL</b>	
Figure-ground	<ul style="list-style-type: none"> <li>- frequently loses place on worksheet</li> <li>- may not finish problems on a page</li> <li>- reading multi-digit number</li> <li>- differentiating between numbers (e.g., 6,9; 2,5; or 17,71) - coins</li> <li>- operation symbols,</li> <li>- copying shapes or problems</li> <li>- writing across paper in a straight line</li> </ul>
Discrimination	<ul style="list-style-type: none"> <li>- before - after concepts; problems with computations involving up-down (eg., addition) left - right (regrouping), problems aligning numbers in multiplication and division</li> </ul>
Spatial	<ul style="list-style-type: none"> <li>- putting decimals in right place</li> <li>- spacing manipulatives into patterns</li> <li>- using number line</li> <li>- understanding numbers(directional)</li> </ul>
<b>MEMORY</b>	
Short-term	<ul style="list-style-type: none"> <li>- retaining math facts</li> <li>- remembering all the steps in an algorithm</li> <li>- retaining the meaning of symbols</li> </ul>
Long-term	<ul style="list-style-type: none"> <li>- difficulty mastering facts over time</li> <li>- initial difficulty with problems during revision</li> <li>- forgets steps in algorithm</li> </ul>
Sequential	<ul style="list-style-type: none"> <li>- counting rationally</li> <li>- completing all steps in a multi-step computation problem</li> <li>- solving multi-step word problems</li> </ul>
<b>LANGUAGE</b>	
Receptive	<ul style="list-style-type: none"> <li>- relating arithmetic terms to meaning (e.g., minus, addend, dividend, regroup, multiplicand, place value) words that have multiple meanings (eg., carry over)</li> </ul>
Expressive	<ul style="list-style-type: none"> <li>- the vocabulary of arithmetic</li> <li>- oral drills in arithmetic</li> <li>- verbalizing steps in solving a word problem or an algorithm</li> </ul>

## BEHAVIOURAL PATTERNS

- |                 |   |
|-----------------|---|
| Impulsive       | <ul style="list-style-type: none"><li>- makes careless mistakes in computation</li><li>- responds incorrectly and rapidly in oral drills</li><li>- attending to detail in solving problems</li></ul>                              |
| Short attention | <ul style="list-style-type: none"><li>- completing work in assigned time, start a problem and not finish it,</li><li>- go to next problem, may frequently be off-task</li><li>- switching from one operation to another</li></ul> |
| Preservation    | <ul style="list-style-type: none"><li>- may work very slowly and go over work several times</li><li>- oral drills</li><li>- oral work problems</li><li>- counting on from within a sequence</li></ul>                             |
| Auditory        | <ul style="list-style-type: none"><li>- writing numbers of assignments from dictation</li><li>- hearing number patterns</li></ul>   |

## Difficulties of Learning Disabled Students Affecting Mathematics Performance

---

### Learning difficulty

### Problem

---

#### Reading Reasoning

- understanding the vocabulary of problems
- word problems
- comparisons of size, quantity
- symbols in math (e.g.  $>$ ,  $<$ ,  $x$ ,  $=$ )
- the abstract level of mathematical concepts and operations

#### Motor

- writing numbers legibly, with speed and accuracy
  - writing numbers in small spaces (ie., writes large)
- 

### Common errors

Lack of competence in the four computational skills (addition, subtraction, multiplication, division) account for 90 per cent of the difficulty experienced among children. In order to be more functional in these skill areas learning disabled students need a great deal of rehearsal and repetition to ensure that these skills become internalized and errors commonly made are virtually reduced. Below is a list of common arithmetic errors with a brief analysis along with a checklist for teachers and parents to identify the types of errors made in the four basic skill areas.

*Common Arithmetic Errors*

<i>S.No.</i>	<i>Analysis</i>	<i>Example</i>
1.	<i>Lacks mastery of basic facts</i>	
	<i>a. Addition</i>	$\begin{array}{r} 32 \\ +43 \\ \hline 74 \end{array}$
	<i>b. Multiplication</i>	$\begin{array}{r} 32 \\ \times 3 \\ \hline 86 \end{array}$
2.	<i>Subtracts incorrectly within the division algorithm</i>	$\begin{array}{r} 70 \\ \hline 3 \ 230 \\ -21 \\ \hline 10 \\ -9 \\ \hline 1 \\ \hline \end{array}$
3.	<i>Does not complete addition</i>	
	<i>a. Does not write whole number</i>	$\begin{array}{r} 85 \\ +43 \\ \hline 28 \\ \hline \end{array}$
	<i>b. Leaves out numbers in vertical addition</i>	$\begin{array}{r} 4 \\ 8 \\ 2 < \hline +3 \\ \hline 15 \end{array}$
4.	<i>Rewrites a numeral without computing</i>	$\begin{array}{r} \text{-->} 72 \\ +15 \\ \hline \text{-->} 77 \\ \hline \text{-->} 32 \\ \times 3 \\ \hline 36 \\ \hline \end{array}$

5. Does not complete subtraction
6. Does not complete division because of incompleting subtraction
7. Fails to complete division; stops at first partial quotient
8. Fails to complete division; leaves remainder equal to or greater than divisor
9. Confuses role of zero in subtraction with role of zero in multiplication
10. Subtracts top digit from bottom digit whenever regrouping is involved with zero in minuend
11. Confuses role of zero in multiplication with multiplicative identity
12. Lacks facility with addition algorithm :
- a. Adds units to units and tens:
- b. Adds tens to tens and hundreds:
- c. Adds units to tens and hundreds:
- 7) 397 (41  
40  
----  
7) 397  
-280  
----  
7  
----

7) 370 (5  
350  
----

9) 729 (80  
720  
----  
90  
----

37  
-20  
----  
10  
----

30  
18  
----  
28

7 x 0 = 7

37  
+2  
----  
59

342  
+36  
----  
678

132  
+ 6  
----  
798

- d. Is unable to add horizontally: 345 + 7 + 13 = 185  
 Thinks:  $3+7+1 = 11$ ; writes 1  

$$\begin{array}{r} 4+3 = 7 \text{ (+1 carried)} \\ 5 = 5 \end{array}$$
8  
5  
----  
185
- May add zero or one to make sum greater
13. Does not regroup units to tens 37  
+25  
----  
52
14. When there are fewer digits in subtraction:
- a. subtracts units from units and from tens (and hundreds) : 783  
-2  
----  
561  
----
- b. subtracts tens from tens and hundreds 783  
-23  
----  
560
15. Does not rename tens digit after regrouping 54  
-9  
----  
55
16. When two zeroes are involved renames hundreds twice but does not rename tens 700  
-326  
----  
284
17. Decreases hundreds digit by one when not necessary 371  
-134  
----  
137
18. Adds regrouped number to tens but does not multiply 35  
x 7  
----  
65\*  

$$\begin{array}{l} * 7 \times 5 = 35; \\ 30 + 30 = 60 \end{array}$$
19. Multiplies by only one number 457  
x 12  
----  
914
20. "Carries" wrong number 8  
67  
x 40  
----  
3220

21. Does not regroup; treats each column as separate addition example	23 + 8 ---- 211
22. Subtracts smaller digit from larger at all times to avoid remaining	273 -639 ---- 446

A brief list of error analysis checklist in the four areas of addition, subtraction, multiplication and division follows.

**Error analysis checklist in addition, subtraction, multiplication and division**

**Addition**

Errors in combinations	Disregarded column position
Counting	Errors in reading numbers
Added carried number last	Dropped back one or more tens
Forgets to add carried number	Derived unknown combination from familiar one
Repeated work after partly done	Disregarded one column
Added carried number irregularly	Error in writing answer
Wrote number to be carried	Carrying when there was nothing to carry
Irregular procedure in column	Added in pairs,
Carried wrong number	Added same digit in two columns
Grouped two or more numbers	Wrote carried number in answer
Split numbers into parts	Added same number twice
Used wrong fundamental operation	Omitted one or more digits
Lost place to column	
Depended on visualization	

**Subtraction**

Errors in combinations	Split numbers
Did not allow for having borrowed	Borrowed when not necessary
Errors due to zero in minuend	Ignored a digit
Said example backwards	Error due to digits being same
Failed to borrow; gave zero as answer	Used minuend as remainder
Added instead of subtraction	Reversed digits in remainder
Error in reading	Skipped one or more details
Used same digit in two columns	Increased digit after borrowing
Derived unknown from known combinations	Based subtraction on multiplication combination
Omitted a column	
Used trial and error addition	

## **Multiplication**

Errors in combinations  
Error in adding the carried number  
Wrote rows of zeros  
Carried a wrong number  
Errors in addition  
Forgets to carry  
Error in single zero combinations,  
zero as multiplier  
Errors due to zero in multiplier  
Used wrong process-added  
Error in single zero combinations,  
zero as multiplier  
Confused products when multiplier  
had two or more digits  
Multiplied by adding  
Did not multiply a digit in sum

Errors in reading numbers  
Omitted digit in product  
Errors in writing product  
Errors in carrying a zero  
Omitted digit in multiplier  
Errors due to zero in  
multiplicand  
Illegible figures  
Forgets to add partial products  
Split multiplier  
Multiplied by same digit twice  
Reversed digits in product  
Wrote the tables wrong

## **Division**

Errors in division combinations  
Errors in subtraction  
Errors in multiplication  
Used remainder larger than divisor  
Found quotient by trial multiplication  
Neglected to use remainder  
Omitted zero  
Counted to get quotient  
Repeated part of multiplication table  
Used short division form for long  
division  
Wrote remainders within problem  
Omitted zero resulting from zero  
Omitted final remainder  
Used long division form for short  
division

Grouped too many digits in  
dividend  
Error in reading  
Used dividend or divisor as  
quotient  
Found quotient by adding  
Reversed dividend and divisor  
Used digits of divisor  
separately  
Wrote all remainders at end of  
problem  
Misinterpreted table  
Used digit in dividend twice  
Used second digit of divisor to  
find quotient  
Began dividing at units digit of  
dividend

## **Developing Computational Skills**

There is something for everybody to gain from the "Universal Language", that is mathematics, the earlier a child is initiated to this 'world of order', the easier it would be for the child to imbibe the quality that the discipline symbolises.

While students with learning disabilities are usually first identified because of their reading problems, the correlation between reading and mathematics is high for many students. Both are languages. One primarily qualitative, the other quantitative. Mathematics demands the same essential features - knowledge of basic skills, conceptual

understanding and speed. Learning disabled students may have problems in one, two or three of these elements.

It has been estimated that lack of competence in the four computational skills (addition, subtraction, multiplication, division) account for 90 per cent of the difficulty experienced by adults in every day life. In order to be functional in these skills, LD students need a great deal of rehearsal, repetition, over-teaching and over-learning to ensure that these skills become internalized and come automatically to the student as needed. Learning these basic skills often become monotonous, it is important to include games, concrete and abstract materials, multisensory approaches and problems the students themselves bring to the learning situation. Most of the mathematical programs indicate an appropriate sequence that the teacher can follow. It is important, however, to discover at what point the student is having difficulty.

Counting is a necessary skill beginning for addition and multiplication. Counting by 1's 2's, 5's and 10's underly addition facts. Adding doubles ( $8+8$ ) is easier and faster than adding different numbers. Therefore, teaching LD students to manipulate numbers into doubles improves their accuracy and speed. Another important conversion is in any problem where a number can be converted to 10. Examples of this is changing  $9 + 6$  to  $10 + 5$ . A third conversion involves position. LD students need to understand that  $2 + 6$  is the same as  $6 + 2$  and that it is more efficient to count on to the bigger number i.e., 6, 7, 8, rather than 2, 3, 4, 5, 6, 7, 8.

Multiplication is even more dependent on counting than is addition. When students understand the relationship between counting and multiplication, their ability to quickly answer problems that involve these facts is improved. The following matrix involving zero to ten in counting and multiplication, increases the student's understanding of numbers and makes them less dependent on rote learning.

If multiplication is a problem for students, have them build this matrix beginning with the counting they already have mastered. This usually involves 1's, 2's, 3's, 5's and 10's. Next, teach them to count by 4's. Many students use their fingers while they count. In fact, it is useful for them to realise that using fingers can be quite appropriate. However, eventually they should discover that the problem with fingers is that they are slow.

Next, teach the nine times table. Many LD students think this is very difficult but in fact, the nine times table involves many cognitive aspects that help them to learn and remember it easily. Have the student look at the nines table separately to discover some of the relations between the numbers. First have them put down those products they already have inserted into the grid.

Show them that the number in the tens column increases from 0 to 9. While the number in the ones column decreases from 9 to 0. Another approach is to convert the 9 to 10, multiply by 10 and subtract the

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

MATRIX	SHOWING RELATIONSHIP BETWEEN COUNTING AND MULTIPLICATION										
	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	0
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36		54	60	
7	0	7	14	21	28	35		49	63	70	
8	0	8	16	24	32	40			64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

NINE TIMES GRID	
$9 \times 0 = 0$	
$9 \times 1 = 9$	$0 + 9 = 9$
$9 \times 2 = 18$	$1 + 8 = 9$
$9 \times 3 = 27$	$2 + 7 = 9$
$9 \times 4 = 36$	$3 + 6 = 9$
$9 \times 5 = 45$	$4 + 5 = 9$
$9 \times 6 = 54$	$5 + 4 = 9$
$9 \times 7 = 63$	$6 + 3 = 9$
$9 \times 8 = 72$	$7 + 2 = 9$
$9 \times 9 = 81$	$8 + 1 = 9$
$9 \times 10 = 90$	$9 + 0 = 9$

number to be multiplied. For example,  $9 \times 7 = (10 \times 7) - 7 = 70 - 7 = 63$ . Finally the student should always check the answer by adding the two numbers in the product, which should always add up to nine; if it does not, the answer is wrong and the student must do the problem again. This matrix may be pasted on the inside cover of the student's mathematics workbook for easy reference. The matrix can also be used to help LD students understand 'zero' since it is visually apparent that no matter how big the multiplicand is, if the multiplier is 'zero', the answer is 'zero'.

**a. Perceptual problems**

Some LD students mix up the symbols in calculations, ie.,  $\times$  read as  $+$ ,  $-$  read as  $/$ ,  $-$  read as  $=$ . Flash cards with these symbols prominently drawn and multisensory approaches are two useful approaches.

In assessment, analysis of the errors the LD student makes can pinpoint his or her problems. One that is frequently found in subtraction comes from inadequate teaching. A frequent instruction when teaching subtraction is to "Take the small numbers from the big one". While this is true in general, it is not always true when dealing with ones and tens in three digit numbers. These are examples of this type of error.

$$\begin{array}{r} 831 \quad 481 \\ -465 \quad -68 \\ --- \quad --- \\ 434 \quad 427 \end{array}$$

Helping a student with this problem is essentially reteaching subtraction including place value and borrowing. Thus, multisensory approaches, especially those that include concrete materials that the LD student can manipulate, are very helpful for students at all ages.

**b. Word problems**

Another difficulty the LD student has with both verbal problem and computations are the cluttered pages. This can be most easily remediated by reducing the number of questions per page, or by boxing them.

Many LD students think that mathematics is completely structured with only one method of finding an answer. A creative approach that can help LD students understand underlying aspects in mathematics involves attending to essential facts in problems and brainstorming a variety of possible solutions.

**MATHEMATICAL TERMS IN BASIC COMPUTATIONS**

Operation	Terms
Addition	8 - addend
	+4 - add
	----- 12 - sum
Subtraction (take away)	9 - minued
	-4 - subtract
	----- 5 - difference
Subtraction (add on)	19 - sum
	-4 - known addend
	----- 5 - missing addend
Multiplication	8 - multiplicand
	x5 - multiplier
	----- 40 - product
Division	8 - quotient
	----- 6) 49 - dividend
	divisor 48 ----- 1 - remainder

**Strategies and Components for Effective Mathematics Instruction**

Examining the mathematical deficits of students have resulted in a number of initial teaching and remediation methods incorporating Concrete - Representational - Abstract (CRA) teaching sequence. Implicit in this method is an emphasis on teaching students to understand the concepts of mathematics prior to memorising facts, algorithm and operations. Although the CRA sequence is widely advocated for mathematical learning, it is rarely used in a systematic manner during during instruction. The Strategic Math Series (SMA) (Mercer and Miller, 1991) provides a systematic means of CRA instruction.

According to the CRA sequence, instruction begins at 'concrete level' where the student uses three dimensional objects to solve computational problems. After successfully solving several problems at the concrete level, the student can proceed to the representational level.

At the representational <sup>on</sup> level, drawings are used to solve computational problems. For eg., in solving the problem  $7 \times 3$ , the student is instructed to look at the first number and draw that many groups using circles. Considering the next number 3, draw three tallies in each circles. The student then counts the tallies in the circles 21 to arrive at the answer. After successfully solving several multiplication problems at this level, the student begins to work at the abstract level.

At the abstract level, the student looks at the computation problems and tries to solve it using objects or drawings. The student reads the problems, thinks of a way to compute the answer and writes the answer.

No objects or drawings are used unless the student is able to answer a problem. Success in mathematics requires the ability to solve problems at the abstract level, therefore it is essential that students achieve mastery at this level.

### **Components of Effective Mathematics Instruction**

The following are some of the components to impart effective mathematics instruction to children with difficulties in mathematics.

#### **1. Select appropriate mathematics content**

Recommending reforms in the content of mathematics curriculum if required.

Answers not only in written work - but improve their ability to think critically and understand concepts, operation and real-life applications as important goals of the curriculum.

### **Some Components of Essential Mathematics**

#### **a. Problem solving**

Applying previously acquired information to new and different situations.

Solving both verbal and non-verbal problems.

#### **b. Communicating mathematical ideas**

Students should learn the language and notation of mathematics

Present mathematical ideas using manipulative objects, drawings, in writing and while speaking

c. **Applying mathematics to every day situation**

Students may be encouraged to translate daily experience into mathematical representations (ie., graphs, tables, diagrams, or experiences and interpret the results).

d. **Focusing on appropriate computational skills**

- Gain proficiency in using operations

(addition, subtraction, multiplication, division with whole numbers and decimals)

- Knowledge of basic facts is essential along with mental arithmetic skills)

2. **Establish goals and expectancies**

a. Setting instructional goals - based on students' learning needs

b. Students need a challenge rather than easy success,  
- difficult but attainable goals.

3. **Provide systematic and explicit instruction**

a. Demonstration - prompt and practise sequence, enhances the student's outcomes

b. Explicit instruction is important for facilitating positive academic growth

- involves highly organised, step by step procedure, identifies the target's, skill presentation

c. Effective instruction enables students to understand the direction and demands of the task

d. Systematic use of learning principles in effective instruction

- Negative student outcomes occur when attention is not maintained, Positive reinforcement is used, spaced and varied practice occurs and motivation is held high

Efficient teaching process involves - demonstration, guided practice with prompts, and independent practice with feedback

4. **Teach students to understand mathematics concepts**

The use of Concrete - Representational - Abstract (CRA) sequence, is an excellent way to teach students with learning problems to understand the concepts, operations and applications.

5. *Monitor progress*

- *Involves the teacher, frequently checking on the behaviour and academic work of students and making instructional adaptations based on observations*
- *Frequent monitoring is a key to student learning*

6. *Provide feedback*

- *Academic feedback is positively associated with student learning and is the best among the teacher behaviour for promoting positive learning outcome*

*Feedback is important in promoting the following student outcomes*

- \* *Mastery of content and skills for further learning*
- \* *Ability to study and learn independently,*
- \* *Plan and monitor learning activities*
- \* *Motivation for continued learning*
- \* *Confidence in one's ability as a learner*

7. *Teach to mastery*

*Mastery learning refers to teaching a skill to a level of automaticity. It provides numerous benefits such as :*

- \* *Improved retention and ability to compute higher level problems*
- \* *Finishing timed tests*
- \* *Receiving higher grades*
- \* *Developing positive feeling towards mathematics*

8. *Teach problem solving*

*Problem solving should be of top priority in mathematics instruction. It includes : components such as :*

- \* *Mathematical knowledge base*
- \* *Apply acquired knowledge to new situations*
- \* *Actively engage in thinking process*

9. *Teach generalization*

*This refers to performance of the targeted behaviour in different, non-training conditions.*

*Selected instructional practices include :*

- \* *Motivation to learn*
- \* *Periodic discussions with students*

- \* Variety of examples and experiences
- \* Skills to mastery level
- \* Solving problems pertinent to daily living

10. Promote a positive attitude toward mathematics

Many students with learning problems have a history of mathematical failures. Attitudes, beliefs and motivation play an important role in the learning of mathematics

According to Mercer and Miller (1992) selected guidelines include :

- \* Setting challenging but attainable goals
- \* Ensuring success
- \* Use progress charts to provide feedback
- \* Communicate positive expectations
- \* Model or illustrate positive attitude
- \* Reinforce students for more effort

The above components when implemented in remedial intervention leads to effective acquisition and mastery of computational skills.

### III. PRINCIPLES IN REMEDIATION

Lack of competence in the conceptual skill areas (addition, subtraction, multiplication and division) necessitates, learning disabled students to take up great deal of rehearsal, repetition over teaching and over learning to ensure that these skills become internalised and come automatically to the student as and when needed.

Since learning these skills often become monotonous, it is important to include games, concrete and abstract materials, multi-sensory approaches and problems the students themselves bring to the learning situation.

The general principles that relate to remediation for a dyscalculic are enlisted below :

Remediation is a determination of the reasons why a student has been unable or unwilling to tackle a task and is unable to meet behavioural and/or performance expectations. It is an analysis of how the task has been presented and the skills and background knowledge that are required to execute the task effectively. These analysis are the most important aspects of remediation and failure to do any task may have a variety of possible causes. Some of the questions one might ask are :

1. Does the child pay attention to, understand and remember what is expected of her/him ? Does s/he understand the language communicated?
2. Has s/he experienced many failures in the past that s/he afraid to attempt the task and fail, or to express her/himself lest s/he makes an error ?
3. Is the task - be it speaking, writing, an academic subject, motor co-ordination, a chore or a social activity - too complex for her/him or too overwhelming ?
4. Does s/he have a notion of how long the task will take and how to fit it into her/his schedule ? Does s/he reprioritize to ensure that important tasks and commitments are attended to on schedule ? Are the tasks completed ?
5. Does s/he have the prerequisite knowledge in doing the task. The LD child may have unexpected gaps in their knowledge. Is s/he aware of what zero means, of what a symbol represents, or what a formulae stand for.
6. Does s/he have the skills to do task such as the co-ordination skills to print or write, or the spelling skills ?
7. If s/he is unable to execute the task in the typical fashion, is s/he aware of alternative possibilities ?
8. Does s/he perceive the patterns such as  $(2 \text{ times } 4) = (4 \text{ times } 2) = (12 - 4)$  ?

9. In what kinds of situations and with which groups do the difficulties arise ?
10. What usually happens before the problem occurs ?

**Simple clues based on principles**

If modern - day education is going to educate the child to mathematical competency and understanding, the curriculum needs to be built upon the following basic principles.

1. **The child needs to discover, understand and master the various mathematical concepts**

For Eg : understanding the concept of number 4 would be indicated by such abilities as knowing that

4 is one more than 3	$3 + 4 = 4$
4 is one less than 5	$5 - 1 = 4$
4 is more than 0,1,2,3	
4 is less than 5,6,7,8	
4 is represented using symbols to represent a set such	

as 1111 = 4  
or  
0000 = 4

Mastering the concept of 4 in addition, subtraction multiplication, division.

2. **The child needs to discover, understand and master the various mathematical meanings**

Eg : knowing that 678 is 6 hundred 7 tens and 8 can also be represented as the number in a pocket chart, place value frame and on abacus.

Other aspects include knowing that addition and multiplication are combining actions, whereas subtraction and division are separating actions.

3. **Once the child's understanding of the how and why of arithmetic develops, he needs to work for automatic mastery to become skillful in the use of mathematics**

This means being able to compute, check results, measure accurately and describe various numerical situations.

4. **Throughout the entire instructional programme the development of problem - solving ability must be carried on**

Problems give purpose to the arithmetic instruction and are basic to the introduction and application of new concepts, facts and processes. All drill and practice exercises or sequences should involve problem solving.

Following are some of the activities that may be included :

#### Activity 1 : Volume

- Aim** : Measure the volume of different substances
- Materials required** : A glass measuring jar, a ball, stone, potato, egg, tomato - paper, pencil, graph paper.
- Method** : Put a small ball in the jar and cover it with water. Note the measure of volume of water reached on the jar. Next remove the ball and again note the measure of water. Subtract to find the volume of the ball.
- Conclusion** : Similarly take the measure for all other collected items. Finally enable the students make a graph of the same.

#### Activity 2 : Size and Weight

- Aim** : To find out the size of the objects when the weight is the same
- Materials** : Scale, weighing balance, measuring jar, china clay.
- Method** : Create different shapes using the given clay for eg., a very flat shape, a cube and slighter flatter one and finally make a note of the weight of the same.
- Conclusion** : The shapes thus made can then be put in a jar of water to measure the volume of the same.

#### Activity 3 : Weight

- Aim** : To make a guess of which is heavier by just looking at them. Check the closeness of the guess.
- Materials** : Balance, rice/dhal/sand/salt/popcorn/groundnuts / chalk etc.
- Method** : Take equal measurements of all the items mentioned above and weigh them. Check with the guess made.
- The weight of one's own classmates 10 of them can also be made in making a guess of who is heavier.
- Conclusion** : Helps in knowing the approximate weights of the various substances used daily in the household or in the classroom.

#### **Activity 4 : Measurement of length and height**

**Aim** : Measuring length of arms and height of students

**Materials** : Measuring tape, paper, pencil

**Method** : Initially help the students measure the length of the arm of 10 students in the class. Next measure their height using the same measuring tape standing against a wall if there is no proper measuring instrument. Similarly measure the length and breadth of doors and windows.

**Conclusion** : Enables gain in knowledge in approximate lengths and breadth of various items and students height.

#### **Manipulative Aids and Resources**

The earlier the people are made to realise that mathematics is the king of all arts and queen of all sciences and the earlier mathematics is considered and accepted as a creative subject of higher applicability, the better will be the quality of individual and social life.

Remediation cannot happen successfully without ample resource materials. Following pages project immunerable activities that could be conducted for experiential learning. Mathematical concepts come alive with clearly marked simple directions, appealing illustrations and a variety of self-motivating exercises. Working with well-graded worksheets at home or in school helps children to develop skills and to build confidence. Young children will love these exercises which instill the idea that learning is exciting, rewarding and fun.

While this series provides enough opportunity for gaining computational skill, no effort has been spared to help the child develop the faculty of thinking and reasoning.

#### **Use of manipulative aids**

- a. Prior to abstract experiences, instruction must proceed from concrete (manipulative) experiences to semi-concrete experiences
- b. Manipulative aids help students understand and develop images of mathematical processes
- c. The activity must accurately represent the actual process. For example, a direct correlation should exist between the manipulative activities and the paper - pencil activities
- d. More than one manipulative object should be used in teaching a concept

- e. The aid should be used individually by each student
- f. Manipulative experience must involve the moving of objects as learning occurs from the student's physical actions on the objects, and not from the objects.

The teacher can use a variety of resources/indigenous materials available in the environment to facilitate learning of mathematical concepts among children.

#### **Play materials/resources for teaching mathematics skills**

Listed below are some of the resource materials which have proved to be beneficial in developing mathematics skills among children.

Date calender, paper cups, tooth picks, tamarind seeds, ice cream cups and spoons, batteries, rexin - shape bits, clock representation, buttons in colours/shapes, pictures of cycles/bikes/cars chocolates/doll, etc., bottle caps, items that float/sink, measuring tapes, paper plates, paper napkins/ribbons, plastic spoons, containers with lids, marbles, small boxes, artificial flowers, balls of different sizes, advertisements - cycles/bikes/cars/chocolates/dolls, etc., cassettes, bamboo, drinking straws, coloured chalk, stones, pebbles, ribbons and clothes clip.

## GAMES

### *Games for Mathematical Concept Learning Introduced*

Games which are an integral part of play, constitute an invaluable component of education in childhood. Games provide movement, exercise concept learning and are also a form of recreation in addition to providing innumerable benefits to children.

Since play with education has emerged as a strategy to promote harmonious and holistic development of children, games can also contribute towards conceptual learning of mathematics.

Title of the game : Go hunting  
Materials required : A bowl, large number of buttons, pebbles  
Category : Individual

**Procedure:** Have large number of buttons/pebbles ready in a box. When its time to start the game, scatter all the button/pebbles on the floor. Tell the children that they have five minutes to collect as many pebbles/buttons as they can. Ask them to scramble for the buttons/pebbles. When the time is up, to enable the children add the buttons/pebbles collected by each one. The child who has collected the maximum number of pebbles/buttons, is the winner.

Title of the game : THREAD BEADS  
Materials required : Large/beads/buttons, thread  
Category : Individual

**Procedure:** Give each child ten or more beads/ buttons and a similar length of thread. The child who threads all the beads/buttons first and tells the total number is the winner. He/she receives applause from the classmates.

Title of the game : COLLECT MARBLES  
Materials required : Chalk piece, marbles/pebbles/ buttons/any one choosen  
Category : Individual

**Procedure:** A circle (cabout 30cm wide) is drawn on the floor. All children stand in a circle. Each child is given 1-2 marbles. 15-20 marbles are kept in the centre. A small circle is drawn around the marbles. Each child using the marbles given to her/him tries to displace the marble from the circle in the centre. The objects thus brought out of the circle is/are kept by the child. The child who is not able to knock of any marble from the circle, in the centre, has to keep her/ his marble in the centre. The child who has collected maximum number of marbles, is the winner.

Title of the game : GUESS THE NUMBER  
Values : Number concept and thinking  
Items required : Small twigs/sticks/bamboo  
Organisation : Group game  
Area : Indoor or outdoor

Description of the game: Each child is given five small twigs/bamboo. All are made to it in a circle. They will then transfer some or all of the five twigs into one hand, unseen by others. The children then start guessing the total number of twigs. The child whose guess is closest or equal to the number of the total twigs is the winner.

Rules of the game : 1. Each student is given only five twigs/sticks  
2. All children must keep their palms closed till the last child guesses the number  
3. Numbers once said should not be repeated

Title of the game : MONEY GAME'  
Values : Concepts of mathematics and money  
Items required : Coins of one rupee, five and ten paise.  
Organisation : Four in a team  
Area : Indoor/outdoor

Description of the game: Each team is given four coins which is distributed in the team. Instructions are given by the teacher which should be followed. For example, add five, multiply ten, add one, subtract fifty. The team finishing first is the winner.

Rules of the game : 1. Calculation may be done on paper  
2. There should be no confusion  
3. Each child gets a coin each  
4. Teacher's decision is considered final

Title of the game : GROUP THE DOTS  
Materials required : Cardboard pieces, coloured paper  
Category : Team

Procedure: Cut the cardboard into equal number of circles, triangles, squares, diamonds and rectangles, stick colour paper on the pieces and provide each team with equal number and the same type of pieces. Mark one dot on some pieces, two dots on some pieces, three on some, four on some and five and so on some pieces. Make sure that there are equal number of pieces of each type (ie., equal number of one dot pieces, two dot

#### IV. REMEDIAL INTERVENTION

For a group of children in this study (N = 18) remedial intervention was offered. The various intervention strategies used are detailed below :

##### Remedial intervention used for dyscalculic children (First phase)

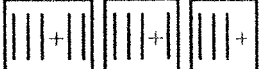



Mathematical concept	Manipulative resources	Activity
<b>A. CLASSIFICATION</b>		
<p><b>1. Sorting</b></p> <p>a. Give students objects that differ in one attribute eg., colour,</p> <p>b. At advanced level, increase the complexity of the classification in any 2 or 3 qualities/attributes</p>	<p>Coloured chalks, beads straw, bamboo,</p> <p>Buttons, drinking straws, ribbons</p>	<p>Sort the given chalks by colour and put them in the tray</p> <p>Sort the given buttons by size shape and colour.</p>
<p><b>2. Matching and sorting</b></p> <p>The first step in the development of number concept is the ability to focus on and recognize a single object or shape</p>	<p>A collection of assorted objects, beads, blocks, seeds, pulses, nuts</p>	<p>Choose only objects of round shape</p>
<p><b>3. Recognition of groups</b></p> <p>Develop competency in the above concepts</p>	<p>Assorted objects to enable grouping</p>	<p>Pile together objects that can be grouped to your choice</p>
<p><b>4. Number stamp</b></p> <p>Make a set of numerals with matching dots</p>	<p>Paint colours, at the end of a pencil or chalk</p>	<p>*Students asked to make matching dots using colours for the numbers written on cards</p>
<b>B. ORDERING</b>		
<p>1. Serial order and relationships</p> <p>Concept - Before After Inbetween</p> <p>Seriation-First Second Third Last</p>	<p>Pebbles, shells leaves, flowers petals, seeds</p> <p>Flowers, stones chalks, dolls</p>	<p>*State the number Before 6 After 8 Inbetween 9-11</p> <p>Size - big, small Weight - heavy, - light</p>

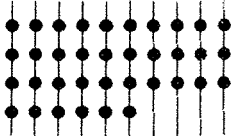
Mathematical concept	Manipulative resources	Activity
<p>Order by size, colour, weight, volume</p> <p>2. Many lines with chalk offered and exercises provided to develop number concepts</p> <p>3. Pattern games Opportunities are provided to discover patterns selecting the objects in a series</p> <p>4. Relationship between concept of size and length, compare and contrast between sizes, shapes provided</p>	<p>Glass of water or sand</p> <p>Draw chalk lines indicating</p> <hr/> <p>* 1 2 3 4 5 6</p> <hr/> <p>* 10 20 30 40 50 60 a line of blocks</p> <hr/> <p>* 100 200 300 400 500 600 a line in sand.</p> <p>Colour symbols, cut outs of shapes, numerals from calendars provided</p> <p>Thermocol shapes, trees, bases, (big/small), paper clips, clothes clips, screws, nails, buttons</p>	<p>Volume- indicate more-less on measuring known volume of water or sand</p> <p>*Number lines when touched, walked upon or jumped upon provides a helpful understanding in using symbols, numerals and their relationships</p> <p>Develop patterns using different colours</p> <p>* Compare objects in terms of shape, size, colour, texture and purpose</p>
<b>C. ONE TO ONE CORRESPONDENCE</b>		
<p><b>1. Pairing</b> This provides a foundation for counting by matching one object with another</p> <p><b>2. Counting</b> Provide motor activities for counting</p> <p><b>3. Recognition of numbers</b> *Recognize the numbers  *Recognize the printed numbers in words</p>	<p>Pairing objects in the kitchen eg. spoons, forks, tumblers, plates Setting a dining table</p> <p>Observing at any visual or auditory stimuli, provided</p> <p>Listening, pointing to objects, skipping objects, counting in 2's 3's, 4's and 5's using ice cream cups, spoons, bamboo sticks as indicated</p> <p>Objects, felt cardboard, sand paper</p> <p>Scale, ruler measuring tape, weighing balance rupees, coins given to develop</p> <p>*Use colour variation for concept development</p>	<p>*Arranged a row of spoons, ask the student to match spoons with the pre-arranged row Provide this experience of setting the dining table</p> <p>Stringing beads and counting the total number by colour shape and size. Placing clothes clips in required numbers. Print numbers on cups to fill required number of objects</p> <p>Match the correct printed number with the number of objects or along printed numerals</p> <p>Measure height and weight of individual students and write in words. Length of tables, doors, windows, blackboard measured and noted</p>

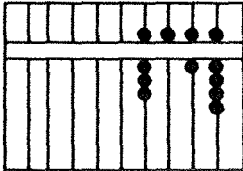
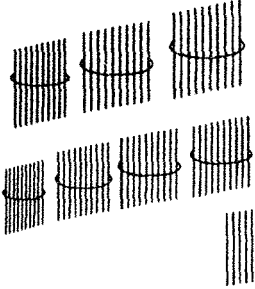
**Remedial intervention used for dyscalculic children (Second phase)**

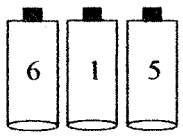
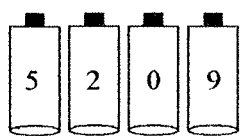
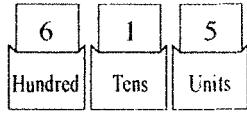
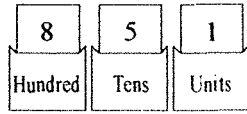
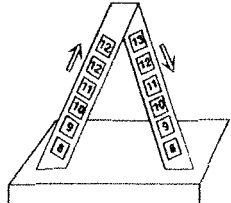
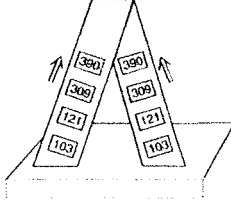
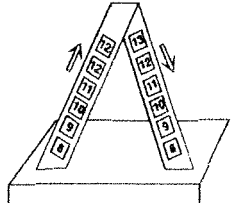
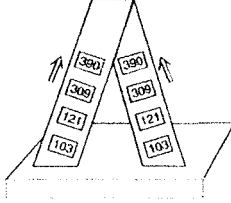
PROBLEM	ERROR	REASON	STRATEGY
<b>Mirror writing or rotation of numbers</b>			
2	5	Lack of concentration	Torch light tracking
3	ε		Writing in air
5	2	Poor identification of numbers	Writing in sand
6	e\9	Poor pre - writing skills	Writing on the back
7	7		a. behind one's (neighbours) shoulders
9	e	Poor handwriting skills	b. on one's hand
		Awkward writing position	c. spread coloured/ plain sand - sand paper surfacing.
		Difficulty in numerical writing	
		Poor visual orientation	
		Perceptual problems	
<b>Reversing digits</b>			
12	21	Poor memory	Torch light tracking
16	61	Poor concept of numerals	Writing in air
17	71		Writing in sand
19	91	See them reversed	Writing on the back
		Perceptual reading problem	a. behind one's (neighbours) shoulders
		Inability to put thought in writing	b. on one's hand
		Poor retention of what has been studied for sequencing	c. Spread coloured plain sand - sand paper surfacing.



PROBLEM	ERROR	REASON	STRATEGY
<b>Numerals</b> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">Addition facts of zero</div> $3 + 0$ $2 + 0$ $1 + 0$ $0 + 0$	$3 + 0 = 0$  $1 + 0 = 0$	Unclear concept  Poor orientation to addition facts  Problem with zero	 $3+2=5$ $3+1=4$ $3+0=3$   $2+0=2$ $1+0=1$ $0+0=0$  ★ Take two piles of drinking straws reduce one pile by removing one by one giving the sum each time. ★ Next remove the straw from the existing pile giving the sum of the counts.
<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">Multiplication facts of zero</div> $4 \times 0$ $2 \times 0$ $3 \times 0$ $1 \times 0$	$4 \times 0 = 4$  $3 \times 0 = 3$	Poor concept orientation  Poor knowledge of multiplication facts	 $4 \times 2 = 8$ $4 \times 1 = 4$ $4 \times 0 = 0$   $3 \times 0 = 0$ $2 \times 0 = 0$ $1 \times 0 = 0$ $0 \times 0 = 0$  ★ From the criss cross placement of the pencils/sticks/straws reduce one pile by removing one by one giving the sum at each stage. ★★ In the second stage, remove the vertical pencils/stick one by one giving the multiplication fact. ★ This is called the flow technique and the effect of this type of "hands on experience" learning inevitably leads to correct solutions





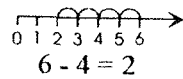
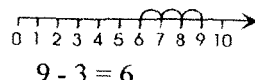
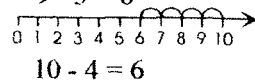
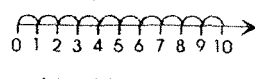
PROBLEM	ERROR	REASON	STRATEGY																																				
<b>Writing in words</b>																																							
0	Zour, 0	- Perceptual problem	ELEVEN TEN																																				
12	Twlve	- Grammatical error	TWELVE TWENTY																																				
19	Ninteen	- Poor retention of what has been studied	THIRTEEN THIRTY																																				
36	Thiraty six	- Inability to put thoughts into writing	FOURTEEN FORTY																																				
40	Fourty	- Tendency to omit words	FIFTEEN FIFTY																																				
50	Fivety	- Poor handwriting	SIXTEEN SIXTY																																				
96	Ninty six, Nintey six	- Poor vocabulary skill	SEVENTEEN SEVENTY																																				
108	Hunder eight	- Deficiency in the ability to learn things in a sequence.	EIGHTEEN EIGHTY																																				
214	Two hunder fourty, Twenty one hunder one fourty	- Confusion regarding place value	NINETEEN NINETY																																				
370	Three hunder seventy, three seventy	- Spelling error	TWENTY HUNDRED 																																				
<b>Place value</b>																																							
4020	4000020	- Disorganisation	a) In columns and rows																																				
110	10010	- Difficulty in understanding place value	<table border="1" data-bbox="1185 1433 1436 1720"> <thead> <tr> <th>C</th> <th>L</th> <th>TH</th> <th>H</th> <th>T</th> <th>U</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>4</td> <td>0</td> <td>2</td> <td>0</td> </tr> <tr> <td></td> <td></td> <td></td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td></td> <td></td> <td>40</td> <td>2</td> <td>0</td> <td>1</td> </tr> <tr> <td></td> <td>7</td> <td>24</td> <td>5</td> <td>4</td> <td>3</td> </tr> <tr> <td>4</td> <td>32</td> <td>76</td> <td>5</td> <td>1</td> <td>9</td> </tr> </tbody> </table>	C	L	TH	H	T	U			4	0	2	0				1	1	0			40	2	0	1		7	24	5	4	3	4	32	76	5	1	9
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		40	2	0	1																																		
	7	24	5	4	3																																		
4	32	76	5	1	9																																		
40209	40201	- Serious inability to spell																																					
724543	7245043	- Poor orientation																																					
43276519	432706519	- Poor directionality																																					
615250		- Movement right to left is difficult to comprehend																																					
21800050																																							
1569852																																							
810960																																							

PROBLEM	ERROR	STRATEGY	
<p>Place value [continued]</p> <p>a. 75</p> <p>b. 105</p> <p>c. 165</p> <p>d. 1065</p> <p>e. 2605</p> <p>f. 1288</p>		<p>Using bamboo sticks or drinking straws</p> <p>Step 1 : Give a few bamboo sticks/straws to the students</p> <p>Step 2 : Bundles of 10's are to be made</p> <p>Step 3 : To make 70/ seven bundles of 10's are kept aside and for 5-five single sticks are selected to make 75.</p> <p>Step 4 : For 100's bundles of 100's are made and similarly the sum 165 can be made</p> $165 = 100\text{'s } (1) + 10\text{'s } (6) + 5 = 165 \text{ is made}$ <p>a) Using abacus</p>  <p>Th H T U</p> <p>Eg. : 8569</p>	<p>b) Tying bundles</p> <p>L TH H</p> <p>(6) (15) (250)</p> <p>C L TH H</p> <p>(2) (18) (00) (050)</p> <p>L TH H</p> <p>(15) (69) (852)</p> <p>L TH H</p> <p>(8) (10) (960)</p> <p>c) Positioning</p> <p>1 0 6 5</p> <p>2 6 0 5</p> <p>1 2 8 8</p> <p>1000 200 80 8</p> <p>d) Using different colours for different bundles</p> 

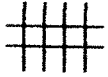
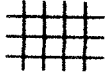


PROBLEM	ERROR	REASON	STRATEGY
<p><b>Writing in numbers:</b></p> <p>Six hundred and fifteen</p> <p>Eight hundred and fifty one</p> <p>Two thousand and fifty two</p> <p>Four thousand two hundred and thirty</p> <p>Five thousand two hundred and nine</p>	<p>6015</p> <p>8051</p> <p>20052, 2, 252, 200052</p> <p>400530, 450030, 405030, 400050030</p> <p>529, 502009, 5000209</p>	<p>Poor concept of place value</p> <p>Lack of continuous drill</p> <p>Poor vocabulary</p> <p>Poor reading ability</p> <p>Confusion in place value</p>	<p>i) Used tins or cans</p> <p>615</p>  <p>5209</p>  <p>ii) Inserters in boxes</p>  <p>615</p>  <p>851</p> <p>Use of</p> <p>1) Ascending and descending ladder</p>  
<p><b>Ascending and descending order</b></p> <p>Write any 5 numbers that are</p> <p>a) Lesser than 12</p> <p>b) Lesser than 18</p> <p>Arrange in increasing order</p> <p>a) 103, 390, 309, 121</p> <p>b) 6049, 2234, 6120, 2078</p>	<p>2, 3, 4, 5, 1</p> <p>14, 16 10, 8, 6</p> <p>12, 13, 16, 14, 15</p> <p>18, 19, 22, 24</p> <p>18, 19, 20, 21, 22</p> <p>390, 309, 121, 103</p> <p>309, 390, 103, 121</p> <p>2078, 2079, 2089</p> <p>6049, 2078, 6120</p>	<ul style="list-style-type: none"> <li>- Difficulty in understanding the concept</li> <li>- Disorganisation</li> <li>- Short attention span</li> <li>- Inability to follow oral directions</li> <li>- Failing to learn theory through examples</li> <li>- Confusion in terms of increasing or decreasing numbers</li> </ul>	<p>Use of</p> <p>1) Ascending and descending ladder</p>  






PROBLEM	ERROR	REASON	STRATEGY
<div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 10px;">Additions facts</div> $\begin{array}{r} 4 + 2 \\ 4 + 4 \\ 5 + 2 \\ 5 + 5 \end{array}$	$\begin{array}{r} 4 + 2 = 5 \\ 4 + 4 = 0 \\ 5 + 2 = 4 \\ 5 + 5 = 11 \end{array}$	<ul style="list-style-type: none"> <li>- Lack of concept of symbols</li> <li>- Unable to read the symbol</li> <li>- Inability to learn things in a sequence</li> <li>- Awkwardness in self expression</li> <li>- Lack of number concept</li> <li>- Poor retention of what has been studied</li> <li>- Short attention span</li> <li>- Lack of co-ordination</li> <li>- On horizontal line addition facts are more difficult to comprehend</li> </ul>	<p>Use of straws/ bamboo/Chalk/ paperstrips/match sticks</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> </div>
<div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 10px;">Additions facts</div> $\begin{array}{r} 5 \\ +6 \\ +3 \\ \hline 11 \end{array}$ $\begin{array}{r} 24 \\ +37 \\ \hline 60 \end{array}$ $\begin{array}{r} 56 \\ +28 \\ \hline 86 \end{array}$	$\begin{array}{r l} 5 & 5 \\ +6 & +6 \\ +3 & +3 \\ \hline 11 & 9 \end{array}$ $\begin{array}{r l} 24 & 24 \\ +37 & +37 \\ \hline 60 & 34 \end{array}$ $\begin{array}{r} 56 \\ +28 \\ \hline 86 \end{array}$	<p>Poor number concept</p> <p>Lack of continuous drill</p> <p>Poor concept in the use of symbols and signs</p> <p>Poor addition skills</p> <p>Directionality - problems solved from left to right</p>	$\begin{array}{r} 5 \text{     } \\ +6 \text{      } \\ +3 \text{    } \\ \hline 14 \text{      } \end{array}$ $\begin{array}{r} 24 \\    +37 \text{     } \\     \hline 61 \text{      } \end{array}$ $\begin{array}{r} 56 \\      +28 \text{      } \\    \hline 84 \text{      } \end{array}$

PROBLEM	ERROR	STRATEGY																															
$\begin{array}{r} 32 \\ 25 \\ \hline 46 \end{array}$ <p>Add 15+27</p>	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td>32</td><td>32</td></tr> <tr><td>25</td><td>25</td></tr> <tr><td>46</td><td>46</td></tr> <tr><td>96</td><td>911</td></tr> </table> <p>15 + 27 = 35</p>	32	32	25	25	46	46	96	911	$\begin{array}{r} \text{III } 32 \text{ II} \\ \text{II } 25 \text{ IIII} \\ \text{III } 46 \text{ IIIII} \\ \hline 103 \end{array}$ <p>Step I</p> <table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr><th>Tens</th><th>Ones</th></tr> </thead> <tbody> <tr><td>1</td><td>5</td></tr> <tr><td>2</td><td>7</td></tr> </tbody> </table> <p>Think 5+7 = 12 12 = 1 ten + 2 ones</p>	Tens	Ones	1	5	2	7	<p>Step II</p> <table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr><th>Tens</th><th>Ones</th></tr> </thead> <tbody> <tr><td>1</td><td>5</td></tr> <tr><td>2</td><td>7</td></tr> </tbody> </table> <p>Step III</p> <table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr><th>Tens</th><th>Ones</th></tr> </thead> <tbody> <tr><td>1</td><td></td></tr> <tr><td>1</td><td>5</td></tr> <tr><td>2</td><td>7</td></tr> <tr><td>4</td><td>2</td></tr> </tbody> </table>	Tens	Ones	1	5	2	7	Tens	Ones	1		1	5	2	7	4	2
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<p>Add 17+18 =</p>	<p>17 + 18 = 25</p>	<p>First add the tens and ones separately. Then if there are more than nine ones exchange ten ones for one ten.</p> <p>Before the exchange</p>	<table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr><th>Tens</th><th>Ones</th></tr> </thead> <tbody> <tr><td>○○○○○○○○○○</td><td>○○○○ ○○</td></tr> <tr><td>○○○○○○○○○○</td><td>○○○○ ○○○</td></tr> </tbody> </table> <p>17 = 1 ten + 7 ones 18 = 1 ten + 8 ones</p> <hr/> <p>17+18 = 2 tens + 15 ones</p> <table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr><th>Tens</th><th>Ones</th></tr> </thead> <tbody> <tr><td>○○○○○○○○○○</td><td>○○○○ ○○</td></tr> <tr><td>○○○○○○○○○○</td><td>○○○○ ○○○</td></tr> </tbody> </table> <p>After the exchange</p> <p>17+18 = 2 tens + 15 ones = 3 tens + 5 ones = 35</p>	Tens	Ones	○○○○○○○○○○	○○○○ ○○	○○○○○○○○○○	○○○○ ○○○	Tens	Ones	○○○○○○○○○○	○○○○ ○○	○○○○○○○○○○	○○○○ ○○○																		
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PROBLEM	ERROR	REASON	STRATEGY
Subtraction			
4 - 3	4 - 3 = 3	Misconception Confusion Lack of attention Poor concept of symbols	Using bamboo/ straw/ice cream spoons
5 - 3	5 - 3 = 8		 4 - 3 = 1
7 - 5	7 - 5 = 3		 5 - 3 = 3
8 - 4	8 - 4 = 5		 7 - 5 = 2  8 - 4 = 4
			e.g.  Using number line when we count backwards we subtract
6 - 3	9 - 3 = 5	Problems with zero	 6 - 4 = 2
10 - 4	10 - 4 = 14		 9 - 3 = 6
10 - 10	10 - 10 = 12	Difficulty in carrying over	 10 - 4 = 6  10 - 10 = 0
51 -30 -----	51 -30 ----- 20	Difficulty in getting proper change after monetary transactions	a) Using seeds or buttons  ●●●●● 51 ● -30 ----- 21
66 -66 -----	66 -66 ----- 126	Adds for subtraction without taking into account the symbol involved	●●●●●● 66 ●●●●●● -66 ----- 00
77 -26 -----	77 -26 ----- 91		

PROBLEM	ERROR	REASON	STRATEGY										
Subtraction (continued) $\begin{array}{r} 86 \\ -42 \\ \hline \end{array}$	$\begin{array}{r} 86 \\ -42 \\ \hline 123 \\ \hline \end{array}$	No knowledge of regrouping	b) Using colour differentiation										
$\begin{array}{r} 108 \\ -79 \\ \hline \end{array}$	$\begin{array}{r} 108 \\ -79 \\ \hline 31 \\ \hline \end{array}$	Alternates columns. Problems with directionality	$\begin{array}{r} 77 \\ -26 \\ \hline 64 \\ \hline \end{array}$										
		Zero concept poor Place value error	$\begin{array}{r} 86 \\ -42 \\ \hline 44 \\ \hline \end{array}$										
			$\begin{array}{r} 108 \\ -79 \\ \hline 29 \\ \hline \end{array}$										
Subtract $\begin{array}{r} 43 \\ -17 \\ \hline \end{array}$	$\begin{array}{r} 43 \\ -17 \\ \hline \end{array}$	$\begin{array}{r} 43 \\ -17 \\ \hline 510 \\ \hline \end{array}$	Another method $43 = 4 \text{ tens} + 3 \text{ ones}$ $17 = 1 \text{ ten} + 7 \text{ ones}$ To take away 17 we must take away 1 ten and 7 ones										
		Before the exchange	<table border="1"> <thead> <tr> <th>Tens</th> <th>Ones</th> </tr> </thead> <tbody> <tr> <td>□□□□□□□□</td> <td>□□□</td> </tr> <tr> <td>□□□□□□□□</td> <td></td> </tr> <tr> <td>□□□□□□□□</td> <td>□□□□</td> </tr> <tr> <td>□□□□□□□□</td> <td>□□□□</td> </tr> </tbody> </table>	Tens	Ones	□□□□□□□□	□□□	□□□□□□□□		□□□□□□□□	□□□□	□□□□□□□□	□□□□
Tens	Ones												
□□□□□□□□	□□□												
□□□□□□□□													
□□□□□□□□	□□□□												
□□□□□□□□	□□□□												
		After the exchange	To have enough ones so that we can take away 7 ones exchange one ten for ten ones. The exchange is in average Cross out a ten and draw 10 ones $\begin{array}{r} 43 = 3 \text{ ten} + 13 \text{ ones} \\ 17 = 1 \text{ ten} + 7 \text{ ones} \\ \hline 43-17 = 2 \text{ tens} + 6 \text{ ones} \\ \hline = 26 \end{array}$										

PROBLEM	ERROR	REASON	STRATEGY
Multiplication			
2 x 4	2 x 4 = 6	Cannot bring tables to memory and repeat sequentially	 2 x 4 = 8
3 x 3	3 x 3 = 6		 3 x 3 = 9
4 x 3	4 x 3 = 7		 4 x 3 = 12
3 times multiplication:		Rigidity of thought Poor concept Lack of drill Poor memory Confusion due to lack of clarity	Using bamboo sticks/ match sticks/ ice cream spoons
3 x 3	3 x 3 = 6		 3 x 1 3 x 1 3 x 1
3 x 7	3 x 7 = 20		
3 x 8	3 x 8 = 25		
			<p>Step 1 : Some bamboo sticks are given to the students and made to tie bundles of 3 each</p> <p>Step 2 : Each bundle of 3 sticks is then counted as follows - Taking the first bundle of 3  <math>3 \times 1 = 3</math> ie <math>1 + 1 + 1 = 1 \times 3 = 3</math></p> <p>Taking two bundles it becomes <math>3 + 3 = 6</math>  or <math>3 \times 2 = 6</math>  or <math>1 + 1 + 1 = 3</math>  <math>3 \times 2 = 6</math>  <math>1 + 1 + 1 = 3</math></p> <p>Similarly three bundles becomes <math>3 \times 3 = 9</math> for verification of the answer, the student can check as follows:</p> <p><math>3 \times 4 = 12</math> (<math>3 + 3 + 3 + 3 = 12</math>) as one takes four bundles of 3 sticks each.</p>

PROBLEM	ERROR	REASON	STRATEGY
<b>Multiplication</b> (continued) $\begin{array}{r} 23 \\ \times 3 \\ \hline \end{array}$	$\begin{array}{r} 23 \\ \times 3 \\ \hline 66 \end{array}$	Cannot carry digits	  
$\begin{array}{r} 23 \\ \times 4 \\ \hline \end{array}$	$\begin{array}{r} 23 \\ \times 4 \\ \hline 812 \end{array}$	Incorrect processing	<div style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block;"> <math>2 \times 3 = 6 \text{ tens}</math>  <math>3 \times 3 = 9 \text{ ones}</math> </div> $\begin{array}{r} 2 \times 3 \text{ tens} = 60 \\ 3 \times 3 \text{ ones} = 9 \\ \hline 69 \end{array}$
$\begin{array}{r} 32 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 32 \\ \times 2 \\ \hline 54 \end{array}$	Place value problem	  <div style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block;"> <math>2 \times 3 \text{ tens} = 6 \text{ tens}</math>  <math>2 \times 2 \text{ ones} = 4 \text{ ones}</math> </div> $\begin{array}{r} 2 \times 3 \text{ tens} = 60 \\ 2 \times 2 \text{ ones} = 4 \\ \hline 64 \end{array}$
<b>Division</b>			
$2 \overline{)8}$	$\begin{array}{r} 8 \\ 2 \overline{)8} \\ \underline{8} \\ 0 \end{array}$	Carelessness Place value problem Sequencing problem Error in copying	$\begin{array}{r} 4 \\ 2 \overline{)8} \\ \underline{8} \\ 0 \end{array}$
$3 \overline{)9}$	$\begin{array}{r} 3 \\ 3 \overline{)9} \\ \underline{6} \\ 3 \end{array}$	Poor concept Difficulty in memorising tables	$\begin{array}{r} 3 \\ 3 \overline{)9} \\ \underline{9} \\ 0 \end{array}$
$4 \overline{)12}$	$\begin{array}{r} 1 \\ 4 \overline{)12} \\ \underline{4} \\ 4 \end{array}$		$\begin{array}{r} 3 \\ 4 \overline{)12} \\ \underline{12} \\ 0 \end{array}$

PROBLEM	ERROR	REASON	STRATEGY
Division (Continued)  $4 \overline{)86}$	$  \begin{array}{r}  41 \\  4 \overline{)86} \\  \underline{41} \\  24 \\  \underline{24} \\  0  \end{array}  $	Does not know to use reminders Place value difficulty at the quotient level. Records the quotient first digit in the ones place	$  \begin{array}{r}  21 \\  4 \overline{)86} \\  \underline{8} \\  6 \\  \underline{4} \\  2  \end{array}  $
$7 \overline{)473}$	$  \begin{array}{r}  19 \\  7 \overline{)473} \\  \underline{7} \\  73 \\  \underline{73} \\  0  \end{array}  $	Does not record zero after dividing a number	$  \begin{array}{r}  67 \\  7 \overline{)473} \\  \underline{42} \\  53 \\  \underline{49} \\  4  \end{array}  $
$8 \overline{)72}$	$  \begin{array}{r}  7 \\  8 \overline{)72} \\  \underline{56} \\  4  \end{array}  $		$  \begin{array}{r}  9 \\  8 \overline{)72} \\  \underline{72} \\  0  \end{array}  $

PROBLEM	ERROR	REASON	STRATEGY
Division (Continued)  $5 \overline{)285}$	$\begin{array}{r} 417 \\ 5 \overline{)285} \\ \underline{20} \\ 8 \\ \underline{5} \\ 35 \\ \underline{35} \\ 0 \end{array}$	Sequencing problem  Missing steps while dividing  Poor place value concept  Confusion in subtraction  Basics poor.	Divisor = Number used for dividing Dividend = Number to be divided by the divisor  Using bamboo Step 1 : The problem is first written down on paper Step 2 : Check if the first digit in the dividend is greater than divisor 5 or less than that Step 3 : Since it is less than 5 the next digit is to be considered. The number then to be divided is 28. Step 4 : Each student is given 28 bamboo sticks, the divisor being 5, they are asked to make maximum bundles each containing 5 bamboo sticks. Each can then make only 5 bundles with 3 bamboos remaining thus $28 \div 5 = 5(5) + 3$ $\begin{array}{r} 5 \\ 5 \overline{)285} \\ \underline{25} \\ 35 \end{array}$  Step 5 : The student then brings down the remaining digit (5) in the dividend writing it exactly next to the remainder (3)  Step 6 : Each student should then be given 35 bamboos thus again making maximum bundles of 5 each. Each student then makes exactly 7 bundles ie $7 \times 5 = 35$ $5(7) = 35$
		Answer :  $\begin{array}{r} 57 \\ 5 \overline{)285} \\ \underline{25} \\ 35 \\ \underline{35} \\ 0 \end{array}$	

Concept of place value - simple clues :

Ten thousand	10,000	20,000	30,000	40,000	50,000
Thousands	1000	2,000	3,000	4,000	5,000
Hundreds	100	200	300	400	500
Tens	10	20	30	40	50
Units	1	2	3	4	5

Place value concept in ascending and descending order used:

Ascending Order

Unit	Tens	Hundreds	Thousands	Ten thousands
0	0	0	0	0
1	10	100	1000	10000
2	20	200	2000	20000
3	30	300	3000	30000
4	40	400	4000	40000
5	50	500	5000	50000
6	60	600	6000	60000
7	70	700	7000	70000
8	80	800	8000	80000
9	90	900	9000	90000

Decending Order

Ten thousands	Thousands	Hundreds	Tens	Units
10000	1000	100	10	1
20000	2000	200	20	2
30000	3000	300	30	3
40000	4000	400	40	4
50000	5000	500	50	5
60000	6000	600	60	6
70000	7000	700	70	7
80000	8000	800	80	8
90000	9000	900	90	9

### Indian System

It will be easy to learn arithmetics if numbers are introduced to the children, as shown in the chart. Begin the counting from the right side i.e., from units (avoid sequential numbers after ten). Guide the children to construct multi-digit numbers gradually. It is the easy, fast and better technique to introduce numbers to students.

### Indian System

Crores	Ten lakhs	Lakhs	Ten thousands	Thousands	Hundreds	Tens	Units
10000000	1000000	100000	10000	1000	100	10	1
20000000	2000000	200000	20000	2000	200	20	2
30000000	3000000	300000	30000	3000	300	30	3
40000000	4000000	400000	40000	4000	400	40	4
50000000	5000000	500000	50000	5000	500	50	5
60000000	6000000	600000	60000	6000	600	60	6
70000000	7000000	700000	70000	7000	700	70	7
80000000	8000000	800000	80000	8000	800	80	8
90000000	9000000	900000	90000	9000	900	90	9

### Western System

It will be easy to learn arithmetic and mathematics, if we introduce numbers to the children, as shown in the chart. Begin the counting from the right side i.e., from units (Avoid sequential numbers after ten) Guide the children to construct multi-digit numbers gradually. It is the easy, fast and better technique to introduce numbers to students.

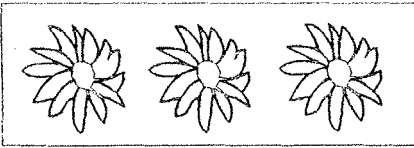
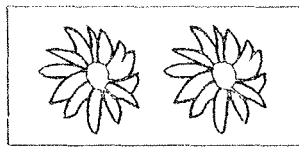
Millions	Hundred Thousands	Ten thousands	Thousands	Hundred	Tens	Units
9000000	900000	90000	9000	900	90	9
8000000	800000	80000	8000	800	80	8
7000000	700000	70000	7000	700	70	7
6000000	600000	60000	6000	600	60	6
5000000	500000	50000	5000	500	50	5
4000000	400000	40000	4000	400	40	4
3000000	300000	30000	3000	300	30	3
2000000	200000	20000	2000	200	20	2
1000000	100000	10000	1000	100	10	1
0	0	0	0	0	0	0

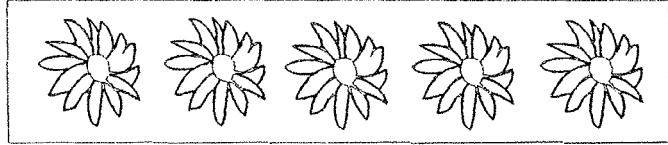
# Mathematical "PROBES"

## ADDITION

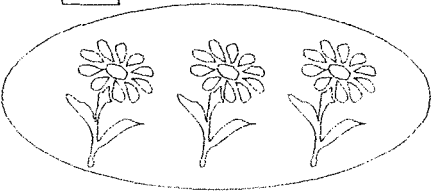
Count and write the numbers

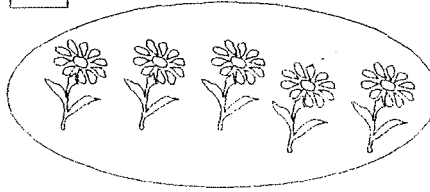
Eg.

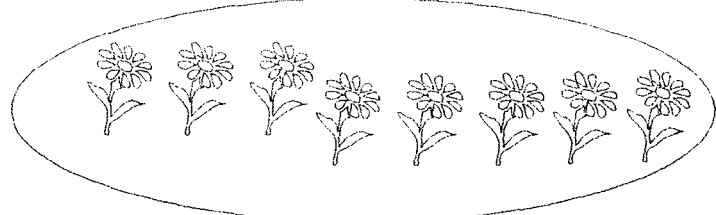
a   b  

c  


1.

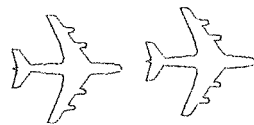
a  


b  

c  

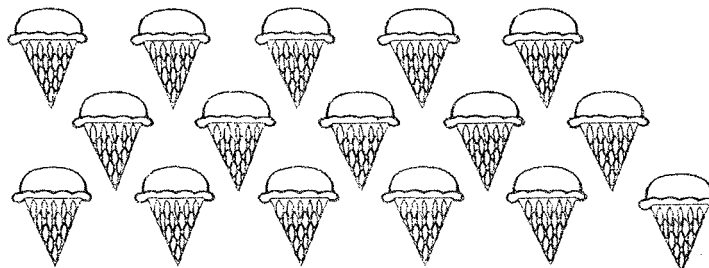
2.

a  

b  

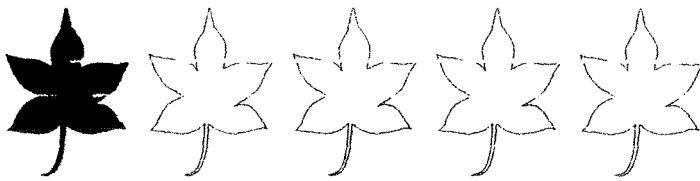
c  

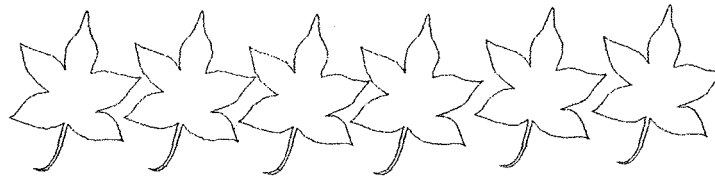
3.

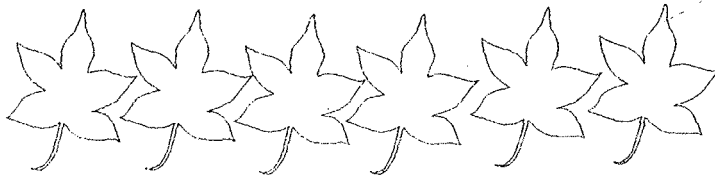


Shade the items as indicated by the number on the right

Eg

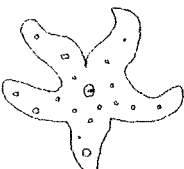
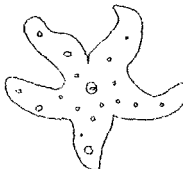
 1

**a**  4



**c**  5

This is how you can add numbers. Complete the following



Eg

 +  = 2

1 + 1

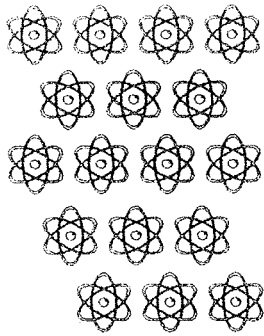
**a**  +  =   

2 +   

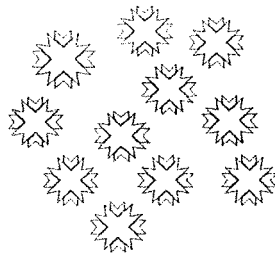
**b**  +  =   

5 +

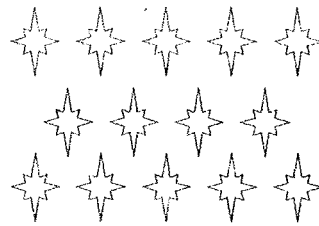
**Add the number of items in each of the following sets**



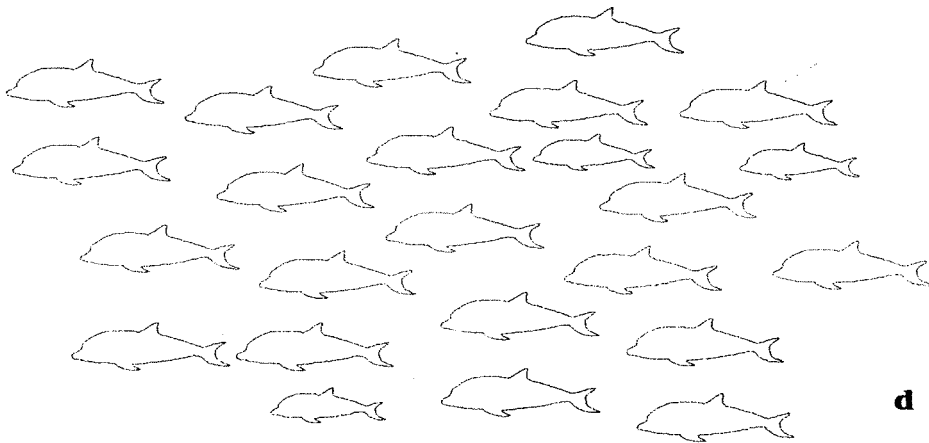
**a**



**b**



**c**



**d**

**Classroom observation**

**Count the number of**

a) Students in your class

b) Windows in the classroom

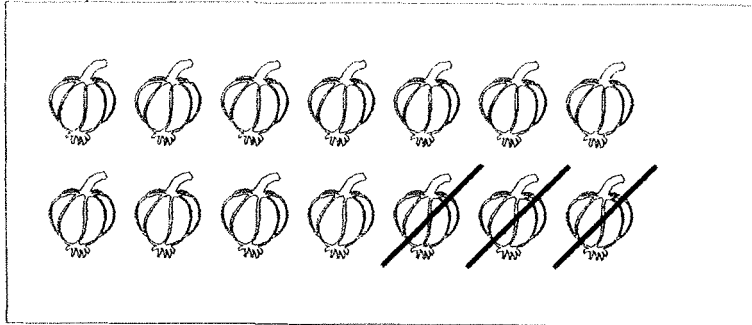
c) Tables in the classroom

d) Pictures on the wall

# Subtraction

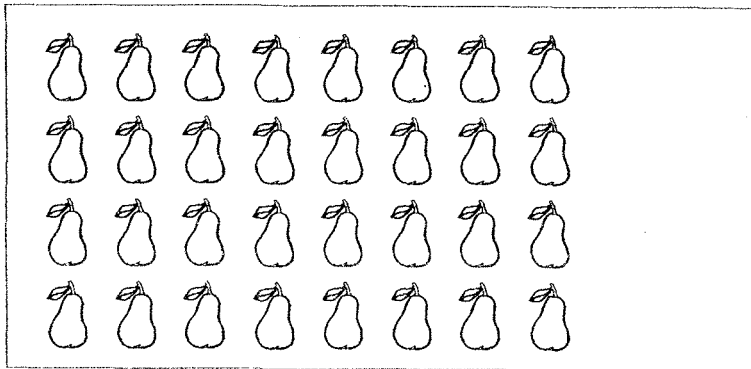
Subtract and write the answers

a



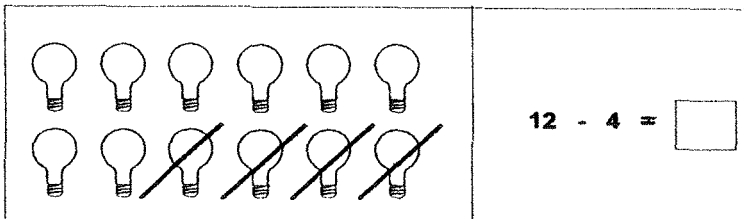
$$\boxed{14} - \boxed{3} = \boxed{\phantom{00}}$$

b



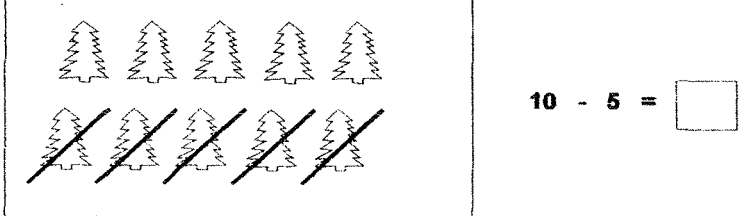
$$\boxed{\phantom{00}} - \boxed{12} = \boxed{\phantom{00}}$$

c



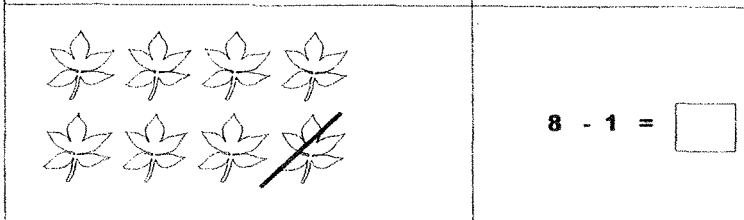
$$12 - 4 = \boxed{\phantom{00}}$$

d

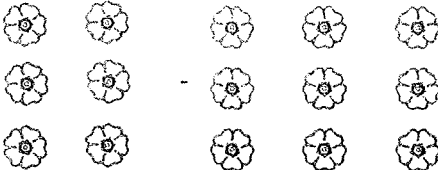
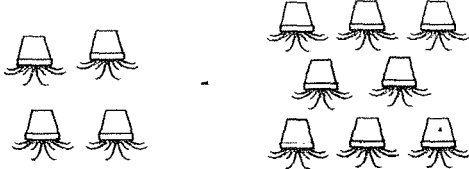
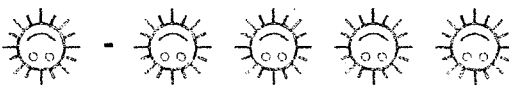

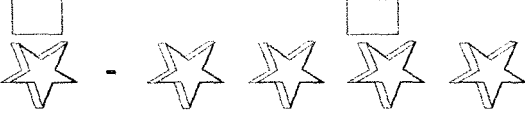
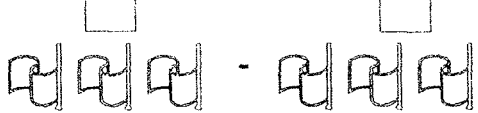
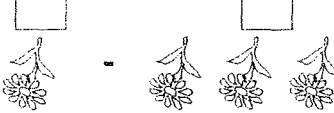

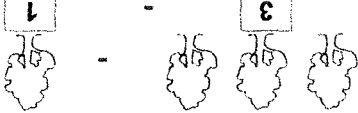


$$10 - 5 = \boxed{\phantom{00}}$$

e



$$8 - 1 = \boxed{\phantom{00}}$$

<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text"/>	=	<input type="text"/>	-	<input type="text"/>	
<input type="text" value="2"/>	=	<input type="text" value="1"/>	-	<input type="text" value="3"/>	

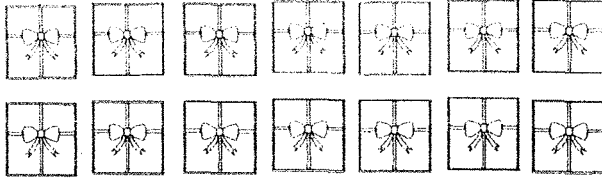
4  
6  
7  
e  
p.  
c  
b  
a  
Eg

How much do you remember

# Multiplication

Multiply and write the answers

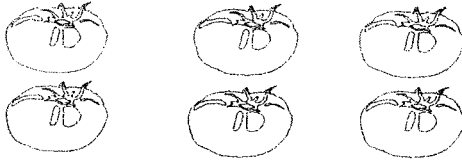
Eg



$7 \text{ Two's} = \boxed{14}$

$7 \times 2 = \boxed{14}$

a

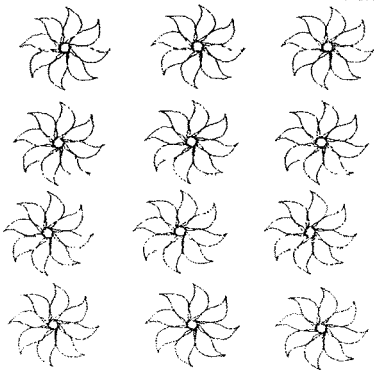


$3 + 3 = \boxed{\phantom{00}}$

$2 \text{ Threes} = \boxed{\phantom{00}}$

$2 \times 3 = \boxed{\phantom{00}}$

b

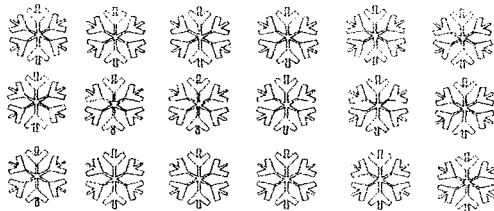


$3 + 3 + 3 + 3 = \boxed{\phantom{00}}$

$4 \text{ Threes} = \boxed{\phantom{00}}$

$4 \times 3 = \boxed{\phantom{00}}$

c

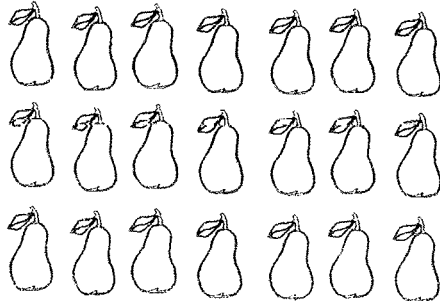


$6 \text{ Threes} = \boxed{\phantom{00}}$

$6 \times 3 = \boxed{\phantom{00}}$

$3 + 3 + 3 + 3 + 3 + 3 + = \boxed{\phantom{00}}$

d

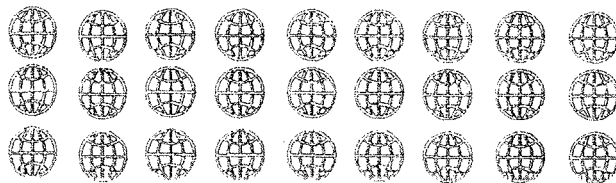


$7 \text{ Threes} = \boxed{\phantom{00}}$

$7 \times 3 = \boxed{\phantom{00}}$

$3 + 3 + 3 + 3 + 3 + 3 + = \boxed{\phantom{00}}$

e



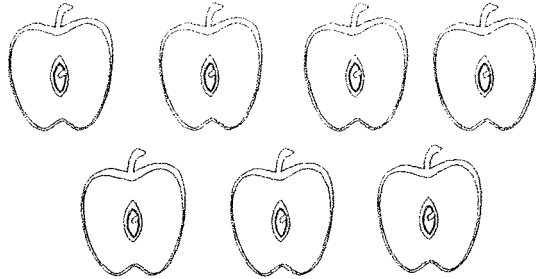
$9 \text{ Threes} = \boxed{\phantom{00}}$

$9 \times 3 = \boxed{\phantom{00}}$

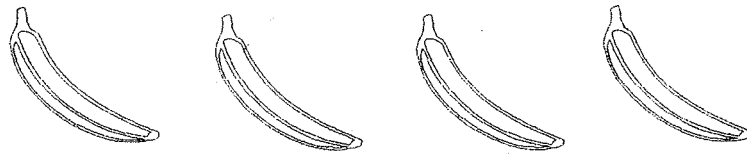
$6 \text{ Threes} + 3 \text{ Threes} = \boxed{\phantom{00}}$

**Colour the following**

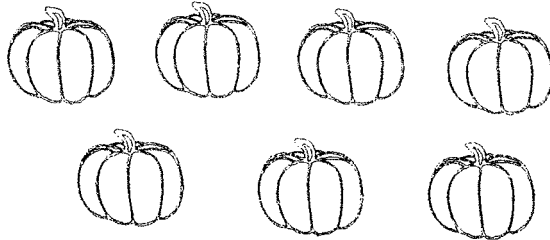
**a 5 apples**



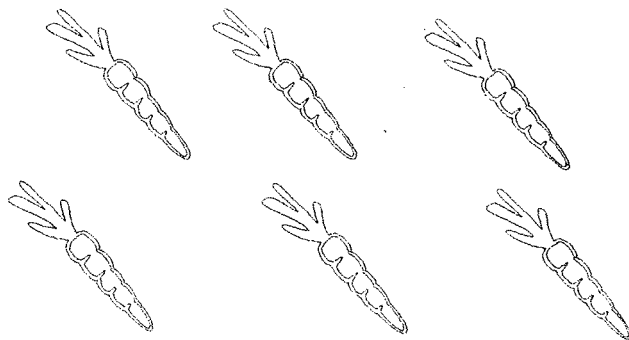
**b 2 bananas**



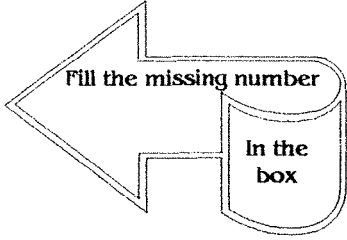
**c 6 pumpkins**



**d 3 Carrots**



# Division



$2 \div \square = 2$

$6 \div \square = 3$

$10 \div 2 = \square$

$14 \div 7 = \square$

$8 \div \square = 4$

$16 \div 8 = \square$

**Good**

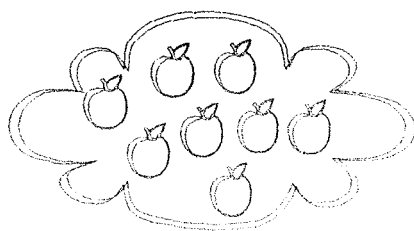
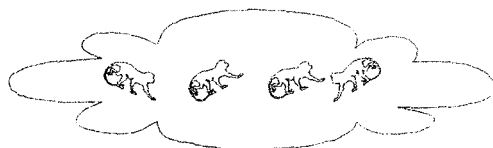
**Fair**

**Poor**

Tick (✓) the correct answer

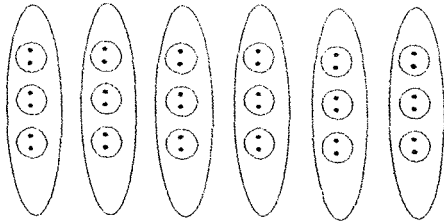
$16 \div 2$	$18 \div 3$
2 8 9	2 4 6
$49 \div 7$	$40 \div 10$
6 7 9	2 4 5
$48 \div 8$	$30 \div 5$
4 6 8	5 4 6

Distributes the mangoes equally among the monkeys



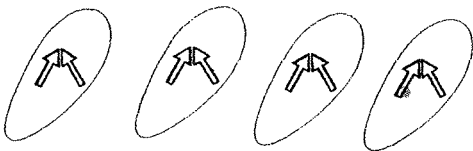
One monkey will get \_\_\_\_ mangoes

**Study each picture, write multiplication and division answer for each**



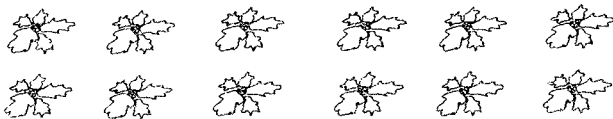
$$6 \times 3 = 18$$

$$18 \div 3 = 6$$



$$4 \times 4 = \square$$

$$4 \div 4 = \square$$



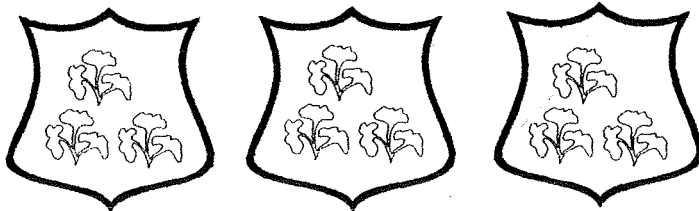
$$12 \times 2 = \square$$

$$12 \div 2 = \square$$



$$5 \times 5 = \square$$

$$25 \div 5 = \square$$



$$3 \times 3 = \square$$

$$3 \div 3 = \square$$

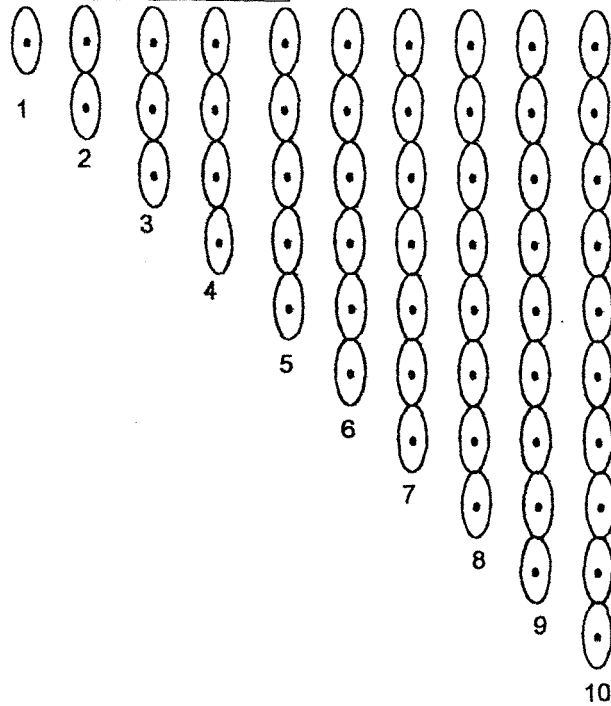


$$8 \times 2 = \square$$

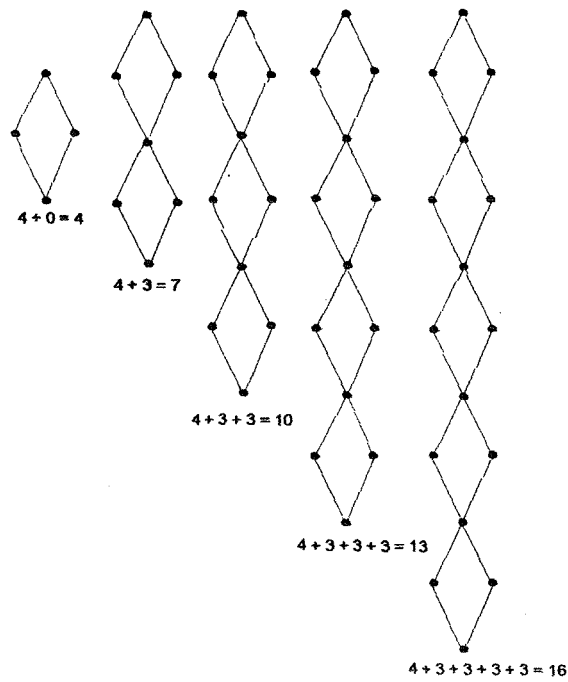
$$16 \div 4 = \square$$

**Teaching basic concepts in mathematics through kolam patterns  
(A traditional design used in floor decoration)**

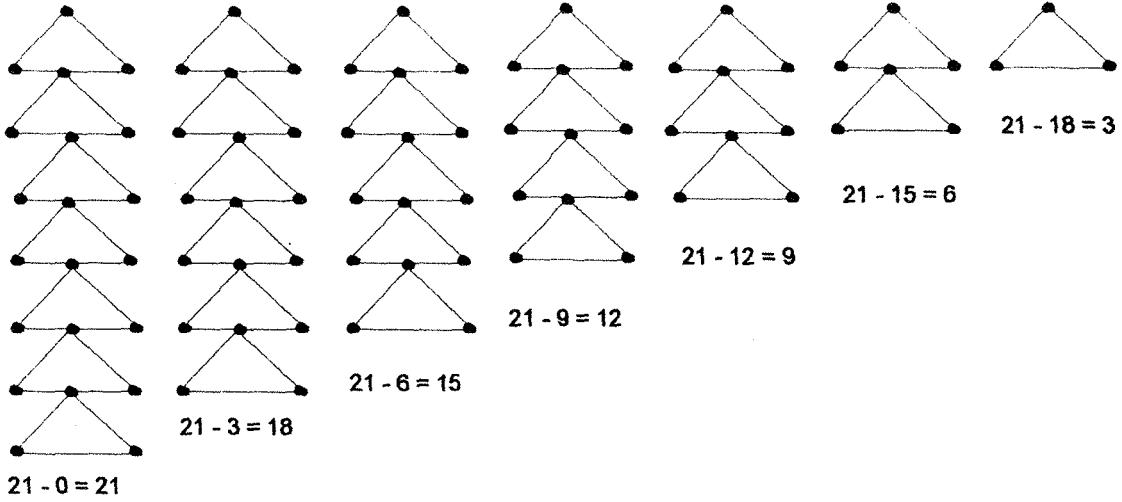
**Ascending and decending order**



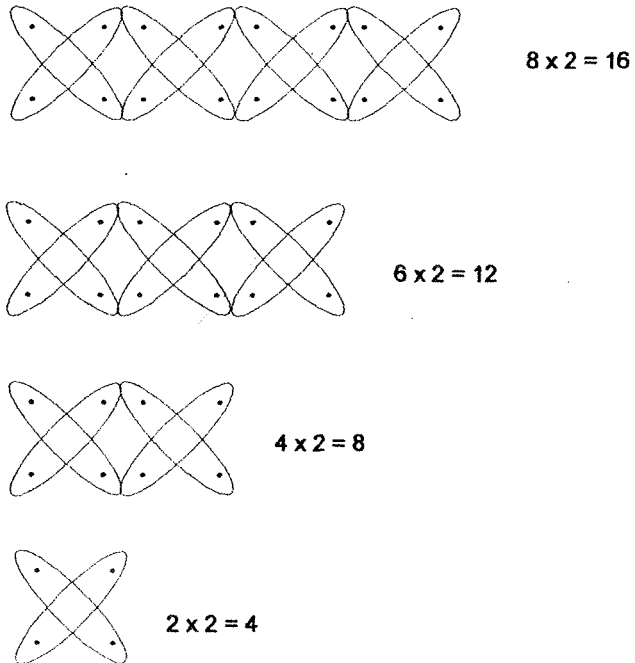
**Addition**



## Subtraction



## Multiplication



## V. GUIDELINES FOR TEACHERS AND PARENTS

"Children must be ready to learn from the first day of school and of course, preparing children for school is a historic responsibility of parents".

President George Bush

Some children do well in school. They learn quickly and remember facts. They "catch on".

Some don't do so well. They have trouble paying attention. Their grades are poor. Yet they may be as smart - or smarter - than their successful classmates.

Why the difference in performance ?

It may not be a question of I.Q. but of behaviour and attitude. Research has shown that these qualities affect success in the classroom.

Successful students behave in certain ways. They have the "right" attitude. They're motivated ... they pay attention... they're relaxed they ignore distractions that might interfere with learning and, when they need help with school work, they know how to get it.

None of those things are inborn, but they can be learned and you, as a parent, can help a child learn them.

The Office of Educational Research and Improvement (OERI) offers four steps children can take to become better students. They are for children of all grades. They will sound simple, because they are. But they can make a world of difference to your children.

You can teach your children strategies for the four steps :

- \* Paying attention
- \* Keeping interested in school work
- \* Learning and remembering
- \* Studying

### **Paying Attention**

Children can learn the knack of paying attention. Never threaten or order them to "pay attention" in school as it won't work ! Some simple techniques will. They are :

### **Using self-talk and positive images**

Children can use words or phrases to help control attention. For example, they can tell themselves to keep their eyes on the blackboard while the teachers is writing on it to explain a problems You can help them practice positive self-talk at home in various situations : when playing a game, helping around the house, or working at a hobby.

Help them stop negative self-talk ("It's hopeless") and to be positive about themselves, to say, "I can do it". Positive self-talk might include the slogan : Quitters don't win and winners don't quit.

No more negative images, either ! Children can and must learn to see themselves doing well in school. Tell them to picture themselves answering questions correctly in class and feeling good about knowing the answers. Spend time talking with them about their successes (as well as their difficulties).

### **Asking questions**

This helps children focus their attention while studying. When reading about World War II, students might ask themselves "Which countries were our friends and allies ?

You can suggest general questions to a child, such as : "What is this paragraph about ? Who did what and why ? Is the main point true or false? Asking questions can grab wandering attention.

### **Setting specific study goals**

Your children can set goals that will help improve attention. Ask them to study a lesson until they can tell you the main point of the paragraph ..... or solve a specific math problem ..... or know specific names, dates and places mentioned in the text. Discuss each goal. Remember that many small goals, one after another, are better than a single large one.

### **Keeping interested**

Learning is a joint effort. Everyone must help students to learn. Teachers are responsible for teaching and parents for parenting, but students must realise that no one else can do their learning for them.

Children must believe that the hours they spend studying and the effort they put into it make the difference between success and failure. Some youngsters believe other things control success/failure - teachers, basic intelligence, or luck. They ignore their own responsibility.

You can help your children accept the fact that their efforts do make a difference. The next time they bring home test results, written comments, or report cards, discuss the reasons why they did well or poorly. Help them relate their efforts to the result.

Do reward a child for improvement. Your praise is music to your child's ears. You might consider treats or trips or privileges for special achievements. Do stress the benefits of doing well in school. Some benefits are immediate, such as having more free time and some are long-term, such as getting a scholarship or an interesting job.

### **Remembering**

OERI research has shown that a child's success in school is determined not just by intelligence but by the strategies he or she uses to master many facts and ideas.

Understanding a subject doesn't just happen. It takes work. It requires taking an interest in the subject and relating new information to familiar information.

Besides teaching the strategies for paying attention, you can help your child use various strategies to remember. You can decide how best to adapt a particular strategy.

Here are the strategies :

### **Making inferences**

Encourage your children to try to draw conclusions from the material they are studying. When they are reading about an invention - perhaps the telephone - they could consider what people would do without telephones.

### **Building bridges**

It helps children to build a bridge between the new and the old - between new information and things they already know. They should look for similarities between the new and the familiar. For example, a child studying our court system could relate the judge's role in setting disputes to his or her own experience with arguments and disagreements.

### **Findings the main ideas**

As students listen or read, they must frequently ask themselves, "What's the point being made here?" By constantly looking for the main idea, they concentrate on learning the important material. This also helps to keep them actively engaged in studying.

### **Categorizing information**

Many school activities involve learning and remembering large amounts of information. Sometimes there are long lists of names and dates. When there are many items of information to learn, students should group them in categories. Students in beginning music classes don't try to remember the names and characteristics of every musical instrument but group them : percussion, wood-winds, strings and brass. Your child should try this technique in subjects ranging from Geography to English to that of mathematics.

### **Studying**

Your child needs a place to study. Whether you live in a one-bedroom apartment or a sprawling bungalow, you can set aside a study area. It can be a desk in a bedroom or the kitchen table. But it must be fairly quiet with good light.

Children also need a time for studying. Help children create schedules. If they set aside time for chores, work, fun and study on a weekly basis, they can make better use of their time. These schedules should be flexible enough to allow for shifts when necessary.

### **Previewing material**

Encourage children to begin an assignment by reviewing the material - for example by reading the introduction to a chapter, the headings and summary. This is like looking at a road map. Here they create a mental "map" of what is ahead. They complete the "maps" details when they read the chapter.

### **Reading and thinking**

When reading the chapter, they should try fit details into their mental "map". This is the time to use the attention grabbing strategies self-talk, positive images and questions. It helps if they pause before each new section to "test" their understanding. Using the strategies for learning and remembering, they can ask: "What conclusions can I draw from this ? How should I categorise the information ? Do I see analogies? What are the main ideas ?

### **Taking notes**

Children can't remember everything they read. It will help them, though, to take notes of the main points. These notes serve as a summary of the most important points. The act of taking them and reviewing them will help the student to categorize the material understand and remember it. And the notes will help in preparing for tests.

### Self-testing

Children should test themselves to see what they know and don't know. They can then apply their study time more efficiently to the sections of which they are weakest. You can help by making up test questions, for example, "What are the chief food products of the country being studied? Why? Do we use these in our home?"

### Preparing for tests

Encourage your children to prepare for tests by spacing studying over days or weeks. They should make sure they understand the material and relate it to what they already know. They should review it more than once. "Cramming" the night before is not a good idea and it is important to get a good night's sleep.

OERI's step to success can help all students from grade-school to high school. They can help poor students improve. They can help good students get better. We hope these strategies/methods will help your children.

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APPENDIX XI

CHECKLIST TO EVALUATE THE EFFICACY OF REMEDIAL PACKAGE BY PRIMARY SCHOOL

TEACHERS

Teacher's Name :

Class handling :

School :

Yes No

1. The package helps in achieving the objectives of remedial teaching
2. Adequate computation skills for primary school children can be taught using the package
3. Information provided in the package is adequate to help dyscalculic children
4. Teachers and parents can effectively use the package without orientation
5. Games introduced provide interesting learning situations
6. Instructional materials on basic concepts of learning disability is informative
7. Remedial programme incorporated is largely applicable
8. Short cut methods to various concept learning in mathematics is useful
9. Manipulative resource materials provides imaginative opportunities for concept development
10. Parents can be equipped to use the package in helping the dyscalculic child

not learn the way he is  
n in a way he can learn"

"Yet day by day, if no life's strand  
We work with patient heart and hand,  
It gathers you, makes dark days bright,  
and gives at last a lovely light"

AV

ils contact

0241  
nd Head  
of Human Development  
am Deemed University  
- 641 043.

SENSITIZATION PROGRAMME ON LEARNING DISABILITIES AMONG CHILDREN

EVALUATION PROFORMA

Name of the participant :

Age :

Male/Female :

Educational Qualification :

Designation :

Official Address :

Name of the School if working:

How did you know about this programme ?

What are your objectives in attending this programme

Is this the first programme you have attended on learning disabilities ?

Yes No

If yes - state the programmes attended

Do you have children with learning problems Yes No  
(in your class) Specify type :

List common errors or difficulties faced by the children

How are the children helped ?

Do you feel that the children are progressing

Are you interested in participating in a workshop to be organised on  
learning disabilities

Did you find this programme useful ? Yes No  
(How)

Give your suggestions for future programmes