CHAPTER - 1
INTRODUCTION

Learning disability (LD) is a handicap like other disabilities such as paralysis or blindness. LD is a disorder that affects peoples’ ability to interpret what they see and hear or to line information from different parts of the brain. Historically, Hinshelwood (1917) and Orton (1937) identified specific reading disabilities among children. Later on the term LD was given by Samuel Kirk (1962) while addressing a group of parents whose children were having serious difficulties in learning to read, were hyperactive, or could not solve math problems. In the modern era such and other difficulties are growing rapidly, therefore, holding everyone’s attention. According to him learning disability refers to a retardation, disorder or delayed development in one or more of the processes of speech, language, reading, spelling, writing or arithmetic resulting from a possible cerebral dysfunction and/or emotional or behavioural disturbance and not from mental retardation, sensory deprivation, or cultural or instructional factors.

According to Encyclopaedia Columbia (2003) “Learning disability in education, is any of various disorder involved in understanding or using spoken or written language, including difficulties in listening, thinking, talking, reading, writing, spelling, or arithmetic. It includes conditions referred to as perceptual handicaps, minimal brain dysfunction (MBD), dyslexia, developmental aphasia, and attention deficit disorder”.

As per the medical dictionary(2001) “Learning disability is a disorder in the basic cognitive and psychological process involved in using language or performing mathematical calculation, affecting persons of normal intelligence and not the result of emotional disturbance or impairment of sight or hearing”.

Actually LD is a complicated term, because a lot of academic and non-academic difficulties are faced by learning disabled (LD) children. Visuomotor problems, perceptual problems (visual/auditory discrimination, figure-ground discrimination), memory problems (auditory/visual), phonological processing difficulties, and learning problems, are included in the non-academic difficulties whereas academic difficulties include reading, spelling, writing (both mechanical and composition), and mathematics.

The term learning disability has been defined in different ways by different researchers. According to Federal definition in Individual with Disability Act(IDEA, 1977) “Learning disability is a disorder in one or more basic
psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include the children having learning problems which are primarily the results of visual, hearing, or motor handicaps, mental retardation, or of environmental, cultural, or economic disadvantages.

U.S. National Joint Committee on Learning disability (1990) defined it as a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual presumed to be due to central nervous (CNS) dysfunction and may occur across the life span. Problems in self-regulatory behaviours, social perception and social interaction may exist with LDs but do not themselves constitute a learning disability. Although learning disabilities may occur concomitantly with other handicapping conditions (e.g. sensory impairment, MR, serious emotional disturbances) or with extrinsic influences such as cultural differences, insufficient or inappropriate instructions, but these are not the result of these conditions of influences. So NJCLD uses the term to refer to a discrepancy between a child’s apparent capacity to learn and his/her level of achievement.

More recently, as per the DSM-IV TR (2005) “Learning disorders are diagnosed when the individuals’ achievement on individually administered standardized tests in reading, mathematics, or written expression is substantially below that expected for age, schooling, and level of intelligence. The learning problems significantly interfere with academic achievement or activities of daily living that require reading, mathematical, or writing skills”.

All the definitions described above have considered some of the aggregate symptoms of learning disability. These definition clearly indicate that learning disability is not a disease, neither is there any emphasis on pathological or other biological dysfunctions.

LD associated behaviour includes short attention span, hyperactivity, and impulsiveness. There are different individualised techniques for remediation of LD including the simultaneous use of several senses (sight, hearing, and touch), slow paced instructions and repetitive exercise to help in perceptual distinction. LD can be
caused by impairment in one or more processes related to perceiving, thinking, remembering, or learning. Language processing, phonological processing, visual spatial processing, processing speed, memory, attention, are included in LD but it is not limited to these factors. LD can also involve difficulties with organisational skills, perception, social interaction, and perspective taking.

Lifelong difficulties are experienced by the individual with LD which stem out from their specific disability (Mercer, 1991; NJCLD, 1988; Smith and Luckasson, 1995). LD may not be limited to a particular age group or a particular setting. Learning disabilities are not thought to be school specific or to be the exclusive province (range of learning or responsibility) of elementary aged children (Keogh and Sears, 1991). It is clear that LD is life long and must be dealt accordingly.

Prevalence of learning disability

Estimates of learning disability from research studies vary from 2% to over 20% (Silver, 1988). According to global literature on this subject, about 1% children are born with severe language disabilities and up to 17% may experience varying levels of language disturbance. Dyslexia, a common form of LD is observed in 10% of the school going population. However, the magnitude of the problem and the prevalence in India has not been fully understood. It is around 13-14% of all school going children (Sakhuja, 2004).

Classification of LD:

According to DSM-IV or ICD-10 individual falling in an IQ range of 70-84 should be classified as learning disabled. But either of them not refers to borderline learning disability. This term is not clearly recognised in major classification systems. The DSM IV listed these learning disorder (i) Reading Disorder: reading skills are weaker than general ability. Can included ability to decode words and/or reading comprehension. Another term for reading or writing disorders is dyslexia. (ii) Disorder of written expression: writing skills than the general ability. Can include the quality of written expression, spelling and/or writing syntax (iii) Mathematics disorder: calculation skills are weaker than general ability (iv) Learning disorder not otherwise specified: can be diagnosed when there is mild deficit in two of the three areas listed above (reading, writing, mathematics) that individually fall short of diagnostic criteria, but together can be considered as a significant impairment. (v) Other disorders are often diagnosed in educational settings, but are not listed in DSM.
IV. These include Auditory Processing Disorder (verbal skills weaker than non-verbal) or Visual Processing Disorder (spatial skills weaker than verbal). The DSM IV also list additional categories, such as “motor skills disorders” and “specific developmental disorders, not otherwise specified”. These diagnoses include delays in acquiring language, academic, and motor skills that can affect the ability to learn, but do not meet the criteria for a specific LD. Also included are certain co-ordination disorders that can lead to poor penmanship, as well as certain spelling and memory disorders. Each of these categories includes a number of more specific disorders. According to some the LD can be divided into three broad categories (i) developmental speech and language disorder - individual with development speech and language disorder have difficulty producing speech sounds, using spoken language to communicate, or understanding what other people say, (ii) academic skill disorder- students with academic skills disorders are often years behind their peers in developing reading, writing, or arithmetic skills, (iii) other learning disorders. Bateman (1965) listed three broad types of LD: reading, visual motor and verbal communication disturbances. In DSM-IV TR (2005) the categorization is same as that of DSM IV (APA, 2000).

Diagnostic criteria:

Diagnosis is made as per the classification given above the criterions accordingly. Besides this the following criteria for diagnosing the LD have been accepted (a) a severe discrepancy between potential ability and actual achievement, (b) learning problems that can not be attributed to other disabilities, and (c) need for special educational services to succeed in school.

As per the DSM IV TR (2005) - a variety of statistical approaches can be used to establish that a discrepancy is significant ‘Substantially below’ is usually defined as a discrepancy of more than two standard deviation (S.D.) between achievement and IQ. A smaller discrepancy between achievement and IQ (i.e. between 1 and 2 SD) is sometimes used, especially, in cases where an individuals' performance on an IQ test may have been comprised by an associated disorder in cognitive processing, a co-morbid mental disorder or a general condition, or the individuals' ethnic or cultural background. If a sensory deficit is present, the learning difficulties must be in excess of those usually associated with the deficit. LD may persist into adulthood. Learning problems predisposes for the later life development of secondary psychiatric disorders
such as anxiety, depression, school phobia or disruptive behaviour disorder. Many social, behavioural, and emotional deficits are also manifested by LD children like low self esteem and social withdrawal which interfere in their day to day functioning. However, an understanding into the characteristics can be milestone in diagnosing the LD.

Causal factors in LD

The cause of a child’s learning disability is not known in most cases. Many causes have been proposed depending on the various situations. There are likely to be different causes, just as there are different types of learning disabilities (e.g. dyslexia, mathematical disabilities). Generally two types of factors are taken into consideration i.e. biological factors and environmental factors.

1. Biological Factors

Following factors are considered under this category:

(i) Brain Damage

Some disabilities may occur due to brain damages (Hynd, Marshall, and Gonzalez, 1991). 20% of the children with LD have sustained a prior brain injury either before birth (prenatal), during (prenatal), or after (postnatal) birth. Neuro-imaging techniques which enabled researchers to discover the specific regions of brains indicated that some reading disabled show different activation patterns from the patterns found in the brains of non-disabled individuals during phonological processing tasks.

Research done by National Institute of Mental Health indicate that there may be variation in the brain structure called the 'planum temporale', a language related area found in both sides of the brain. In people with dyslexia, the two structures were found to be equal in size whereas in non-dyslexic people, the left planum temporal area was noticeably larger. Some scientists believe that reading problems may be related to such differences. Dykman, Ackerman, Clements, and Peters (1971) found that damaged cortical areas are related to specific learning deficits.

As defined by NJCLD definition of learning disability also stated that learning disorders are “presumed to be due to central nervous system”. Some researchers also believe that all LD children have some type of brain injury or CNS dysfunction. William and Oransky (1980) stated that it is not the fault of child that he couldn’t learn; he has some brain injury that prevents him from learning. Most of the theories
do not relate LD to brain damage due to two major reasons (a) lack of evidence: not all LD children display medical evidence of brain damage, and not all brain injured have learning disabilities; (b) the brain damage assumption can serve as a built-in excuse for ineffective instruction when a student fails to learn, his teacher may be quick to blame the brain damage as a cause for preventing him from learning. However, to conclude, LD may be caused by slight brain damage. But no direct cause and effect relationship has been established.

(ii) Biochemical Imbalance

Biochemical disturbances in the body have been suspected as a cause of LD. Resistance to thyroid hormone (RTH) is one of several hormone resistance syndromes identified via molecular genetic studies and is associated with poor school performance, learning disability, and symptoms of hyperactivity (Hauser, 1998; Heindel, 2000). In addition, Vitamins, carbohydrates etc. are important food gradient which are essential for our body and brain. Abnormal synthesis of vitamin can be a possible cause of LD (Cott, 1972). Fiengold (1975) also found that artificial colours and flavours added to food can cause learning disability and hyperactivity in a child. Many researchers claim the positive results of diet in LD. But Spring and Sandoval (1976) found that large doses of vitamins did not improve the performance of LD children.

(iii) Heredity

There is slightly greater likelihood of having reading problem with siblings and children of reading disabled persons. There is much evidence that heredity may be the causal factor in some family with dyslexia. Denckla (1973) and Bannatyne (1971) reported high percentage of dyslectic children who have a history of the condition in the family. Bakwin (1973) found 84% concordance in dizygotic twins. Researchers have located possible chromosomal loci for the genetic transmission of phonological deficit that may predispose a child for reading problems later. Hallgren (1950) found familial concordance for reading disorders (dyslexia) and a twin study also found such concordance. Hallahan and Kauffman (1980) said that LD tends to run in families but it is due to heredity or something else is yet not so clear. Rovet (2004) found that individual with Turner Syndrome (arises from a loss of X-chromosome material) show a distinct neurocognitive profile involving visuo-spatial deficits and selective memory and attention difficulties. They are at higher risk of learning disability.
2. Environmental factors

Impoverished environment in early childhood and poor instruction may contribute to the achievement. A significant correlation was found between environmental influences on early childhood development and later achievement in school.

Children having infrequent communication with their parents were more likely to have deficits in vocabulary, language use and intellectual development before entering the school. Friedman (1973) interviewed 53 families and found that in 19 cases the communication between parent and child regarding parental expectations, child performance, or disappointments with performance were characterised by ambiguity or dishonesty. In 18 cases permission was given by the parents to the child to fail, the immature continue in school and students underachieve, avoid stress, act out resistance to the educational process, or passively resist school learning. Roy (2004) found that thickness of cerebral cortex reduced due to heavy smoking; also the neurons of cerebral cortex become small and reduced brain weight. He also noted an overall decrease in “dendritic branches”. This study shows that greater the dose of nicotine, greater the biological effects upon the offspring. It supports many other linking i.e. increased hyperactivity, attention deficits, lower IQ and learning disabilities in children with parents who smoked curing pregnancy.

Premature births i.e. before 36 weeks gestation have very special needs in terms of learning problems, physical disabilities, sensory deficits and attention deficits (Saigal, 1991). According to ICFPLD (2004), learning disabilities may be the result of accidents and infections in childhood such as meningitis and encephalitis. A study of animals done by National Institute of Health showed a connection between exposure to lead and learning difficulties. In a study rats exposed to lead experienced changes in their brain waves slowing their ability to learn. The learning problems lasted for weeks, long after the rats were no longer exposed to lead. Prenatal exposure to toxins can affect the brain development of the fetus and lead to later learning disorders. Maternal cigarette smoking is associated with hyperactivity and mild intellectual and academic decrements in offspring (Nichols and Chen, 1981). Marijuana smoking can cause cognitive delay and alcohol consumption may lead to subsequent learning problems (Phelps and Grabowski, 1992). Toxins not only affect the fetus but also affect the children after birth. The neurological, psychological, intellectual, learning and behavioural effects of contacts with environmental toxins after birth have been
well documented, including lead, arsenic, aluminium, cadmium, carbon-monoxide, mercury, radiation and chemotherapy etc. (Smith, 1991).

Socio-economic status (SES) is also found to be a contributing factor. Studies found that children born to low SES families are at far greater risk for school learning and behavioural difficulties than children raised in middle or higher income families (Kavale, 1980; Wener and Smith, 1982). Poor quality of teaching can be another environmental factor contributing to academic differences (Hallahan and Kauffman, 1994; Lovitt, 1978). 90% children labelled as learning disabled are showing disability because they are not taught properly, and it is not due to disturbance in their perception, synapses or memory. So learning disabilities are not born but made. Lovitt (1978) cites that LD children have behavioural disorders and lack of motivation is another contributing factor. Martin and Holbrook (1985) found that high motivation may partially overcome the weakness.

Characteristics of students with LD:

The term characteristic refers to those particular traits or qualities typically observed in the individuals having learning disability (Myers and Hamill, 1990). Clements (1996) identified a variety of characteristics of learning disability which result from minimal brain dysfunction. Soft neurological signs, emotional problems, disabilities in communication, attention, academics, thinking, and perception are included in these.

(i) Academic deficiencies- Learning disabled children generally have problem with their academics. Although academic disabilities are noted in reading, oral language, written language, and mathematics but reading problems are the primary disabilities among these individuals (Lovitt, 1989; McLeod and Armstrong, 1982). Evidence suggests that reading disabilities are not simply a development lag in linguistic or basic reading skills but these are persistent deficits. Most of the reading problems in children lie at the word, rather than the test, level of processing (i.e. inability to decode the single word accurately and fluently). These children generally have a dysfunction in the awareness of phonological structure of words in oral language (Stanovich, 1988). Problem in writing and spelling are faced by many students. Students with LD perform significantly lower across written expression task, especially in vocabulary, grammar, punctuation and spelling when compared to their normal counterparts. Such difficulties appear in their written work in the form of spelling errors, lack of appropriate punctuation, and syntax (Anderson, 1982).
Many students with LD have major problems in numerical reasoning and calculation. Researchers found students with LD have maths score on an average approximately at 30th percentile. Difficulty may stem from slowness in operation execution (Kirby and Becker, 1988); developmental delays (Cawley, Fitzmaurice-Hayes, and Shaw, 1988); memory deficiencies (Bley and Thornton, 1995) etc. Such difficulties can interfere with successful acquisition of mathematical concepts and skills in areas such as computation, problem solving, mental calculation, geometry etc. Repeated and meaningful practice with feedback and direct instruction with reading and writing usually improves the performance of LDs in maths.

(ii) Motivation

LD students lack the necessary motivation for success (Adelman and Taylor, 1983). Students may blame (themselves) for unsuccessful experiences (Smith and Luckasson, 1995) or successful ones to luck, rather than their abilities and effort for success (Pearl, 1982). These groups develop learned helplessness as they expected to fail and for problem solving depend on other people (Smith and Luckasson, 1995). These children have ‘learned helplessness’ because they think that they do not have control over success or have little control, have no internal motivation to prove their competence; they give up before begin to learn due to their belief in their “stupidity” or external factor preclude success (Adelman, 1979; Lewis and Patterson, 1989). According to Torgesen and Licht (1983) these students did not interact with material, possess effective learning strategies, or seek assistance or in other words these are passive or inactive learners (Wong, 1980).

(iii) Attention and hyperactivity

Students who display developmentally inappropriate character of inattention, hyperactivity, and impulsivity are said to have attention hyperactivity disorder (ADHD). ADHD include fidgety behaviour, distractibility, impulsivity, problem of staying in seat, as well as problem in task completion, cause and effect difficulties, and poor communication and/or social skills such as interrupting and not listening (APA, 1994). Approximately 1/3 of students with LD are thought to have ADHD (Hallahan, 1989).

Hallahan (1975) found that LD students have more attentional difficulties than do their normal peers. Some researchers found that LD have problems in selective attention abilities such as selecting relevant aspects of a task (Keogh and Margolis, 1976) and sustained attention such as focusing on and maintaining task behaviour.
(Hallahan, Kauffman, and Llyod, 1996). Alley and Deshler (1979) said that teenagers with learning disabilities often shift their focus from one stimulus to another and fail to take advantage of the organisation given to class material either by teachers or the text. As Keogh and Margolis (1976) found that students with learning problems have difficulty in focusing attention due to which certain memory problems arise i.e. take more time to study a lesson and remember less well than the typical learners.

(iv) Social skills

Many LD Students are not well accepted by their peers, have social skills deficits, and have difficulties in making and maintaining friends (McIntosh, Vaughn, and Zaragoza, 1991). According to Bryan (1991) LD have social skills deficit in four areas; including how they (a) view themselves, (b) are viewed as socially competent by others, (c) communicate the rules and language of social interaction, and (d) behave in social situations. Ellis and Friend (1991) explained that LD students may lack adequate social skills or may have skills but lack generalization abilities (i.e. be cognitively aware of an appropriate social skill but not able to apply this knowledge to different situations). Blalock (1981) found that these deficiencies continue into the adulthood as LD people have problems in making and keeping friends, and spend lesser time in leisure activities. Ellis and Friend (1991) mentioned that adolescent students with LD may lack appropriate social skills or may possess skills but lack generalization abilities (i.e. be cognitively aware of appropriate social skills, but cannot transfer this to different situations). So these deficits must be traced out and remediate as compulsory part of curriculum at all grade levels.

(v) Perceptual skills

Visual and auditory abilities to receive and integrate neurological messages are called perceptual skills. Perceptual deficiencies are associated with LD, but are controversial, and so they are not included in some of the current definitions (Hamill and Larsen, 1974; Hammill, Goodman, and Wiederholt, 1974) surrounding assessment and treatment of these hypothetical constructs. At elementary school level success in reading is highly related to auditory-perceptual skill than to visual-perceptual skills. Low correlation is found between visual-perceptual skills and reading success (Kershner, 1977; Solan, 1987). Some of the learning disabled individual have difficulty in quickly recognizing seen word or calling visual images to mind (e.g words with irregular spellings) because they pick up information from visual images at a slower rate than typical rate (Richards, Samuels, Turnure, and
Ysseldyke, 1990). Students can have difficulties with discrimination tasks, but specific academic activities such as dyslexia (e.g. discriminating between b and p, or was and saw) must be focused instead of non-academic activities.

(vi) Discrepancy between aptitude/intelligence and achievement

The discrepancy is taken as most defining character of learning disability. It is generally used for identifying students with LD (Mercer, King, Sears, and Mercer, 1990). Children can have average abilities in intelligence and general language. But the children can have an unexpected under achievement (Mastropieri, 2001). Discrepancy is the difference between performance on achievement test (e.g. oral language or written language) and intelligence test score. Definition given by Bateman (1965) included the description of an educationally significant discrepancy between estimated intellectual potential and actual level of performance related to basic disorders in learning processes. But some studies reported that 1/3 to 1/2 or more children identified as learning disabled do not display a significant discrepancy between achievement and potential (Kavale and Reese, 1992). But recently Kavale and Forness (2000) found that researchers, practitioners and the public commonly assume that IQ discrepancy is a marker for a specific type of LD that is unexpected and categorically distinct from other forms of underachievement.

(vii) Memory

Memory is defined as the “ability to encode process and retrieve information that one has been exposed to (Sawson and Cooney, 1991) and meta-cognitive skills involve knowing what techniques are necessary for task completion and employing self regulatory strategies to monitor task completion (Barker and Brown, 1984) LD students show memory abilities comparable to younger students who are normal. Researches on short term memory and long term memory have shown that LD students (a) lack effective strategies, such as rehearsal or organisation, to assist in memorising information (Torgesen and Goldman, 1977; Vellutino and Scanlon, 1987), (b) lack effective meta-cognitive skills to facilitate recall (Wong, 1982), and (c) possess limited semantic memory capabilities (Swanson, 1983).

Learning and memory: Learning is an everyday process, that is experiential in nature. According to Marx (1969) learning is a relatively enduring change in behaviour which is a function of prior behaviour (usually called practice). It is a dynamic process which is highly relevant for growth and development. According to
various theories (Atkinson & Shiffrin (1968), Waugh & Norman (1965), Tulving (1985) etc.) the subject first perceive and acquire the material and then this material is stored in the brain.

In memory the contribution of Ebbinghaus (1885) and McGeoch (1932, 1942) are noteworthy particularly with reference to the materials to be used as learning tasks. In LTM the non-sense syllabus are generally used. These refer to either a consonant, vowel, consonant (CVC) or at times consonant, consonant, consonant (CCC), of different association values.

Memory is a process in which individual encode, store and retrieve the information. The two most common division of memory are Short Term Memory (STM) and Long Term Memory (LTM).

**STM**:

STM is the part of memory that holds the information about 30 seconds, although the length of storage depends on a number of factors e.g. nature of matter learned and serial position effect (Glanzer and Cunitz, 1966). The encoding is STM is generally phonological. The storing capacity of STM is ±7 chunks (Miller, 1956). The forgetting here is generally through displacement and interference and retrieval is rapid and serial exhaustive (Sternberg 1966, 1975). Rehearsal is very important in STM as it transfer information from STM to LTM (Rundus 1971). Craik and Watkins (1973) reported that elaborative rehearsal is more important than maintenance rehearsal for transferring information from STM to LTM.

**LTM**:

LTM is that part of memory which contains words, sentences, ideas, concepts and the life experiences we have experienced and it is retained for a very long period of time. It is assumed that there is no true forgetting in LTM but forgetting a result of mismatch between encoding and retrieval cues (Tulving 1972). Tulving have divided LTM into semantic and episodic memory. **Semantic Memory** contains the meanings of words and concepts and the rules for using them in language. **Episodic Memory** contains the memories of specific things that have happened to a person (reminiscences).

Individuals perform different tasks by acquiring, storing, or retrieving information with the help of cognitive skills (Scheid, 1989). Students with learning disabilities are less mature in their repertoire of memory strategies and in their awareness and use of these strategies. Generally they do not use spontaneous verbal rehearsal efficiently, do not organize information for recall, do not use memory cues unless prompted, or do not use all the available cues. They seem unaware of how
memory could be facilitated or which strategies are appropriate on different tasks (Owings, Peterson, Bransford, Morris and Stein, 1980). But LD students can be taught how to (a) approach tasks (b) use strategies to facilitate learning, and (c) monitor their own performance to determine if effective learning is occurring (Brown and Palincsar, 1987).

**Dealing with LD**

A variety of specific strategies are used to deal with specific LD:

1. **PLEASE** is designed to facilitate meta-cognitive problem solving. The strategy provides students with a repertoire of behaviours through the use of a first letter task independently. In this technique students are taught to:
   - (i) **Pick topic** - students are taught how to pick their topic, their audience and appropriate textual format.
   - (ii) **List idea** - in it students are taught various techniques of listing information about the topic to be used in sentence generation.
   - (iii) **Evaluate list** - in it students are taught to evaluate and best way to organize the ideas and generate supporting sentences.
   - (iv) **Activate paragraph with topic sentences** - students are instructed how to write a short and simple declarative topic sentence
   - (v) **End with concluding sentence and Evaluate work** so that the students can evaluate their written work for capitalization, overall appearance and spelling.

2. **SQ3R** is a useful technique for fully absorbing/grasping written information. It helps to make a good mental framework of a subject, into which one can fit facts correctly. It helps a person to study 'goals'. It also prompts an individual to use the review technique that will help to fix information in the mind (Kuther, 2001). In this technique following steps are used:
   - (i) **Survey** - scan the contents, introduction in order to pick up a shallow overview
   - (ii) **Question** - make a note of questions on the subject that come to mind, (iii) **Read** - read in detail through useful sections
   - (iv) **Recite** - run through the appropriate sections of the documents in mind several times
   - (iv) **Review** - this review can be by rereading the document, by expanding notes, or by discussing the material with others.
3. TREE – writing problems are dealt with it (Graham, Harris, and MacArthur, 1991). In this,
(i) topic is to be identified on which the one is writing a paper,
(ii) React to each paragraph - explain the selected topic,
(iii) Examine reasons - the third step is to examine each sentence in each paragraph
(iv) Ending - write a concluding paragraph or summarize the main ideas of the paper.

A detailed look on the strategies clearly indicates that there is need of in-depth understanding of the problems of the LD and the techniques being used as a strategy. A lot of expertise about how to use a strategy, and their actual implementation is required. Further these strategies have been specified for a specific problem e.g. either reading or writing etc. This limitation of specificity and specialization has limited the use of the well known, well researched and well established strategies. It would be highly beneficial if some technique could be looked for, that does not need any training, is easy and economic in terms of money and efforts, requires no much patience to handle the LD population and the like. To the view of researcher, perhaps one such technique could be the negative ion therapy. Environment controlling efforts have led the people to develop artificial air-conditioning for temperature regulation and maintenance of freshness in houses, clubs and workplaces which reduces the quality of the air, on which the person depend for the survival. All this increase the positive ions in the inside air.

Air Ions:

Air is the most important resource for our survival. One can live for a few days without water or food but can not survive even a minute without air. One breathes 10,000 litres of air per day to maintain life. An important component of air necessary for survival is the air ion. There are ions in the air around us all the time, but changes in their concentration or in ratio from positively to negatively charged molecules can have marked biological effects on plants and animals. Indeed ion depletion and charge imbalance may play a significant role in wide human ailment.

All air borne particles on which electrical forces exercise an essentially greater effect than the forces of weight and inertia are called air ions (Laza, 2000). Or in other words, electrical charges of the atmosphere are called ions (Goldstein and Arshavskaya, 1997). Ions are atoms or molecules that have gained or lost an electron. Ions are formed when an electron is detached from a neutral molecule or atom. The original molecule becomes positively charged. The molecule which loses an electron
becomes a positive ion and the molecule on gaining an electron becomes a negative ion. When sufficiently high energy acts on a gaseous molecule ejecting an electron an air ion is formed (Robinson and Dirnfield, 1963).

Balance of positive and negative ion in air is called ionisation. Every molecule has a nucleus of positively charged protons surrounded by a field of negatively charged electron. In a stable molecule there is equilibrium of the two forces. Electron can be displaced easily from their orbit as they are 1800 times lighter than the protons producing negatively charged molecule. The original molecule becomes positively charged. Molecular collisions transfer the charges, so that positive charges come to reside on molecules with the lowest ionisation potential, while electrons are attached to the species of the greatest stability. Small number of molecules of water vapour, hydrogen and oxygen cluster to form small air ions. In normal pollutant free air over land, there are 1500-4000 ions/cm$^3$ (Krueger, 1972; Ryushi, Kita, Sakurai, Yasumatsu, Isokawa, Aihara and Hawa, 1998).

The energy for ionization comes from a variety of natural environmental sources including background radiation, cosmic rays, electromagnetic waves of solar origin, waterfalls, radioactive elements in soil, ultraviolet radiation, storms, winds, and the friction of blowing sand or dust. When people breathe clean mountain air, go to beach, around waterfalls and moving water (including showers), they absorb negative ions. The friction created by the movement of the molecules displaces electron, creating an abundance of tiny negatively charged oxygen molecules. These molecules are breathed into our lungs entering the blood stream. This is the main source of energy for the living organisms.

Negative air ions are of various sizes; small, medium and large. Only the small negative ions can be inhaled and can have their positive biological effects. Small air ions of oxygen are found in refreshing or invigorating environment such as at waterfalls, in pine forests, or on the seashore where waves are breaking on the rocks (approximately 4,000 small negative air ions/cm$^3$). Ryushi et al (1998) reported the 1,00,000 negative ions/cm$^3$ at Yosemite Falls. Person feels ‘recharged’ after breathing in such environment (highly charged air containing small inhalable oxygen ions).

**Effects of Air Ions:**

Ancient textbook on Yoga also suggest that for a perfect mind and body, breathing exercise should be practised near a waterfall, in a cave or, best of all, in a
cave under a waterfall. The Yoga masters may not have known about negative ion, but they were familiar with their beneficial effects (Soyka and Edmands, 1977). Even in the modern time scientists are experimenting on this valuable and life supporting energy.

Negative air ions are more mobile and earth’s surface repels the negative ions due to negatively charged surface. The ratio of positive to negative ions in normal pollutant free air over land is 1.2 to 1 (Krueger, 1985). On the other hand, urban areas have low negative count due to pollution which destroys negative ions; the level is below 100 ions/cm³ on Los-Angeles freeways during rush hours. The difference between fresh air in open natural environment and that found in stuffy, polluted building and vehicles is experienced physically by many.

In a survey in Rohtak (Haryana, India) on cognitive abilities amongst computer operators by Batra (2005) found no any significant effect of long working (i.e. 5 years) on computers on simple cognitive tasks.

Many experimental observations show that air ions are physiologically active and produce functional alteration varying from unnoticeable to considerable. Air ions produce a wide range of responses in different species for example in bacteria, protozoa, higher plants, insects and animals (including man). In some cases both positive and negative ions produce the same biological reaction, in other cases, they elicit the opposite effect. These charged particles are invisible and affect the physical and mental well being of a person (Batra, 2008).

(i) Positive air ions:

According to Topley (1992), all air pollutants, nuclear, industrial, and domestic, result in increasing the accumulation of positive charges in the surrounding atmosphere. The air in open country areas is predominantly positive due to probably wind-carried pollutants originating from distant industrial zones. At home, the screen of television gives off electric emission that generates positive ions in the air and on the surface of all items with the close vicinity of the TV set. The positive ion creates discomfort. On a hot dry day positive ions concentration increases which creates physical and psychological side effects. During dry winds about 30% of the population reported migraine, depression, mood swing, lethargy or respiratory symptoms (Krueger, 1976; Sulman, 1980; Sulman, 1984). Air abounded with positive ions increases body pain, sickness, headaches, dizziness, twitching of the eyes, nausea, fatigue, faintness, respiratory difficulties, allergies, asthma, heart and
circulatory disorders, low B.P., increased reaction time (Slote, 1961; Halcomb and Kirk, 1965), more pain sensitivity whereas psychological side effects of increased positive ions are increased irritation, insomnia, tension, emotional imbalance, exhaustion, compulsion to medication, apathy or listlessness towards work (poor school achievement), learning disability, insecurity, anxiety, depression (especially after 40-50 years of age), suicidal rate increased by 20%, larger number of admission to clinics in drug cases. It also disturbs the normal function of thyroid gland (Gualtierotti, 1968).

Krueger (1976) found that exposure of positive air ions increases the death rate in diseased mice. Other researches have also shown that animals became agitated, aggressive, and more prone to respiratory illness on exposing to positive ions. Batra (2002) studied the effect of video display units and found that video-operators inhale less negative ions as video displaying units generate positive air ions. Whereas a study conducted at Rohtak (Haryana, India) by Batra (2005) on computer operators found that those working on computer for last five years had poor subjective well-being. These health changes were due to electric changes in the atmosphere, particularly air ion concentration and ion polarity ratio. All these factors indicate a possibility of role of negative ions in memory.

(ii) Negative Air Ion:

In contrast to positive ions, negative ions promote alpha brain waves (Assaels, Pfeifer, and Sulman, 1967) and increase brain wave amplitude which lead to higher mental activation. Negative ions induced alpha waves spread from the occipital area to the parietal and temporal and even reach to the frontal lobes, spreading evenly across the right and left brain hemisphere, all of these produce overall calming effect, benefiting meditation and concentration. On the physical side, negative ions give relief from hay fever, sinusitis, bronchial asthma (Jones et al, 1976); allergies (Smith and Kruger); migraine and burn (David, 1960; Kellogg, 1984); and post operative pains (David, 1962).

It has been observed in many studies that these ions lessen infections, dry and heal the burn faster and leave fewer scars. Negative ions have also been shown to have positive effects on a variety of biological subsystems (Kotaka, 1978). Sulman, Levy, Pfeifer, and Superstine (1975) conducted intensive clinical and bio-chemical studies of Sharav patients and designed the cluster of sign and symptoms (migraine, nausea, irritability, etc.) the serotonin irritation syndrome. These complaints were
successfully treated by inhalation of air containing large number of small negative ions or by administration of serotonin blocking drugs.

Inbar, Rotstein, Dlin, Doton, and Sulman (1982) has reported that negative air ions improved cardio-vascular and thermo-regulatory system function in men performing a bicycle exercise trial in a hot (40°C) environment. Heart rate, body temperature and perceived exertion were all reduced.

Buckalew and Rizzuto (1982) reported relaxed and less tired feeling after exposing to negative air ions for at least six hours. The negative ions kill the harmful bacteria and lead to a person's well being (Batra, 2008). Batra and Kumar (2006) worked on the negative air ions and found an improvement in psychomotor performances.

These ions also improve the task performance and reduce stress caused by computer operation (Nakane, Asami, Yamada, and Ohira, 2002). Negative ions result in greater improvement for complex tasks than for simple tasks (Hawkins, 1985; Batra, 2005). All the studies discussed above are showing beneficial effects of negative air ions therapy on different areas. This therapy not only influences the cognitive performance of normal children but also of the learning disabled and mentally retarded (Morton and Kershner, 1980, 1984).

There are studies indicating an improved cognitive performance and memory (Baron, Russels, and Arms, 1985; Batra and Rashmi, 1997). To our awareness a series of studies were conducted by Morton and Kershner (1984, 1987, 1990). These studies indicated (i) enhanced incidental recognition memory for three groups of subjects (normal achieving, learning disabled, and educable retarded children); (ii) normalization of the right ear advantage on a dichotic listening task for learning impaired subjects; and (iii) a counter priming effect on the dichotic listening task, also for the learning impaired subjects.

Mechanism of Air Ion Action:

Long ago, it was stated that air ions bombard the skin surface and produce electrical currents, which not only exert a direct effect on nerve receptors but by penetrating the inner layers of the skin produce functional changes in subjacent organ. He also considered that 78% of the ions of various sizes inhaled may reach the alveoli where several reactions may possibly occur. The possible chains of events may include the following: (i) light ions penetrate the alveolar barrier and reach the blood directly; (ii) the fraction of the oxygen ions of the medium and the heavy ions
penetrate into the blood while the vehicle molecules remain in alveoli, and (iii) upon impact of the ions on the alveolar wall the electric charges affect the blood cells and the capillaries by electrostatic induction.

For knowing the exact mechanism underlying the response to air ions, researchers worked on the changes in blood levels of serotonin (5-HT), a powerful neurohormone. This can produce the profound neurovascular, endocrine, and metabolic effects throughout the body. 5-HT is involved in various processes such as sleep, nerve impulse transmission and in mood fluctuation. It is generally agreed that both the skin and the respiratory tract are ion receptors and latter is clearly more important one. Rogawski and Aghajanian, (1980) described that the serotonin appears to inhibit neural firing at the level of diencephalon, inhibiting the flow of information to higher cortical levels in rats. Some studies have linked high blood platelet levels of serotonin with such learning problems as mental retardation (Hanley, Stahl, and Freedman, 1981; Schain and Freedman, 1961) and attention disorders (Goldman, Thibert, and Rourke, 1979; Irwin, Belendiuk, McCloskey and Freedman, 1981). So high level of serotonin decreases the learning potential and reduction in it is potentially beneficial. Serotonin has been considered to be an important memory hormone. Negative air ion exposure reduce the serotonin (5-hydroxytraptamine, 5-HT) as reported by Diamond, Conner, Orenberg, Bissell, Yost, and Krueger,1980; Gilbert,1973; Krueger, Andriese, and Kotaka,1969; Krueger and Kotaka,1969. The serotonin reduction may lead to beneficial effects on information processing. There is much literature showing that high level of serotonin can interfere with learning, and presumed reduction in serotonin (drug induced or ion-induced) may facilitate learning. Positive ions raised the blood level of 5-HT, while negative air ions have opposite effects (Krueger, 1980).

With this background, we may now proceed to the second chapter of Historical resume.