# CHAPTER-1

## INTRODUCTION

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CHAPTER-1

INTRODUCTION

1.1 EDUCATION OF THE BLIND: PERSPECTIVE

1.1.0 Blindness is a sensory disability rendering an individual partially or totally sightless. A blind child is an exceptional child, in the sense that he deviates from the sighted child in his physical, mental and social characteristics to such an extent that he requires a modification of school practices or special educational services in order to develop to his maximum capacity (Kirk, 1963).

The visual impairment is universal, it can be found among people of any class, caste, religion, community or nation. Sometimes, this exceptionality is hereditary, sometimes environmental and sometimes it is the interactive effect of both.

The phenomenon of blindness has certainly been with human race since the dawn of its civilization. The blind were subjected to utter hostility, before they could receive the right of bare existence from the society. But it was of immense historical significance since it enabled some promising blind people to prove their intellectual prowess and, thereby, their usefulness for the community. We find examples of exceptional personalities in history.

Sporadic examples of excellent intellectual attainments by gifted blind individuals can be traced in world history commencing with the fourth century A.D. By 18th century there was a change in the social conscience about the status of this segment of society. It vibrated the minds of philosophers and compelled them for directing their energy towards
forwarding appropriate ideas for enabling common blind to receive education. The process was quickened and crystallized by the churning of political environment of 18th century in France. But, it was Valentin Haüy (1745-1822) who put these philosophical ideas and thoughts into practice.

France was the cradle of new attitudes towards blindness. The philosophical groundwork towards the education of blind was laid by Diderot, a physician to King Louis XV. In his essay "Letter on the Blind for the Use of Those Who See", published in 1749, he has given his own conviction about blind people that they could lead normal lives and that they could be intellectually competent. This essay was mostly based on his contacts with Nicholas Saunderson, an outstanding blind Mathematician, and Maria Theresia von Paradis, highly talented pianist. Diderot and his contemporaries in the United States supported the needs, rights, values and obligations of the individuals including blind people.

1.1.1 Lowenfeld gives the review of four phases in the evolution of the status of blind in society. These are 1. Separation, 2. Ward status, 3. Self-emancipation and 4. Integration.

In the first phase, in early civilizations, for example, Sparta, Athens and Rome, blind and other children with other defects were put to death in various ways. Even philosophers like Plato, Aristotle and Seneca approved it and it was also legally sanctioned. On the other hand some blind people were venerated by their contemporaries, as in case of Homer and Prophets like Tiresias and Phineous. This was a benevolent form of separation.
In the second phase, with the rise of modern religions like Christianity and Islam, which taught compassion and tolerance, the blind along with orphans and aged were protected and considered as wards of the society under the auspices of the Church and other religious Institutions. Asylums and hospitals were founded. However, most of the blind were left to beggars' lot and were dependent on alms from the philanthropic individuals and Institutions.

In the third phase, under the protection of this ward status some blind became well known as bards, singers and musicians. From the beginning of 18th century there appeared many blind individuals throughout the Western world who acquired education and became outstanding in various fields. Some by their own efforts while others having outstanding tutors who assisted them in adapting the tools of learning to their needs. Few such examples are Nicholas Saunderson (1682-1739), a Professor of Mathematics at Cambridge University and second is English Road Builder and Engineer Sir John Metcalf (1717-1810), third is Scottish poet and Minister, Thomas Blacklok (1721-1791) and a fourth, Swiss Naturalist Francois Huber (1750-1831), he specialized in the life of bees and fifth example is that of Maria Theresia Von Paradis (1759-1824) a famous Viennese singer and pianist. Many of these self-emancipators devised various ways of writing, doing arithmetic and higher mathematics, corresponding with each other and making embossed maps and other appliances individually needed by them.

In the West, education of the blind was pioneered by Valentin Hauy (1745-1822). His interest in the education of blind children was created after his two experiences. One, he saw some blind men in grotesque costumes performing a skit in a cafe, which elicited pity and ridicule from the audience. Valentin Hauy resolved to teach blind people to read so that they could earn their living in more dignified way. His second experience was
about Maria Theresia von Paradis. He had attended a concert given by Maria. Hauy was intrigued to learn about her ability to read and write using pinpricked letters (Koestler, 1976; Lowenfeld, 1975).

Hauy immediately set about fulfilling his earlier pledge to educate blind children. He established the first school for the blind in the world at Paris in 1784. His first student, Francois Lesueur, though a bright adolescent had to do begging to support his widowed mother and siblings. Francois agreed to study half the day so that he could continue begging the other half. Eventually, Hauy subsidized his education so that he could give up begging entirely.

In spite of political upheavals in France and in the life of his school, Hauy's contribution was a lasting one. He emphasized reading and fostered the development of embossed print and instituted vocational training at his school.

Another great contribution to the advancement of education for blind children was made by Louis Braille (1809-1852) in early 19th century. He developed and standardized embossed dot code. The significance of Braille's contribution is critical. Without a system of effective communication through reading and writing, the education of blind children would undoubtedly have remained as it had been through the Middle Ages (Lowenfeld, 1975; Kirtley, 1977).

It was over a half century after the foundation of Hauy's Institution that the first schools for blind children were opened in the United States. Three private schools were then founded almost simultaneously. In 1829, the New England Asylum for the blind, subsequently named Perkins Institution and Massachusetts Asylum for the blind, and now
called Perkins School for the Blind, was incorporated (Richards, 1909). Later, several special schools for the blind were established in various parts of United States. Samuel Gridley Howe (1801-1876) made innovations for the education of deaf-blind. Laura Bridgman and Helen Keller were notable deaf-blind persons who studied at Perkins.

The first sustained attempt to place children in a public day school setting began in Scotland. In 1872, the Scottish Education Act included provisions for educating blind children along with sighted children in public schools. This was most likely the first legislation which officially called for integrated education of blind pupils with their non-handicapped peers (Lowenfeld, 1975).

In the late 1890s in Chicago, parents tried to persuade the Board of Education to set up an Institution for blind children so that they could go to school near their homes. Frank H. Hall, the then Superintendent of Illinois School for the Blind, went to Chicago several times to convince the educational authorities not to set up a special institution but rather to enroll the children in the regular classes making only the special provisions necessary to enable them to complete their work. He believed that contacts and competition with their sighted peers with whom they would live and work in the future was preferable to segregation during the school years (Irwin, 1955).

In September 1900, Hall deputed one of his teachers, John Curtis to carry out an experimental programme in Chicago. He divided the city of Chicago into geographical grids and established a special room in one conveniently located school within each grid. Blind children spent most of their time in regular classes. Special teachers were employed to teach Braille and typing and to help the blind students achieve full participation in the schools (Abel, 1957; Irwin, 1955).
1.1.2 Just like in the West, in India too, the blind individuals were considered as very unfortunate persons in early days of civilization. They were looked upon with pity and sympathy in the society. There were no facilities for their education although blindness was no bar in acquiring knowledge in pre-writing period when knowledge was imparted through word of mouth. Amidst such hostile environment some self-emancipating blind scholars proved their intellectual utility and made a place in history. There are many examples of Indian saints and sages like Mahakavi Surdas and Saint Virjanand who were the embodiment of intellectual excellence. Some blind scholars are believed to have contributed Shlokas to our Vedas. References to the disabled are not infrequent in our Indian literature, particularly in "Sant Wangmaya".

Despite all these, the general attitude of the Indian society towards blindness has been a mixture of pity, sympathy and hostility. Genesis of many such attitudes may be found in history, traditions, culture, literature and religion of India. For instance, some of the Indian societal attitudes towards the blindness originate out of the belief in the theory of 'Karma' and the theory of 'Reincarnation of Soul'.

The blind are neglected and excluded, and there appears to be almost a conspiracy about it, howsoever unintentional it may be. Informal social relationships with sighted persons lead to a communication gap. This is on account of the lack of knowledge about how the mind of the blind works, and secondly due to the absence of knowledge about their special needs resulting in society giving either more than the required help or no help at all. And lastly, the lack of understanding of the basic fact that blind persons are like other human beings, possessing good as well as bad qualities, emotions and feelings of
love, hatred, pride, etc., high or low level of intellectual abilities as well as strengths and weaknesses.

Owing to centuries of isolation and segregation, the blind have remained a special class of people considered to be either gifted, geniuses and as possessing a 'sixth sense' or as poor souls who do not know even simple and elementary things of life. These stereotyped images are no doubt serious impediments in achieving equality for the blind.

The emergence of a democratic philosophy in this developing welfare country has recognized probably for the first time, the significance of individuality and exceptionality in the total development of blind persons and in the realization of the national goals of the country. Such a social change has brought about a significant departure in the attitudes and perceptions about the exceptional individuals. They are now no more considered as a social load, a burden to society, dependent on the mercy of the parents and able citizens.

The identification and recognition of individuality and exceptionality of the people with blindness has instilled in them the hope of being functionally useful, professionally productive and successful citizens of the country and contributing equally in the total development of the nation. Special education and effective psychological services constructed the success story of the exceptional children. This change in the attitudes and perception towards and about exceptional children in the Indian society and the political philosophy became evident in 19th century.

The 18th century produced many social reforms and political movements sending ripples of new ideas to all the corners of this land, which not only changed the physical world but revolutionized the minds as well. In such an environment of political awakening, social
vigour and cultural regeneration, Miss Annie Sharp, a Christian Missionary conceived the idea and gave birth to first ever school for the blind in the country at Amritsar in 1887. It was moved to Dehra Dun in 1903. It is now called Sharp Memorial School for the Blind. By the turn of century four more schools were set up. But the guiding force behind these Institutions was compassion and philanthropic benevolence and the instructions at these Institutions lacked sound pedagogical principles and were devoid of socio-economic realities. Many of them were not providing academic environment or educational infrastructure and could hardly justify being a school. However, their importance lies in presenting a challenge to build a sound educational system for the visually handicapped in independent India. Consequently the number of special schools rose rapidly and there were 115 in mid 60s (Kothari Commission Report 1964-66). By 1988, the number of such schools became around 200, (NIVH, 1990). The recent directory published by District Rehabilitation Centre (DRC) has put it about 250.

National Policy on Education (1986) has resolved to make special efforts to equalize opportunities for the disadvantaged group of disabled children. The N.P.E. Programme of Action (1987) stressed the need for a reach out plan to universalize primary education in the group of mild and moderately handicapped children with the rest by 1990 in the age group 6 to 11 years and by 1995 in the age group 6 to 14 years. This group of children was to be educated in common with other children in general schools. The Programme of Action (POA) also suggested that the disabled children who join special schools as soon as they acquire communication skills, self-help and basic academic skills may also be integrated with their peers in general schools. Only those disabled children whose needs could not be met in general schools should be taught in special schools. It implies that educational system will have to be sensitized and prepared for providing education to large number of disabled children in general schools. To achieve this goal,
review of the scheme of integrated education for the disabled and acceleration of the pace
of its implementation have been envisaged in the Programme of Action.

Most of the targets laid in POA, 1987 are yet to be achieved. The POA, 1992 suggested
action points for the Eighth Five-Year Plan, which were as follows:

1. Universal enrollment of all disabled children with minimum levels of learning through
curriculum adjustment that can be educated in common schools by the end of Ninth Five-
Year Plan.
2. Universal enrollment of those as well who can be educated in special schools or special
class in general schools with achievement according to their potential.
3. Reduction of dropout rates at par with other children. Access to Secondary and Senior
Secondary education with resource support and availability of vocational training
specially for mentally handicapped children.
4. Restructuring pre-service and in-service teacher education programme to the needs of
disabled.

The POA also suggested implementation strategies to translate this into practice.

Education is one of the essential inputs to ensure quality life to the individual. That is
why the right to education finds a place in the Constitution. The goal of universalization
of primary education (UPE) provides direction to planned developmental efforts. To
achieve this goal, educational facilities have expanded enormously in the post-
independence era. Millions of children have been benefited from these facilities. The
fruits of UPE have not, however, reached special groups of children despite its enormous
expansion in the post-independence era. The NPE 1986, therefore, laid special emphasis
on the removal of disparities and the need to equalize educational opportunities by
attending to the specific needs of those who have been denied equal opportunity. Outlining the steps to ensure equal opportunities for the handicapped, NPE states that objective should be 'to integrate the physically and mentally handicapped with the general community as equal partners, to prepare them for normal growth and to enable them to face life with courage and confidence'.

1.1.3 Recommendations of Various Commissions and Committees on the Education of the Blind

A 'Government of India Report on Blindness 1944' is very relevant. Most of the modern educational programmes for the visually handicapped in this country owe their origin to the recommendations of this Report. In accordance with its recommendations, a unit for the blind was established in the Ministry of Education in April 1947. The establishment of Central Braille Press at Dehra Dun also resulted from it. Kothari Commission (1964-66) considered the education of handicapped, including visually handicapped, at some length and advocated for making their education as an integral part of general education system. The commission wanted 15% school aged blind children to be educated by 1986, which is yet to be achieved. It also recommended a Cell at N.C.E.R.T. to study the work done in the country and abroad in the field of education for handicapped. The Cell was also required to prepare material for their teachers. It was set up in early 80s. The NPE'86 recognizes education as one of the essential inputs to ensure the quality of life for an individual. For this purpose, the Policy had laid great stress on the quality of educational facilities for handicapped, including visually handicapped. It proposed to achieve the goal of universalization of Primary Education by 1990 for the mild and moderately handicapped children in the age group 6 to 11 years. The handicapped children in the age group 6 to 14 years were to enjoy educational opportunities by 1995,
and with regard to severally handicapped children, by 2000 A.D. It had also forwarded
details about the special facilities to be set up at district level for all categories of
handicapped children and the number of inmates, provision of vocational training in
common with others or at the centre attached to such District Schools as well as the
financial assistance to be made available to such children. For the attainment of these
goals, POA has plans of organizing advocacy programmes for administrators and
teachers in common school system, including training component on the management of
this group of children, developing expertise at SCERT, preparing alternative learning
material and supplying necessary additional equipment for pre-vocational and vocational
courses in common schools. The real test ahead is how quickly it can help the visually
handicapped in receiving equal opportunities and full participation in all spheres of
social, cultural, economic and political life, not only in letter but in spirit also.

It is noteworthy that the schools established during this period adopted sound pedagogical
principles to guide their academic curriculum and socio-economic realities have been
kept in view while introducing additional activities. The goal apparently became to
prepare students to be socially useful and economically productive members of the
society. And, also, they have served their purpose successfully to an extent.

1.1.4 Johann. Wilhelm. Klien, founder of the Imperial School for the Blind, Vienna,
forwarded the concept of integrated education for the visually handicapped in early 19th
century. He endeavored to translate this idea into practical proposition by preparing a
Handbook to guide general teachers in their educational venture for the sightless. Samuel
Gridley Howe was much more enthusiastic in favour of sending blind students to
mainstream schools and considered "Special Schools" unnatural. In India, Union
Ministry of Education in collaboration with Royal Commonwealth Society for the Blind
(RCSB), now known as Sight Savers, made initial efforts to draw a scheme for the integrated education for the visually handicapped children in mid-sixties but the venture could not make significant breakthrough. It was in the year 1974, that the Union Ministry of Social Welfare prepared a scheme for this purpose. The first programme under this scheme was initiated in Govt. Senior Secondary School situated inside President's Estate, New Delhi. This Scheme provides many incentives in the form of extra emoluments to teachers dealing with handicapped children, grants to educational institutions for construction of resource rooms, purchase of additional equipment and also ensures free supply of books. The handicapped children are provided many allowances and facilities under this scheme. The task of implementing the scheme was transferred to the Union Ministry of Education in 1982, which, in turn, placed the responsibility of its implementation and drawing up of needed plan of action on the National Council of Educational Research and Training (NCERT). The scheme has since been revised in 1987, later in 1992, in the light of NPE, 1986 and NPE, 1992. The number of visually handicapped children has been rather small to take advantage from the scheme.

Integrated education appears to be sound and attractive as well as economical. However, its success depends upon various factors like the quality of teachers engaged in these programmes, initiative of school administrators, availability of needed special equipment, teaching aids, books in Braille and other material; and motivating seeing peers in accepting these children.

1.2 TEACHING OF MATHEMATICS:

Mathematics cultivates child's thinking and reasoning skills. The child learns to seek and discover ideas himself. Mathematics lays the foundation for systematical thinking
through the numerical and spatial aspects of the objects. The need to learn Mathematics differs to a great extent for the visually impaired in Special Schools and those who have been integrated to general educational programmes. In Special Schools while teaching Mathematics, some specific areas considered complicated, are omitted by the teacher. This omission causes discrepancy among the students in learning the subject. In the end all the students might have missed the same amount of information. This will not affect the homogeneity of performance among the blind students of a class. But in integrated programmes, situation is entirely different. The entire contents are taught in the class. An average student of the general school gets more information in Mathematics than students of a special school. Thus the visually handicapped child will be at a disadvantage if he is not provided with the necessary content to cope with the sighted children in an integrated setting. Mathematics as a subject is important for a blind child just as it is for other children.

For both sighted and visually handicapped children, modes of learning are different. Teaching to sighted children is through writing on the blackboard supplemented by oral instructions. While for a visually handicapped child mathematical Braille code, appropriate material and devices are important, along with appropriate teaching techniques and strategies.

Mathematical Braille code must be introduced to children as and when they occur in the text. By doing so children should develop knowledge about the Braille mathematical code and their practical use. Hence, earliest is the best. Right from the first standard, the child should be exposed to text material wherein Braille mathematical codes are incorporated. This will give him an idea regarding the format of presentation. For example, making all the 'equal to' signs vertically in the same column. They need to be
taught how to write different steps of a problem. Second, the students are taught the use of appropriate devices for mathematical calculations, such as Taylor Frame and Abacus.

Both devices have some advantages and limitations and, therefore, there are differences in their uses. For calculations, abacus takes less time than that of Taylor Frame. However, mathematical structure e.g., linear equations cannot be shown on abacus while it is possible in Taylor Frame. Similarly, formats in Geometry, Trigonometry and similar subjects cannot be presented either in abacus or in Taylor Frame. Still if both are compared in terms of time and utility, abacus has slight edge over the Taylor Frame. It is handy and can be easily carried by the child. To sum up, Mathematics learning is not very difficult but is a long process and makes the child and teacher feel that it is difficult. This cannot be achieved overnight, it needs continuous effort. In short, with proper material and good resource teachers’ and regular teachers’ co-operation and co-ordination and thorough follow-up of learning, learning of Mathematics could be made possible and easier for visually handicapped children in educational programmes.

1.3 IMPLICATIONS OF RESTRICTED VISION IN TEACHING LEARNING MATHEMATICS

According to Lowenfeld (1950), there are three basic limitations imposed upon an individual due to loss of vision. These are in the range and variety of his experiences, in his ability to get about and in his interaction with the environment.

Vision and hearing are two main distance senses. Vision has the most important function in serving as a unifying and structuring sense (Witkin, Birnbaum, Lomonaco, Lehr & Herman, 1968). In developing his conception of the world, the blind student relies upon
the use of his remaining senses. Touch and kinesthetic experiences as well as audition are the most important sensory avenues used for this purpose. Whereas vision gives details of form, size, colour and spatial relationship of objects, audition gives clues of distance and direction provided the object makes any sound. Audition does not assist in gaining concrete ideas of objects as such.

A blind person gains knowledge of the spatial qualities of objects only by tactual observations in which kinesthetic experiences play an important role. Since touch requires direct contact with the object to be observed, blind children often gain a partial knowledge of objects that they cannot observe in toto. Also, the sense of touch generally functions only if it is actively employed for the purpose of cognition. Whereas vision is active as long as the eyes are open. A blind student needs to learn systematically what a sighted child can pick up incidentally from the environment. Thus, a blind child is limited in the range and variety of his experiences and educational measures are necessary to overcome this limitation.

Blindness imposes restriction in mobility. A blind child does not feel free to move, to run, to play and to make merry as the seeing children do because of the lack of visual stimulation. On account of restrictions in mobility, a blind child's interaction with the environment is also restricted. Thus, he becomes deprived of a great amount of knowledge and information.

These direct effects of blindness have certain educational implications. The blind child gains knowledge but he gains it in a different way and the knowledge itself is sometimes of different nature (Lowenfeld, 1973). Visual experiences have a long distance object quality, which is unique among the human senses. The lack of sight causes detachment
from the physical and social environment. This loss of experience due to lack of vision is compensated to some extent through touch and hearing. But, both these senses have certain limitations. Distant objects (Sun, Moon and heavenly bodies), too large objects (mountains, large buildings, big animals), too small (an ant or a fly), too fragile (butterfly, air bubbles), moving objects (aeroplanes), burning or boiling objects cannot be observed tactually.

Blindness is certainly a major sensory impairment. In spite of that, blind children gain education by making use of their non-visual senses e.g. hearing and touch. Hearing has its main function as a medium of verbal communication. Since, much knowledge is communicated through language, blindness does not put the individual at a significant disadvantage in this respect (Cutsforth, 1950; Lowenfeld, 1973)

Similarly, tactile senses convey spatial form, surface quality, texture, resilience, weight, temperature and pliability of the objects to a blind student. Thus, blind students are able to gain education in all subject areas to a large extent including Mathematics. Mathematics is largely learnt by listening to the teacher. Mathematics makes use of power of imagination. The power of imagination has little to do with vision. Therefore, lack of sight should not restrict blind students from learning Mathematics. As mathematical concepts are abstract in nature, they need to be taught through systematic experiences in a sequential form.

In the days when rather formal teaching of Mathematics was initiated, it was optimistically stated that there were no difficulties inherent in the subject of Mathematics itself, which could not be overcome by blind pupils. A teacher, however, feels that there are difficulties both in the presentation of material and in the subsequent process of
understanding and recording results due to non-availability of requisite equipment and appropriate methodologies for the purpose. The teachers of Mathematics in special schools do not take interest in teaching Mathematics to visually impaired students. Due to these difficulties, as mentioned earlier, the teaching of Mathematics is done partially, i.e. by omitting the teaching of certain mathematical concepts like Algebra, Geometry, Trigonometry, etc. The difficulties outlined above are in fact not such that cannot be overcome, since many teachers out of their conviction and creative thinking have devised their own ways and means for teaching all mathematical concepts to blind students at par with their seeing counterparts, keeping in view the vital need and importance of the subject of Mathematics.

1.4 NEED, IMPORTANCE AND RATIONALE

The National Policy on Education (NPE, 1986) visualizes Mathematics as the vehicle to train a child to think logically, reason and analyze systematically, blind students cannot be excluded any way. NPE (1986) also aims at providing equal educational opportunities to all the handicapped children as the objective of education. Whereas, Mathematics makes the essential part of the curriculum at both elementary and secondary levels, but the teaching of Mathematics is not emphasized upon in most of the existing educational systems for blind students in India. In recent times, educationists have realized the importance of teaching Mathematics to blind students. The study of Mathematics is imperative in today's technological society.

Although visual impairment is a condition of the visual system, its effects may extend far beyond the visual system itself to affect every area of development, both perceptual and non-perceptual. In the perceptual area, vision provides a detailed, precise and continuous
source of information about objects and people. The impairment of vision removes or restricts this direct source of information. In the area of conceptual development, vision is important in the identification of objects, events and people, and it provides information about the short-term continuity of objects. If vision is impaired, the task of acquiring the integrated concept is much more difficult. Thus, there are a number of cognitive lags in the development of a blind child (Higgins, 1973).

In the first instance, Mathematics appears to be a difficult subject for blind children to grasp. On the contrary, it has been optimistically observed that there were no difficulties inherent in the subject of Mathematics itself, which could not be overcome by blind pupils. A teacher, however, feels that there are difficulties both in the presentation of material and in the subsequent process of understanding and recording results. Fortunately, many of the problems arising in the teaching of Mathematics have been energetically tackled by resourceful and imaginative teachers by developing and adopting concrete material in graded schemes of work to provide learning situations appropriate to the child's level of understanding, with greater success.

In order to use these situations as effectively as possible, a good deal of discussion is required relating to the objects handled and opportunities for tactile investigations and manipulations. Beginning at the simple level the pupils are lead into the mastery of different ways of recording and representing different mathematical problems and their solutions through increasing complex stages. The attempts at recording should be introduced gradually as the idea of pattern and relationship develops, so that what is symbolized is understood, and the whole process of developing mathematical concepts is tied in with vital activities. As experience and understanding increase, more formal and
more abstract work can be introduced, with problem posed and solutions worked out with a decreasing need to refer to concrete examples.

Blindness, though a major sensory impairment, does not restrict blind children from gaining education. By making use of their non-visual senses e.g. hearing and touch, blind children are able to gain education in all the subjects including Mathematics. Mathematics is largely learnt by listening to the teacher and making use of power of imagination. As mathematical concepts are abstract in nature, they need to be taught through systematic experiences in a sequential form. This is all the more important for blind children at elementary stage.

By studying Mathematics at primary level, blind students learn to master basic mathematical vocabulary and computational skills related to number, money, time, measures of length, mass and volume, large numbers, Geometry, etc. All these abilities acquired through the learning of Mathematics prove useful in many future life situations, including vocational and occupational settings. The system of mathematical concepts is beneficial in gaining and organizing knowledge of other subject areas. The basic mathematical concepts and skills taught at the primary level help the blind students to tackle real life problems.

The child with little or no sight has lacked or has received diminished incidental experiences in seeing printed or written words displayed in slogans and advertisements in his everyday environment. So visually handicapped children are likely to have a limited experience of visual patterns and shapes of the kind encountered by the fully sighted child in graphic and pictorial material as well as in the objects that surround him in his ordinary daily life. Not only in infancy, but as he is growing up too, his deprivation of
the clear visual experience of form and shape may put him at some disadvantage compared with the fully sighted child. Even in the secondary school stage Thwaites (1970) refers to the ways in which the visual stimuli of modern architecture and industrial design impinge on the minds of seeing children, and draw their attention to the mathematical concepts.

Traditionally, the learners are presented with mathematical expressions through textbooks and classroom presentations. The learners encounter the challenge of symbols without understanding them and, therefore, have dreaded symbols, and for that reason, Mathematics. The problems involve learning mathematical terms, their symbols and using them in expressions. For blind children the symbolic language does not pose any exceptional handicap. Once they are through the Braille code for literacy, mathematical code may be added gradually.

Since the goal of education is to train learners to function adequately in post school environments, it is important to periodically review the syllabus of mathematics being taught in the light of needs of the adults. Concepts of time, measurement, estimation, and Geometry play roles in action performed daily in post school environment. In fact, many of these mathematical concepts play a greater role than do computational skills. Thus it is very important to learn the subject of Mathematics as prescribed by NCERT and not to exempt any part or section of the syllabus for visually challenged students. There are certain sections in Mathematics, which seem to be difficult for students at that very stage. Keeping in view their importance and utility for the students in post school stage, these apparently difficult sections are not exempted for seeing children. The principle holds good for visually impaired students too. Certain concepts of Mathematics might be
difficult for blind students but can be learnt with slight modification in the method of teaching.

Unfortunately appropriate tactile material and aids are not readily available in schools to help the blind child in learning missing visual experiences and developing fundamental mathematical concepts and skills like counting, concept of shape, size and spatial relations, measuring and computation etc. Secondly, the pace of learning Mathematics by blind students and their individual differences are not taken care of by a teacher. Hence, there is an urgent need to develop a technique of learning which provides for making effective use of appropriate teaching material for learning Mathematics effectively and which also takes care of the pace of learning of blind students.

Attempts have been made to develop curriculum and learning materials for teaching Mathematics to blind children. One of the recent attempts has been the UNICEF-assisted project for developing teaching material and guidelines to use it for teaching Mathematics to blind children at primary stage (1988-90). These attempts, though innovative, have not yielded the desired wider results due to one or the other reason. There was an urgent need to look for effective alternative strategy.

National Policy on Education stresses child-centred and activity based approaches in teaching methodology. Each child has his own needs, interests and limitations, which need to be taken care of. The teaching should generate stimulating environment in the class. Students can learn any concept by themselves at their own speed provided the facilities are available to them.
Programmed Learning Technique has many distinct advantages and is one such important strategy, which has proved useful in many areas both in India and the western countries. In light of these facts, the present study intended to develop the programmed learning material in teaching Mathematics to the blind students at primary level and tested its effectiveness.

Programmed learning technique provides adapted equipment, textbooks and material to teach Mathematics to the blind students. In programmed instruction, the learning material is presented in such a way that learning becomes an interesting activity. Programmed learning technique does not provide any scope of passivity and inertia for the students. Programmed learning technique is based on Skinner's Theory of Operant Conditioning. In programmed learning, an information to be learnt is broken into small sequential units or frames. The learner makes a response to each of these frames. The learner is immediately reinforced for his correct response, which motivates the student. Also, the material is organized in hierarchical order, providing greater chances for the correct response. Thus, developing and using programmed learning material for teaching Mathematics to the blind students makes the teaching of Mathematics an interesting process and ensures its success.

Programmed Instruction implies self-instructional and self-controlled, carefully specified and skillfully arranged learning experiences. It is an application of the principles of behavioural sciences and technologies in the field of education. Sidney Pressey had actually designed several self-testing devices in 1920s; it was Professor Skinner who pleaded for application of the knowledge derived from behavioural psychology to classroom procedures and suggested automated teaching devices as a means of doing so.
Professor Skinner emphasized that to acquire or learn behaviour, student must engage in behaviour. It is not enough to attract students' attention but more important, the attention of the student should actually be directed to what the teacher wants them to learn. Reinforcement i.e. the knowledge of the correctness of learning behaviour, must be immediate and frequent; the knowledge that student is right is sufficient reinforcement to encourage him to learn more. Skinner also pointed out that "holding students together for instructional purposes in a class is probably the greatest source of inefficiency in education". In his view, if certain behaviour is expected of a student after the learning experience, he must be encouraged to perform in that manner during the learning session itself. A student learns better and is motivated to learn more if the step taken by him is confirmed to be correct, that is to say if the learnt behaviour has been reinforced.

It is easier to learn one step at a time. If the behaviour to be learnt were analyzed into parts, which are properly spaced and arranged in logical sequence, it would be easier to learn the whole desired behaviour by learning one step at a time. There should be few errors in the learning process so that the student practices correct responses and these responses are reinforced immediately by the knowledge of results so that he makes closer approximation to the responses which are the desired outcomes.

There are five principles of programmed learning. First, principle of small steps; second, principle of active responding; third, principle of reinforcement; fourth, principle of self-pacing and fifth, principle of student testing.

Some of the main characteristics of Programmed Learning are:
1. Programmed instruction is the process of constructing sequences of instructional material in a way that the rate of learning is maximized, motivation of the student is enhanced and understanding is fostered.

2. Assumptions about the learner, related to particular level of reading competence, command of vocabulary and his background in the subject matter are closely stated and put in definite terms.

3. The objectives underlying the programme are defined in explicit and operational terms.

4. The subject matter of the programme is presented by breaking it into small steps in a logical sequence. The small steps gradually increase in complexity and the information grows in depth. Changes occur in quality and quantity. Programmed learning lay emphasis on the interaction between learner and the programme.

5. The learner is made to respond actively. For doing it correctly the student receives reinforcement and establishes a pattern of stimulus-response-response interaction.

6. Programmed instruction sequence takes into consideration the initial behaviour of the learner with which it starts and the terminal competence in subject matter, which the learner is to achieve.

7. Programmed instruction provides for immediate feedback information. It is based on the theory of reinforcement.

8. Programmed instruction is based on the behaviouristic principles of psychology. A fair amount of stress is given on the development of understanding through the handling of various cues in the learning process.

10. In programmed learning situation the learner progresses at his own pace.

11. Programmed learning enhances the capacity of the learner to discriminate or to generalize by frequent application and thus offers the learner an interesting and challenging project.
12. Programmed learning provides for constant evaluation through the record of learners' responses. The quality of the programme can be improved through checking the number of errors at each step.

13. Programmed instruction enables the teacher to diagnose the problems of the individual learner.

14. The teacher can give explanation in the classroom if the error is common or he may arrange individual conferences on specific points.

15. Teachers are in a position to devote their time to more creative educational activities.

Programmed Instruction can be used in teaching different subjects. Teaching of Mathematics, along with the subjects like science, social studies and elements of Indian languages can be done with the help of this technique. The teacher has to formulate objectives of teaching a particular subject, undertake content analysis of the subject matter in the light of objectives, frame a chain of questions which will lead the pupils in the direction of the objective and present the questions to the students.

The teacher will have to play the role of a friend, guide and philosopher in the class when the pupils are engaged in solving their riddle. The teacher will have to do remedial teaching, as the weaknesses of his pupils will be located in the very act of learning. The pupils will also undergo a process of self-evaluation as he completes his work.

1.5 DEFINITION OF THE TERMS USED IN THE STUDY

Educational terminology has different interpretations; therefore, it is necessary to define key terms used in the study. This ensures that there is no misunderstanding of the theme as well as the results of the study. The following terms in the present study are defined.
A general definition of the terms used is followed by a more specific definition in context of the present study:

1.5.1 PROGRAMMED LEARNING:

1.5.1.1 In the words of J.D. Williams, 'Programmed learning' may be defined as, "The arrangement of material to be learnt into an orderly series of learning experiences, in each of which material is presented to the learner, a response is elicited and feedback given."

1.5.1.2 In the words of Apter (1968), "Programmed Instruction is a method of instruction in which the information to be taught is broken into small units which are to be presented to the students usually in the written form in a carefully planned sequence. Each unit or frame not only contains information but also terminates into a question."

1.5.1.3 Mankle (1988) has defined Programmed Learning as "Systematically planned, empirically established and effectively controlled self-instructional technique providing individualized instruction to the learner through logically sequenced small segments of the subject matter."

1.5.2 PROGRAMMED LEARNING IN THE PRESENT STUDY

In the present study Programmed Learning refers to a method of instruction in which the study material is presented to the students in the written form in a carefully planned and logically sequenced small units called frames. The learner makes response to the questions given at the end of each frame and gets immediate information about the correctness of his response.
1.5.3 PROGRAMMED LEARNING MATERIAL

The learning material used in understanding the concept, skill, presented in sequentially arranged steps, would be called Programmed Learning Material. The subject matter is presented by breaking it into small steps, called frames. These small steps gradually increase in complexity. The learner is made to respond actively and immediate feedback is given to him.

1.5.4 PROGRAMMED LEARNING MATERIAL IN PRESENT STUDY

In the present study logically sequenced units of information called frames were presented to the blind students in Braille followed by the relevant questions.

1.5.5 TRADITIONAL METHOD OF TEACHING

In Traditional Method of Teaching the teacher teaches through lecture method. The teacher makes use of a blackboard and chalk to support his teaching. No additional material is provided to the students. This method is also known as Chalk and Talk Method of teaching. In it the teacher plays the important role of giving lecture and explaining and students play less active role.

1.5.6 TRADITIONAL METHOD IN PRESENT STUDY

In the traditional Method of teaching Mathematics to blind children the students make use of Taylor Frame/Abacus (devices for calculation). Sporadic attempts are also made
by the teachers in developing some teaching aids, but largely the lecture method is
followed with textbooks in Braille.

Though the concept of Traditional Method was not there in the title of present study,
which aims at comparing the Programmed Learning Methodology with that of
Traditional Method of teaching, yet it is not out of place to define it.

1.5.7 EFFECTIVENESS

Effectiveness refers to the extent and the level to which the desired learning is achieved
at a faster pace with clarity of mathematical concepts, application of skills and
operations.

According to New Webster's Dictionary of the English Language (Edition, 1979),
'Effectiveness' means serving to effect the purpose; producing the intended or expected
results; in force or operation.

'Effectiveness' means having the desired effect; producing the intended result.

1.5.8 EFFECTIVENESS IN THE PRESENT STUDY

Effectiveness in the present study refers to the scores of blind students in the
Achievement Tests conducted after the completion of teaching of a concept in
Mathematics.
1.5.9 BLIND STUDENTS

1.5.9.1 Medical Definition of Blindness:

A person with normal eyesight can read the Snellen Chart's biggest letter E from 200 feet distance. If the vision of the person is so impaired that to see the Snellen Chart's biggest letter E, he has to come within 20 feet range or even nearer he is considered as legally blind in advanced countries. His vision is rated as 20/200. This is not a fraction of anything. It simply means that what he sees with difficulty at 20 feet that can be seen clearly from a distance of 200 feet by a normal eye. According to this definition a person is blind whose central visual acuity is 20/200 (i.e. 6/60 meters) in the better eye after correction (with correcting lenses), and/or the field of vision narrows down to 20 degree or less.

1.5.9.2 Definition as per `Persons with Disabilities' Act, 1995:

A. A person shall be deemed to be blind if he suffers from either of the following conditions, viz.: (a) total absence of sight, or (b) visual acuity not exceeding 6/60 or 20/200 (Snellen) in the better eye with correcting lenses, or (c) limitation of the field of vision subtending an angle of 20 degree or worse.

B. A person with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception or a visual field of less than 19 degrees from point of fixation, but who uses, or is potentially able to use vision for the planning and/or execution of a task.

In USA and some other advanced countries the definition is 20/200 or 6/60, but in many other countries the definition has not been accepted officially.
In India too, like USA and other advanced countries, the Union Social Welfare Department accepts 20/200 or 20-degree field for scholarship, concession and other financial purposes. In England for practical and statutory purposes, a very flexible definition i.e. 'too blind to perform work; for which eye-sight is essential' is accepted and practical limits are taken to be as visual field reduced to small area around the fixation point or alternatively a visual acuity is not more than 3/60 in the better eye.

Instead of a rigid definition, all the factors are to be taken into consideration to define the persons' functional abilities in different areas of education and rehabilitation.

1.5.10 BLIND STUDENT IN THE PRESENT STUDY

With respect to the present study, the blind students are those who either are totally blind or have only light perception i.e. they do not have functionally usable vision.

1.6 STATEMENT OF THE PROBLEM:

The problem at hand in the present study was to find meaningful way of teaching Mathematics to blind children, which has been a neglected area in the education of the blind. To study scientifically, the problem is stated as follows:

"Developing Programmed Learning Material for Teaching Mathematics to Blind Students and Testing its Effectiveness"
1.7 OBJECTIVES OF THE STUDY:

The present study was designed with the following objectives:

1.7.1 Main Objectives:

1.7.1.1 To develop Programmed Learning Material for teaching Mathematics to blind students at primary level.
1.7.1.2 To study the use of Programmed Learning technique as an alternative instructional strategy for teaching Mathematics to blind students at primary level.
1.7.1.3 To study the effectiveness of Programmed Learning technique for teaching Mathematics as compared to the traditional method of teaching.
1.7.1.4 To study whether programmed learning technique is equally effective irrespective of the gender i.e., both for boys and girls.
1.7.1.5 To study the strengths and weaknesses of Programmed Learning Technique for teaching Mathematics to blind students at primary level.
1.7.1.6 To study the effectiveness of programmed learning method in teaching the concept of large numbers to blind students.
1.7.1.7 To study the effectiveness of the programmed learning technique in teaching the concept of length and speed to blind students.
1.7.1.8 To study the effectiveness of programmed learning method in teaching the concept of mathematical operations, time and money to blind students.
1.7.1.9 To study the effectiveness of programmed learning strategy in teaching the geometrical concepts to blind students.
1.7.2 Subsidiary Objectives:

1.7.2.1 To develop relevant tools for use with blind students to study the effectiveness of Programmed Learning Technique in teaching Mathematics at Primary level.

1.7.2.2 To develop necessary teaching aids and text to be used by the blind students and their teachers.

1.8 DELIMITATIONS:

In a limited time, and with the limited purpose of study, it was not possible for the investigator to make extensive evaluation of programmed learning technique in teaching various subjects to blind children. Hence, the study has the following limitations:

1.8.1 Study was limited to the blind children having functionally unusable vision with no additional disability.

1.8.2 Study was limited to a sample of 30 boys and 30 girls (i.e. 60 blind students in total) from Special Schools in Delhi.

1.8.3 The subjects were matched on the Verbal Test of WISC-R for I.Q.

1.8.4 The development of Programmed Learning Material was restricted to certain identified concepts and skills, chosen from the syllabus prescribed by NCERT for Mathematics at Primary level.

1.8.5 Only Linear Programmed text was developed and Programmed Learning Material was developed in tactile form only.

1.8.6 The experiment was limited to Hindi medium only.

Having understood the limitations of the loss of sight, its educational implications, importance of learning Mathematics for a blind student, the objectives and limitations of
the study. The investigator undertook extensive review of the related subject matter with a view to assimilate the information on the related research. The relevant information gathered is organized and presented in Chapter-2 of the present study.