CHAPTER—I

INTRODUCTION
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INTRODUCTION

This chapter discusses the educational needs of children with Special Educational Needs (SEN) in general and Children with Visual Handicap in particular. Discussion also focuses on the concept of Mainstreaming - Integrated education and inclusive education as forms of mainstreaming. Discussion is elaborated under:

1.1 Education of children with special education needs

- Background
- Mainstreaming – Integrated Education
- Education of Children with Visual Handicap

Basic education involves imparting of basic skills of reading, writing and arithmetic. The study focused on development of arithmetic skills hence, importance of arithmetic skills, its development and evaluation at primary school level, is detailed under

1.2 Development of Arithmetic Skills

- Importance of Arithmetic Skills at Primary School Level
- Development of Arithmetic Skills among Children with Visual Handicap
- Evaluation of Arithmetic Performance

Cognitive development of a child and its relation to acquisition of knowledge and skills imparted through the education system has close relationship. Hence, cognitive development and its implications on development of arithmetic skills particularly at primary stage of education is presented under

1.3 Learning and Cognition- Piaget's Theory of Cognitive Development

- Piaget's Stages of Cognitive Development
- Significance of Piaget's Stages of Cognitive Development – General
- Significance of Piaget's Stages of Cognitive Development – Children with Visual Handicap
- Significance of Piaget's Theory for Development of Arithmetic Skills

Finally, the context of study is presented.
1.1 EDUCATION OF CHILDREN WITH SPECIAL NEEDS

1.1.1 Background

Education must empower an individual to lead a responsible life conforming to the societal norms and culture. Educational needs irrespective of any disadvantages forced upon an individual either by nature or the prevailing socio-economic conditions of the society are to be recognised as a basic human right. The goal of Universalisation of Education cannot be fulfilled until the needs of disabled children too are brought within the educational network.

1.1.1.1 Importance of Primary School Education

Emphasising on the need for providing basic education to all, goal 2 of Millennium Development Goals (The Millenium Development Goals, 2006), states that 'Providing children a basic education is the best investment the world can make in its future. Education reduces poverty by providing everyone with choices and opportunities to create a better life for themselves. Without universal primary education, no real progress can be made on the other Goals. Educated women have fewer children, get medical help sooner and provide better care and nutrition for their children. This reduces hunger, infant and maternal mortality, the spread of HIV/AIDS, and environmental damage' (paragraph 2).

The Government of India attaches great importance to the elementary education and has accepted the Universal Elementary Education (UEE) as the national goal. An attempt at realizing the national goal begin with the National policy on Education (NPE) 1968 and NPE 1986 as revised in 1992
which states – free and compulsory education of satisfactory quality should be provided to all children up to the age of 14 years, besides ensuring higher Government and non-Government expenditure on education that should constitute 6 percent of GDP before the commencement of twenty-first century. Primary education or basic education develops capabilities for human development and creates a base of numeracy and literacy that enables people to be more innovative and productive (United Nations Development Programme, 2001). It was an unfinished dream of the Government of India by the end of 2000 AD and could not practically be provided till today. Hence, a new scheme, Sarva Shiksha Abhiyan (SSA) has been evolved to pursue the UEE in a mission mode. The goals of SSA are: that all 6-14 age children (i) are in school/Education Guarantee Scheme (EGS) Centre/bridge course by 2003, (ii) complete five-year primary education by 2007, and (iii) complete eight years of schooling by 2010.

Structure of school education in India, is predominantly grouped into primary, upper primary, lower secondary and upper secondary school. First five years of primary education is also referred as lower primary school. Year 6 and Year 7 of schooling comprises the upper primary. As per the educational structure of India, the lower primary grades comprise of children in the age range of 5 and 6 years – 11 years. Structure of education in India, with typical age range and levels of education is given in the below picture.
Achievement of universal primary education is aimed at providing the primary education to all including children with special needs. Recently, more emphasis has been laid on the quality of education at the primary education level than just imparting the skills of reading, writing and arithmetic. Quality in terms of classroom environment, attention to varied needs of children, teacher training and community involvement is being promoted as a pre-requisite of completion of primary education. Re-iterating on the quality of education, National Curriculum of Framework 2005 emphasizes that 'Quality is not merely a measure of efficiency; it also has a value dimension. The attempt to improve the quality of education will succeed only if it goes hand in hand with steps to promote equality and social justice. Multiplicity of subsystems and types of schools tend to have a detrimental effect on the overall quality of the education system because the attention of the more articulate sections of society gets passed on a small fraction of the student population. It is desirable to evolve a common school system to ensure comparable quality in different regions of the country, which is the goal of this National Curriculum Framework, and also ensure that when children of different backgrounds study together, it improves the overall quality of learning and enriches the school ethos. In syllabus designing and textbook writing, the items showing sensitivity to cultural differences often come in as afterthoughts rather than as in-built features of the process. The case of gender and special needs is similar', (National Curriculum of Framework, 2005).

UNESCO promotes access to good-quality education as a human right and supports a rights-based approach to all educational activities (Pigozzi, 2004).
Within this approach, learning is perceived to be affected at two levels. At the level of the learner, education needs to seek out and acknowledge learners' prior knowledge, to recognize formal and informal modes, to practise non-discrimination and to provide a safe and supportive learning environment. At the level of the learning system, a support structure is needed to implement policies, enact legislation, distribute resources and measure learning outcomes, so as to have the best possible impact on learning for all (Education for All Global Monitoring Report, 2005).

Emphasizing on the quality of education, Education for All (EFA) Global Monitoring Report 2007 states: The EFA goals were conceived as an indivisible whole, addressing the rights of all children, youth and adults. Thus, the educational needs of populations in situations of conflict and crisis, or people who are marginalized through language, disability, poverty or culture, deserve special attention. The goals further call for quality in education for everyone, as a prerequisite for the acquisition of sustainable skills, knowledge and attitudes that enhance human capabilities and counter poverty and inequality (Education For All Global Monitoring Report, 2007).

The Millennium Development Goal (MDG) education target is that by 2015 all children will be able to enjoy a full course of primary schooling. It is the only absolute MDG and without the inclusion of disabled children, it will be one that is impossible to reach. The extent of the task is demonstrated by the fact that there
are over 150 million disabled children in developing countries, only 3% attend school (Facts on Children, 2006).

1.1.1.2 Definition of disability and Special Educational Needs (SEN)

Who are disabled children? Who are children with special educational needs? How are children with special educational needs identified? These are some of the questions that need to be answered before planning any educational services for children with special educational needs. An attempt is made in this section to provide a definition for disability and discuss some of the educational needs of children with special educational needs.

Julka (2006) outlining guidelines for practitioners of Inclusive education discusses definition of disability. Julka (op cit) states: "there is no single agreed upon definition of disability. There are different conceptual models of disability that suggest significant changes in the way disability is understood and explained. These models, programmes, and the rights instruments reflect two primary approaches or discourses: disability as an individual pathology (defect) or a social pathology. In other words these approaches can be expressed in a dialect of "medical model" versus "social model". The medical model views disability as a problem of the individual requiring medical care. This is to be provided to the individual as a treatment by professionals. In other words, it considers disability as an individual defect that needs to be corrected. The implication is that to be normal like others, persons with disabilities need to be cured by miracles or medicine. This has led people to believe that persons with
disabilities are not capable, not educable and not fit to study especially in mainstream schools. They are to be kept safely away in special schools amongst their own kinds" (pp.13-14).

Further, commenting on inequality in education system owing to the based on ‘medical model’, Julka (op cit) states “such exclusion from the mainstream schools and from society on the basis of disability is a striking example of inequality. On the other hand, the social model of disability views disability, as a socially created problem. For example if the child with disability is having problem in gaining access to the school and participate in the classroom it is not because of her disability per se but because of the school system that has failed to fulfill its obligation to be accessible to children with disabilities. According to International Classification of Functioning, Disability and Health (ICF, The World Health Organization, 2001), disability under the social model is not an attribute of an individual, but rather a complex collection of conditions, many of which are created by the social environment. Hence, the management of the problem requires social action, and it is the collective responsibility of the society at large to make the environmental modifications necessary for the full participation of people with disabilities in all areas of social life. The issue is therefore an attitudinal or ideological one requiring social change, which at the political level becomes a question of human rights” (p. 14).

Identifying the needs of the children with special needs, Julka (2006) states – “A child has special educational needs if s/he has difficulty in learning.
This may require special educational provision to be made for him or her. A child may have learning difficulty because of a disability which hinders his/her from making use of the existing educational facilities provided for all other children of her class. A child may have learning difficulty because of some other reasons too" (p. 24).

Kisanji (1999) reviewing the historical and theoretical basis of inclusive education mentions that inclusive schooling, in the first instance, recognises that special learning needs can arise from social, psychological, economic, linguistic, cultural as well as physical (or disability) factors, hence the use of the term "children with special needs" rather than "children with disabilities". Second, it recognises that any child can experience difficulty in learning, short-lived or long-term, at any time during the school career and, therefore, the school must continually review itself to meet the needs of all its learners.

Peters (2003) in a report to the World Bank regarding inclusive education: achieving education for all by including those with disabilities and special education needs quotes operational definition of Special Educational Needs (SEN) by International Standard Classification of Education (ISCED) that has been adopted by the Organization of Economic Co-operation and Development member countries. According to ISCED-97, Definition of Special Needs Education and Special Education Needs is - 'The concept of SEN extends beyond those who may be included in handicapped categories to cover those who are failing in school for a wide variety of other reasons that are known likely
to impede a child's optimal progress. Whether or not this more broadly defined group of children are in need of additional support depends on the extent to which school need to adapt their curriculum, teaching and organization and/or to provide additional human or material resources so as to stimulate efficient and effective learning for these pupils, (p.11).

1.1.1.3 Educational provisions for children with special needs

Having discussed the definition of disability and special educational needs in the previous section (section 1.1.1.2 Supra), various educational provisions made for the children with special needs is explored here.

Education should develop the whole child and cultivate all of the skills, attitudes, and knowledge necessary for successful integration into society. Schools should provide students with opportunities to discover, model, experience, and learn consequences. This is true for all populations of learners, both with and without disabilities; but it is especially true for students with developmental disabilities, because they often have difficulties with social, emotional, communication, motor, and behavioral development, in addition to academic learning (Alper & Ryndak, 1992).

Education is recognised as a fundamental right in India. India began its journey towards the goal of universal and free basic education little more than fifty years ago with the Indian Constitution stating, 'The State shall endeavour to provide, within a period of ten years from the commencement of this Constitution, for free and compulsory education for all children until they complete the age of
fourteen years'. From that statement to the formulation and adoption of the 
Persons with disabilities (Equal opportunities, Protection of Rights and Full 
Participation) Act passed on 22nd December, 1995 (Persons with Disabilities Act, 
1995), many milestones have been reached in providing educational services to 
persons with special needs. Recently formulated Right to Education Bill 2005 – 
Draft (Right to Education Bill, 2005) is a re-affirmation of the fundamental right of 
every child for basic education. Emphasising on the Child’s Right to Free and 
Compulsory Education of Equitable Quality, it is stated in the draft bill that ‘every 
child who has attained the age of 6 years shall have the right to participate in full 
time elementary education and to complete it, and towards that end shall have 
the right, subject to the provisions of this Act, to: i) be admitted to a neighborhood 
school in accordance with the provisions of Section 14, and ii) be provided free 
and compulsory education in such school, in the manner provided in this Act 
Provided that a child who, due to her severe or profound disability, or 
disadvantage, or nature of occupation of her parents, cannot be provided 
elementary education in a neighborhood school, shall have the right to be 
provided education in an appropriate alternative environment as may be 
prescribed’. The Free and Compulsory Education Bill 2004 (Free and 
Compulsory Education Bill, 2004), provides guidelines to the appropriate 
government to provide free and compulsory education to all children and pay 
special attention to the needs of the disadvantaged groups, which includes 
children with special needs. Outlining the duty of parents and guardian in this 
regard, it is stated in the Bill that - “it shall be the duty of every citizen who is a
parent or guardian of a child, unless prevented by a valid reason to enrol his child or ward in a recognised school; cause the child to attend such schools with at least such minimum regularity as prescribed and provide the child full opportunity to complete elementary education”.

The national commitment on this issue has been aptly summarised in the India Education Report, 2002 (India Education Report, 2002):

- The disabled have the same human rights as other citizens of a country.
- Increased autonomy of the disabled is a fundamental requirement if they are to obtain the same rights as their fellow citizens.
- Policy for the disabled should not be developed in isolation but should be an integral component of policies for society as whole.
- Integration of the disabled into the education system cannot be regarded as an issue separate from the policies for society as a whole.
- The disabled are entitled to a comprehensive education which provides continuity of service from early detection and intervention through schooling, vocational preparation, independent living in the community, and lifelong education.

Two historic legislations enacted in the 1990s have given education of children with special needs in India a sound direction and a solid footing. The Rehabilitation Council of India Act (RCI), 1992 (RCI Act, 1992 & Amendment, 2000) passed in Parliament was created by the then Ministry of Welfare
(presently known as the Ministry of Social Justice and Empowerment) to regulate manpower development programmes in the field of education of children with special needs. The major responsibilities of the RCI are to regulate training policies and programmes in the field of rehabilitation of people with disabilities; to bring about standardisation of training courses for professionals dealing with people with disabilities; to prescribe minimum standards of education and training of various categories of professionals dealing with people with disabilities; to recognise institutions/universities running degree/diploma/certificate courses in the field of rehabilitation of the disabled and to regulate recognition wherever facilities are not satisfactory, and to maintain a Central Rehabilitation Register of institutions possessing the recognised rehabilitation qualification.

According to National Policy for Persons with Disabilities, 2006: Education is the most effective vehicle of social and economic empowerment. In keeping with the spirit of the Article 21A of the Constitution guaranteeing education as a fundamental right and Section 26 of the Persons with Disabilities Act, 1995, free and compulsory education has to be provided to all children with disabilities up to the minimum age of 18 years. According to the Census, 2001, fifty-one percent persons with disabilities are illiterate. This is a very large percentage. There is a need for mainstreaming of the persons with disabilities in the general education system through Inclusive education. Sarva Shiksha Abhiyan (SSA) launched by the Government has the goal of eight years of elementary schooling for all children including children with disabilities in the age group of 6-14 years by 2010. Children with disabilities in the age group of 15-18 years are provided free

The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995 (Persons with Disabilities Act, 1995) has identified seven categories of disability, both physical and mental. Chapter V of the Act pertains to Education. It enjoins upon the government to ensure that every child with a disability has access to free education in an appropriate environment till the age of 18 years and inter alia provides for the establishment of special schools, facilities for imparting non-formal education and education through open schools/universities to disabled children, organising teacher training programmes, taking steps for adaptation of curriculum, reform of the examination system, promoting research and providing various facilities to the disabled children. Chapter IX emphasises the promotion and sponsorship of research, and giving financial incentives to universities to enable them to undertake research. Many of the aspects specified in the Act are being covered by the Integrated Education for Disabled Children (IEDC) scheme entirely, particularly in respect of facilities for disabled children (Articles 27[f], 30 [a-c]), and partly in respect of others.

As aptly pointed out in the India Education Report, 2002 (India Education Report, 2002), the last decade of the century has seen the recognition of the fact that children with disabilities and special education needs constitute a significant group in the monitoring of Education for All (EFA) targets. A number of enabling
provisions have been created by the way of legislation, through the role of premier institutions as well as capacity building of the government and the non-government organisations sector to provide inputs by way of manpower, learning materials, and others for upgrading the quality of educational programmes, especially at preschool and elementary levels. However, there are still serious challenges, which would require increased effort and decisions for ensuring educational facilities in all parts of the country.

At the international level, Article 3.5 of Meeting Basic Learning Needs proclaimed in the World Declaration on Education for All (Jomtien, 1990) states, 'the learning needs of the disabled demand special attention. Steps need to be taken to provide equal access to education to every category of disabled persons as an integral part of the education system'. Dakar Framework for education, 2000 (UNESCO, 2000) re-affirms the vision of the World Declaration on Education for All (Jomtien 1990) and states 'that all children, young people and adults have the human right to benefit from an education that will meet their basic learning needs in the best and fullest sense of the term, an education that includes learning to know, to do, to live together and to be. It is an education geared to tapping each individual's talents and potential, and developing learners' personalities, so that they can improve their lives and transform their societies'.

Emphasizing on education of the disabled, The Salamanca Statement on Special Needs, 1994 (UNESCO, 1994) proclaims that every child has a
fundamental right to education, and must be given an opportunity to achieve and maintain an acceptable level of learning. Every child has unique characteristics, interests, abilities and learning needs. Education system should be designed and educational programmes should be implemented to take into account the wide diversity of these characteristics and needs. Those with special educational needs must have access to regular schools, which should accommodate them within a child-centered pedagogy capable of meeting their needs.

Introducing Basic Guidelines for Including Disabled Children in Schools, UNESCO states, "over the years, through more careful consideration of the environments in which all children learn, specialists in the area of education for children with disabilities have adopted a more holistic view of such children's needs. There is now widespread agreement that mainstream learning environments can, and should, include children who may have particular learning needs due to developmental delay or impairment. There is a greater understanding of what is needed to make the mainstreaming of disabled children into regular schools possible and successful, and a growing awareness that the philosophy and methods of what is now called 'inclusive education' are much like the philosophies and methods proposed to achieve 'quality education'. Indeed, the shift to child-centred (as opposed to curriculum-centred) approaches to teaching and learning is blurring the lines between 'children' and 'children with special needs'. These approaches are based on a recognition that individual children learn, and develop, in different ways and at different rates, and they
seek to create a learning environment that responds to the needs of every child, including those with disabilities" (Save the Children UK, 2002).

“What we have accomplished in human rights is the complete conceptual switch stating that no child should be forced to adapt to education. The principle requires complete reversal. Education should adapt to the best interests of each child”, Dr Katarina Tomasevski, Special Rapporteur on the Right to Education, United Nations Commission on Human Rights, May 2004, (Albert, 2005).

Thus, it is evident that the focus has to be on the qualitative levels to be attained by the disabled through schooling and on sustaining the institutional and organisational structures for their educational development. Mainstreaming the disabled, into the education system has been approached in varied ways, of which integrated versus inclusive education models has gained more popularity owing to its practical implementation. However, either of these approaches cannot be implemented in its fullest sense due to numerous constraints. Below a discussion on Mainstreaming – Integrated Education and Inclusive education highlights the efforts made to implement these models including issues and constraints. General discussion followed by implementation issues at national and international level is also discussed.

1.1.2 Mainstreaming – Integrated Education and Inclusive Education

"Mainstreaming disability into development cooperation is the process of assessing the implications for disabled people of any planned action, including legislation, policies and programmes, in all areas and at all levels. It is a strategy
for making disabled people’s concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that disabled people benefit equally and inequality is not perpetuated. The ultimate goal is to achieve disability equality’ (Miller & Albert, 2005).

Recognising that the basic needs of the people with disabilities are the same as for all other citizens, intervention and provision of education of these children is mainly debated over two approaches – segregated versus integrated approach of education. Meeting the special needs of students with disabilities in regular schools has created many challenges for school leaders, teachers and parents of students with and without disabilities.

For the last twentyfive years or so the drive towards integration has been supported by international instruments such as the 1994 UN Salamanca Declaration, specific legislation such as the 1993 Special Education Act in the U.K., and the 1990 Individuals with Disabilities Education Act (IDEA) in the U.S.A. The movement has been supported in India by legislation -The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995. The intention is that the educational and social needs of children with special needs be met through effective and non-discriminatory programs in the regular school (Ward & Center, 1999).

Educating children with special needs invariably raises discussion about two major approaches of mainstreaming - integrated approach and Inclusive
approach. Both these approaches are discussed separately in the following sections.

1.1.2.1 Integrated Education

Integration is the opposite of segregation and the process of integration consists of those practices and measures, which maximize a person’s (potential) participation in the mainstream of his culture (Wolfensberger, 1972).

The idea of mainstreaming or integration was based on two assumptions. The first was that all disabled children are first and foremost learners, and many can be combined into a single special education programme. Thus, it combined children traditionally categorised as behaviour disordered learning disabled and educable mentally retarded into a single programme. Blind, partially seeing and partially hearing children also were included from time to time, as were speech handicapped, disadvantaged and gifted children. The second assumption was that most exceptional children (children with special education needs) could profit some integration in a regular class programme, provided they are properly scheduled and provided with appropriate services. A major focus of the approach, therefore, was to prepare exceptional learners for integration and participation in the regular classroom by means of a special education programme.

Community-Based Rehabilitation (CBR) network, India, 2000 (Helander, Rao & Kulkarni, 2000) stresses that integration is not a goal in itself. Placing a
disabled child in an ordinary setting is only a first step on the road to integration. CBR identifies the various forms and degrees of educational integration as:

(a) **Physical integration**: This form of integration attempts to reduce the physical distance between disabled and non-disabled children. A group of disabled children can form a Special Unit or Class that is physically attached to a regular school.

(b) **Functional integration**: This form of integration attempts to reduce the functional distance between disabled and non-disabled children. It may involve sharing of resources in activities such as music, art, drama and sports.

(c) **Social integration**: This form of integration attempts to reduce social distances and to encourage spontaneous contact between disabled and non-disabled children.

(d) **Societal integration**: This form of integration attempts to widen a disabled person's radius of interactive relations to achieve what the motto of the UN international Year of Disabled Persons 1981 summarised in words: “Full participation and equality” (pp. 4-5).

A National Policy on Education 1986 (National Policy on Education, 1986) and Programme of Action 1992 (Programme of Action, 1992) stressed the need for mainstreaming or integration of education of the disabled children. This programme is recognised to provide equal educational opportunity for the disabled children, sought to bring about effective measures to promote academic
development and vocational possibilities, achievement, self-sufficiency and independence among school-age children with different kinds of disabilities.

Integrated education provision as reported in India Education Report, 2002 (India Education Report, 2002) emerged out of compulsion rather than choice. In the process of bringing more disabled children under the umbrella of educational services, integration emerged as the cost-effective approach and, therefore, the general education system started accepting special needs children in general schools. The centrally sponsored scheme of integrated education that was initiated in 1974 is being implemented in various states of the country. Based on the Census Data, 2001 (Census, 2001) following tables depict the total number of enrolment of children with varied disabilities in the mainstream school and also data on disabled population being served by the Integrated Scheme of Education for Disabled Children (IEDC) particularly at primary and upper primary level of schooling. As the study focussed on a group of children with visual impairment in the state of Karnataka, the tables below show data for the state in regards to enrolment of children with varied disabilities in mainstream schools and schools under IEDC scheme.
Table 1

Enrolment of children with different disabilities in recognised schools
School Stage: Primary (Census 2001a)

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Visual Impairment</th>
<th>Hearing Impairment</th>
<th>Orthopaedic (Locomotor Disability)</th>
<th>Intellectual Impairment (Mental Retardation)</th>
<th>Others</th>
<th>Multiple Impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td>63,844</td>
<td>49,523</td>
<td>228,769</td>
<td>101,718</td>
<td>32,754</td>
<td>23,703</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td>47,983</td>
<td>33,323</td>
<td>132,822</td>
<td>60,795</td>
<td>21,538</td>
<td>14,375</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>111,827</td>
<td>82,846</td>
<td>361,591</td>
<td>162,513</td>
<td>54,292</td>
<td>38,078</td>
</tr>
<tr>
<td>Karnataka</td>
<td></td>
<td>3,750</td>
<td>2,434</td>
<td>7,861</td>
<td>5,298</td>
<td>1,751</td>
<td>1,190</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,744</td>
<td>1,873</td>
<td>5,127</td>
<td>3,551</td>
<td>1,261</td>
<td>796</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,494</td>
<td>4,307</td>
<td>12,988</td>
<td>8,849</td>
<td>3,012</td>
<td>1,986</td>
</tr>
</tbody>
</table>

Table 2

Number of schools according to availability of integrated education for Disabled children (IEDC) and number of teachers trained in facilitating teaching Children with disabilities (Census, 2001b)

<table>
<thead>
<tr>
<th></th>
<th>Primary Schools</th>
<th>Upper Primary Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Schools having IEDC programme</td>
<td>No. of teachers trained in facilitating teaching children with disabilities.</td>
</tr>
<tr>
<td>India</td>
<td>85,780</td>
<td>38,300</td>
</tr>
<tr>
<td>Karnataka</td>
<td>1,171</td>
<td>1,270</td>
</tr>
</tbody>
</table>

The data indicate that an effort has been initiated at a national level to bring out information on children with special needs. Under the District Primary Education Programme (DPEP) launched in 1994 (DPEP, 2004) as a centrally sponsored scheme, integrated education for all children with mild to moderate...
disabilities is being given special emphasis. National Policy for Persons with Disabilities, 2006 (National Policy for Persons with Disabilities, 2006) asserts the commitment made by Government of India in providing education for persons with disabilities with the following statement: 'It will be ensured that every child with disability has access to appropriate pre-school, primary and secondary level education by 2020'. The policy also mentions on the special efforts that will be made to ensure that the education to persons with disabilities is provided according to their special needs in an environment that is conducive for them.

Dash (2003) commenting on the preparation of a programme to integrate the disabled children in the regular classroom stresses on conceptualising the primary requisites for survival and success in such a classroom. Using the major components of any interaction between a teacher and a child – curriculum, conditions and consequences describes exceptional learners with respect to their competence and readiness in these three areas. Identifying the strengths and weaknesses in relation to curriculum, conditions and consequences, provides an administrative and instructional framework for increasing the competence of person with disability in these areas.

Further, World Bank (1994) reports that India has the largest number of children with special needs integrated into ordinary schools in the Asia region and, due to paucity of special schools round the country, an amount of casual and unplanned integration is already taking place, however, no major study has been done to review the efficacy of this integration.
For the past few decades, emphasis has been more on 'inclusive model' of education for persons with disabilities. National Policy for Persons with Disabilities in this regard states: “According to the Census, 2001, fifty-one percent persons with disabilities are illiterate. This is a very large percentage. There is a need for mainstreaming of the persons with disabilities in the general education system through Inclusive education”, (National Policy for Persons with Disabilities, 2006). Shift from ‘integration’ to ‘inclusion’ is not simply a shift in terminology, made in the interests of political correctness, but rather a fundamental change in perspective. It implies a shift away from a ‘deficit’ model, where the assumption is that difficulties have their source within the child, to a ‘social’ model, where barriers to learning exist in the structures of schools themselves and, more broadly, in the attitudes and structures of society. Underlying the ‘inclusionary’ approach is the assumption that individual children have a right to participate in the experience offered in the mainstream classroom.

Julka (2006) draws major differences between the Integrated and Inclusive approach to education of the disabled and mentions that – “Integrated education emphasizes placement of children with disabilities in mainstream school. The major thrust is on attendance. The school system remains rigid and as a result very few children with disabilities are able to cope with the demands of such a rigid system. This is a system that would not accept many of our children with disabilities on the basis of not being prepared enough. In other words, in integrated education, the child is seen as a problem and not the system. S/he is considered to be different from others and if s/he cannot learn it
is her/his problem. Hence, Integrated education is based on the medical model of
disability and views a child with disability with clinical blinders needing remedy.
Inclusive education, on the other hand is all about effective learning by all children including children with disabilities. It is based on the social model of
disability and considers that if the child is not learning then the system needs to be blamed. Integrated Education can be a stepping stone for inclusive education” (p. 10).

1.1.2.2 Inclusive Education

Inclusive education, which has its origins in special education, originally set out to meet the needs of learners who were being traditionally excluded from the school or were otherwise marginalized within the classroom. A series of shifts from focusing on the disabled child as a problem to focusing on changes in the management of the classroom, revealed surprising changes in learning. The results demonstrated benefits to those who were traditionally excluded from learning as well as all the others in the classroom. Today inclusive education or ‘inclusion in education’ is a conceptual approach aimed at achieving quality education by making changes to accommodate all learners regardless of their physical, social or psychological differences (Balescut & Eklindh, 2006).

The following UNESCO quote reflects more recent thinking by educationalists and researchers about the need to make school systems more inclusive - “Inclusion is seen as a process of addressing and responding to the diversity of needs of all learners through increasing participation in learning,
cultures and communities, and reducing exclusion within and from education” (UNESCO, 2004).

Over the years, the term 'inclusive education' has come to replace the term 'integrated education'. Many people working in the field of education consider these two terms to be meaning the same thing. They understand it as only a change in terminology and nothing else. In their words inclusive education means "including children with disabilities in regular classrooms that have been designed for children without disabilities," (Julka, 2006). Giving a broader understanding of the term inclusive education, Julka (op cit) states – "it refers to an education system that accommodates all children regardless of their physical, intellectual, social, emotional, linguistic or other conditions. The range of challenges confronting the school system while including children with diverse abilities and from diverse backgrounds have to be met by creating a child centred pedagogy capable of successfully educating all children. An inclusive class may have amongst others, children who are disabled or gifted, street or working children, children from remote or nomadic populations, children belonging to ethnic, linguistic or cultural minorities or children from other disadvantaged or marginalized groups" (pp. 7-8).

Inclusive education is considered to be a process of increasing the participation of all students in schools, including those with disabilities. It is about restructuring the cultures, policies and practices in schools so that they respond to the diversity of students in their locality. If, as is widely considered, quality
education is education that is responsive, relevant, developmentally appropriate and participatory, then inclusive education is also quality education (FRESH Tools for Effective School Health, 2007)

In India, inclusive education is still in its infancy. In this regard, it is noteworthy to mention about the work done by the Community-Based Rehabilitation (CBR) Network in South Asia (Helander et al., 2000). CBR defines inclusive education as a flexible and individual support system for children and young people with special educational needs (because of disability or for other reasons). It forms an integral component of the overall educational system, and is provided in regular schools committed to an appropriate education for all. Identifying the characteristics of Inclusive Education, CBR states:

(a) "Inclusive education preferably takes place in a regular class, in the student's nearest, regular school. Separation from the regular class environment – whether partially or, in exceptional cases, fully - occurs only where there is evidence that education in a regular class, accompanied by supplementary support and services, fails to meet the student's educational, emotional and social needs.

(b) Inclusive education recognises and responds to, the diversity of children's needs and abilities – including differences in their ways and pace of learning. It does so by using individualised teaching methods, adapted curricula, as well as tailor-made teaching aids and materials.

(c) Inclusive education is teamwork – a responsibility shared by the whole
school. But it is the regular classroom teacher who—provided with support services—plays the major role. Such support services may take different forms. They may include providing an itinerant/mobile, specially trained resource teacher, whose task is to advise and assist the classroom teacher, modification and adaptation of the physical environment, the curriculum, the timetable and evaluation procedures to that of organising appropriate guidance and counseling” (pp. 5-6).

There has been a rapid growth in the number of special schools alongside the promotion of integrated and inclusive education. In the early 1990s there were approximately 1,035 special schools but by 2000 the number had more than doubled to reach around 2,500, with most concentrated in urban areas, particularly in Mumbai (Singal, 2004). Special schools are the responsibility of the Ministry of Social Justice & Empowerment (MSJE) not the Ministry of Human Resource Development (MHRD). The MSJE provides ‘grants in aid’ to various NGOs to run these schools, though most do not receive any government funding. This means that there is a lack of oversight of special schools to ensure that the curriculum, teaching methods and overall care are of a high standard. Special schools also have vested interests, which in practice work against the development of inclusive practices. The rapid increase in special schools has undermined the development of inclusive education (Thomas, 2005).

At a global level more and more work is being done to address the issues of integrated education and build a continuum-based model of inclusive
education. The impact of inclusive education on students with and without disabilities and their educators has been described as equivocal in a recent review (Salend & Duhaney, 1999) that highlights the complex array of factors that contribute to the success or failure of inclusion programs. The conflict between ideological support for inclusion and the evidence of its difficult progress has led to calls for more rational discussion that acknowledges the realities of implementing inclusion and seeks workable solutions (Clark, Dyson, Millword & Robson, 1999).

The international movement towards inclusive education received significant impetus with the publication of the Salamanca Statement in which UNESCO called on all governments to adopt an inclusive education policy by enrolling all students in regular schools (UNESCO, 1994). Ward and Center (1999) on Success and Failure in Inclusion holds opinion that optimism about the placement of students with special needs is indeed desirable, but in their view, much of the uncritical nature of the discussion derives from confusion between inclusion as an ultimate goal, and inclusionist practice as a technical means of achieving the goal. Since inclusion is one of a number alternative approaches to its achievement, it should be subjected to the level of rigorous research-based scrutiny merited by its importance. This particularly applies to the academic achievement, an area that should be most accessible through IEP (Individualised Education Program) data.
In recent years, inclusive education policy to support the education of students with disabilities in regular schools has generated significant debate, not only in terms of its philosophy and ideology, but also in relation to the research evidence of efficacy and outcomes associated with its implementation (Kavale & Forness, 2000).

Even in the context of the most committed approach to Education For All (EFA), systems still exclude vulnerable groups of children from educational opportunities, so there is an urgent need for an inclusive approach to EFA. "The question is often asked why inclusive education is necessary as a new educational strategy, particularly in those countries that have a commitment to and apparent existing policies on education for all...Will the adoption of a strategy to build more inclusive education systems and institutions help or hinder the achievement of the very urgent and important objective of EFA? The answer is emphatic. Without the development of inclusive policies in education EFA will not be achieved", (UNESCO, 2001).

In relation to inclusive education, emphasising on the major issues faced by the educational leaders, Bailey (2002) states that “inclusive education requires significant resources in order to be implemented. Complaints of insufficient funding and lack of teaching resources to cope with inclusion are ubiquitous among educators responsible for its implementation”.

A continuum-based approach has been proposed by Jenkins (2002) in his research paper on continuum-based approach to inclusive policy and procedure.
According to this approach, emphasis is on focusing all policies and procedures for assessing each student's special needs, designing an IEP to meet the needs, and then drawing on the school's human and financial resources to meet each individual set of needs.

Figure: 1 A continuum-based model of inclusive education, Jenkins (2002).

Jenkins (op cit) concludes that appreciation of the complexity of inclusion leads to a focus on understanding the policies and practices that may either promote or diminish the effectiveness of inclusive processes in schools. When schools adopt an inclusive approach underpinned with a re-conceptualisation of
resource allocation to support the capacity of the schools as a whole, then, it is proposed that the inclusive education of students with disabilities is more likely to become sustainable.

The following words of Benget Lindqvist, United Nations Special Rapporteur on Disability amply clarify the concept of inclusive education (UNESCO, 1998) - "It is not our education systems that have a right to certain types of children. It is the school system of a country that must be adjusted to meet the needs of all children".

It appears that the demands of planning education for addressing the needs of disabled are not necessarily identical to those for general education services. The requirements of the children with disabilities, even in terms of the number and location of services, cannot be projected in the manner in which they are for any usual planning exercise in education. The issue is further complicated when carrying out an exercise for specific disability. For example, education of the blind throws up challenges that are different from those of the hearing impaired or the orthopaedically handicapped. Thus, it is recognised that there is a continuum of student needs which may require a corresponding range of alternative provisions, a principle, which is somewhat more controversial. For, although some educationists would claim that full-time inclusion in the regular classroom is the only acceptable placement in human rights terms, the vast majority, while broadly sympathetic to the principle, would be critical of its desirability in actual practice.
Summarising the modes of education made available to children with special needs, Jangira (1986) concludes, “All modes of education - residential, integrated and inclusive have the same goal of formal education of the disadvantaged groups. They, however, differ in the means of achieving the same. The residential education focuses at attainment of education through special schools, whereas integrated education aims at providing education to disadvantaged children within the ordinary educational system. Mainstreaming in the United States, Integration in the United Kingdom and India, Normalization in Scandinavian countries, though differing in conceptual and operational nuances, have the common denominator of educating children with special needs, as far as possible, in ordinary schools”. Johnson (1994)’s view resonates with the conclusion of Jangira (1986) that “with careful planning, it should be possible to meet the unique needs of all students within one unified system of education - a system that recognizes and accommodates for differences” (p. 158).

Children with Visual Handicap ([CVH] operational definition vide Section 3.4 Infra) bring their unique needs to the system of education that needs to be addressed in order to achieve the EFA targets and proclaim quality education. Below section discusses the education of Children with Visual Handicap in terms of their status of education and their special needs.

1.1.3 Education of Children with Visual Handicap

“A Visually Handicapped Child with an intact central nervous system who has not been provided with the opportunities to stimulate other possible sensory
experience finds it easy to become passive and disinterested in his surroundings resulting in a marked delay in his cognitive functioning. Such is the importance of early active exploration, exposure to a wide variety of concrete experiences and the deliberate planning of unifying experience to a substitute for the integrating power of the missing channel" (Lowenfeld, 1973).

Aims and purposes of education of the children with sight and children with visual impairment are same. Therefore, their curricular programme is also same. The environment of classroom, the special equipment and the special teacher are all provided to compensate for the visual defects, not to change the curriculum. Support services for teacher to cope the integration of the Children with Visual Handicap in regular schools is of much importance and the success of integration depends on the active participation of teacher in not only recognising the special needs of these children but also to ensure that the pedagogy and instructional material is adequately modified to meet the needs of these children.

**Prevalence of Visual Impairment**

The educational system can be geared to meet the demands of this special group based on the prevalent population who have been recognised to be Visually Handicapped and are in need of special services. Identification of children, who are born blind is not a difficult task. But children with less visual impairments may not be identified until they attend primary schools, where vision becomes important in the performance of schoolwork. A National sample survey
of India made a comparative statement on prevalence and incidence of the
disabled population in the 2001 census report (Data on Disabled population,
2004). Below Tables (3 – 6) gives an overview of the incidence of disabled
population by sex, residence and type of disability.

Table 3

Distribution of the disabled by sex and residence – 2001 India

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td>21,906,769</td>
<td>16,388,382</td>
<td>5,518,387</td>
</tr>
<tr>
<td>Males</td>
<td>12,605,635</td>
<td>9,410,185</td>
<td>3,195,450</td>
</tr>
<tr>
<td>Females</td>
<td>9,301,134</td>
<td>6,978,197</td>
<td>2,322,937</td>
</tr>
</tbody>
</table>

Table 4

Distribution of the disabled by sex and residence – 2001 Karnataka State

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td>940,643</td>
<td>661,139</td>
<td>279,504</td>
</tr>
<tr>
<td>Males</td>
<td>537,730</td>
<td>375,809</td>
<td>161,921</td>
</tr>
<tr>
<td>Females</td>
<td>402,913</td>
<td>285,330</td>
<td>117,583</td>
</tr>
</tbody>
</table>

Table 5

Distribution of the disabled by type of disability, sex and residence – 2001 India

<table>
<thead>
<tr>
<th>Type of disability</th>
<th>Sex</th>
<th>Total</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total disabled population</td>
<td>Persons</td>
<td>21,906,769</td>
<td>16,388,382</td>
<td>5,518,387</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>12,605,635</td>
<td>9,410,185</td>
<td>3,195,450</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>9,301,134</td>
<td>6,978,197</td>
<td>2,322,937</td>
</tr>
<tr>
<td>In seeing</td>
<td>Persons</td>
<td>10,634,881</td>
<td>7,873,383</td>
<td>2,761,498</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>5,732,338</td>
<td>4,222,717</td>
<td>1,509,621</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>4,902,543</td>
<td>3,650,666</td>
<td>1,251,877</td>
</tr>
</tbody>
</table>
Table 6

Distribution of the disabled by sex and residence – 2001 Karnataka State

<table>
<thead>
<tr>
<th>Type of disability</th>
<th>Sex</th>
<th>Total</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Persons</td>
<td>940,643</td>
<td>661,139</td>
<td>279,504</td>
</tr>
<tr>
<td>Total disabled population</td>
<td>Males</td>
<td>537,730</td>
<td>375,809</td>
<td>161,921</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>402,913</td>
<td>285,330</td>
<td>117,583</td>
</tr>
<tr>
<td>In seeing</td>
<td>Persons</td>
<td>440,875</td>
<td>304,701</td>
<td>136,174</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>241,439</td>
<td>164,907</td>
<td>76,532</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>199,436</td>
<td>139,794</td>
<td>59,642</td>
</tr>
</tbody>
</table>

Age-wise categorisation of the number of persons with disability in seeing (visual impairment) for the recent census (2001) has not been finalised. A survey conducted during 1990-1991 by Department of Welfare of Disabled, Government of Karnataka reports the age-wise (Table 7) prevalence of Visually Impaired group in the state of Karnataka, India (Survey of Persons with Disability in Karnataka 1991 – A Report, 2004).

Table 7

Survey of Persons with Visual Impairment in Karnataka, 1991 by age group

<table>
<thead>
<tr>
<th>Age Group (in years)</th>
<th>0-6</th>
<th>7-14</th>
<th>15-41</th>
<th>45-49</th>
<th>60-64</th>
<th>64</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>3805</td>
<td>6780</td>
<td>14139</td>
<td>6865</td>
<td>3895</td>
<td>8800</td>
<td>44284</td>
</tr>
</tbody>
</table>

As is evident from the above table, number of Visually Impaired population is fairly large and the government is committed to address their special needs. Among the various needs including identification, provision of facilities and special appliances, education is a crucial need that will help the person with visual impairment to become independent and enjoy full participation in the
society. It is imperative at this stage to enquire the importance and specific needs for education of persons with visual impairment.

**Educational Needs of Persons with Visual Impairment**

Visual impairment can modify the normal patterns of growth and development, creating barriers to learning. Scholl (1987) in this regard emphasises that the impact of these barriers will differ for each individual pupil, depending on the variables associated with the visual impairment (age of onset, degree of vision, etiology of the visual impairment); the presence of other educationally handicapping conditions such as mental retardation or emotional disturbance; attitudes of family, school, and community; and the social and cultural characteristics of the family. Not relying on visual senses for learning, Children with Visual Handicap adopt other sensory channels (eg: touch and smell) special skills and equipment of learning. Despite of these barriers, blindness does not preclude learning or economic independence provided modifications and adaptations are made for blind children in the regular school program. Stressing on the educational needs of Children with Visual Handicap, Hatlen (1987) categorically states that the learning needs of Blind and Visually Impaired can be divided into three categories: needs that are met by adapting the curriculum, needs that are met by changes in methodology (adapting teaching – learning materials for partially sighted and children with total blindness), and developmental and educational needs that are unique to these children. To serve the needs of these children, the educational system needs to be armoured with
an “expanded vision” that utilises the present resource levels and the unprecedented capacity to communicate for broadening the means and scope of learning opportunities. The need for special approaches for Children with Visual Handicap is re-iterated by Mukhopadhyay, Jangira, Mani and Choudhary (1987) has been highlighted by stating that the whole gamut of the curriculum for children in school and community is centered around two significant aspects, “the opportunity” and the “experience”. Often children are provided with opportunities but the mere provision of opportunities does not mean the acquisition of experience. The understanding of the self and the world is not “whole” when experience is denied (p. 64).

Education for the Visually Handicapped has to be tailored according to their needs, specifically speaking primary education of the Visually Handicapped should be to consolidate their development and help them in making up their deficiencies and to lay a sound and meaningful foundation for formal education from which the child can effect an optimum learning. The schooling should be spontaneous and structured in an encouraging environment. Upon leaving school, a child with visual handicap should be at par with his Sighted (operation definition vide Section 3.4 Infra) peer. Development in the areas of cognition, environmental interaction, self-grooming, 3R’s and vocational skills gain central importance in designing curriculum for the Visually Handicapped. Each of these skills are not divorced from each other but complements each other in the overall personality development of the child with visual handicap.
Scholl (1987) remarks that from birth onward visual impairments limit or deprive pupils of a valuable source of sensory input. This may have an impact on cognitive development, causing delays and deficiencies that interfere with social, emotional, psychomotor, academic, and vocational development. Learning by visual imitation often is not possible and incidental learning is limited. To compensate for these deficits, pupils must be provided with specialised media, materials, equipment, and instruction in compensatory skills to learn to use their limited vision effectively and efficiently and to maximise the use of other sensory channels in the learning process, primarily hearing and touch.

In a practitioners guide on Including Children and Youth with disabilities in education, Julka (2006) discusses some common characteristics of Children with Visual Impairment – The population of students with visual impairments is very heterogeneous. They may differ from each other on a number of factors like visual functioning, socioeconomic status, parents’ support, cultural background, age of onset of visual impairment, their cognitive abilities and the variety of experiences they have been exposed to. Some of them may even have more than one disability. However, one important characteristic common among all is the limited ability to learn incidentally from the environment. For example, a young child who can see properly is exposed to the alphabets incidentally before they start to read. These letters appear on boxes, on toys, on news papers delivered everyday at home or on street signs at various places. Such incidental opportunities need to be created for children with visual impairments. Some more characteristics common to children with visual impairments, include - 

\textit{Limitation in...}
the range and variety of experiences: Since the child with visual impairment cannot perceive objects in the environment beyond his/her grasp including those that are too large, too small or are moving, early concept development is particularly influenced. Limitation in the Ability to Get Around: Restriction in movement due to limited spontaneous ability to move may influence a child’s early motor development and early explorations of the world. This limited ability to move may result in reducing the opportunities for intellectual and social development of the child (pp. 38-39).

Placement of Children with Visual Handicap is a much-debated issue. From certain implementation experiences, it is being recognised that though integration of Children with Visual Handicap helps to reduce the gap of social interaction and fosters equal participation in the social setting, progress of education may lag for children in integrated setting in comparison to special setting. This is due to the special modalities that are used to educate the Child with a Visual Handicap. In a regular setting unless, the child has mastered these modalities may find it difficult to keep the pace with the Sighted peer and the teacher might find allocation of more time and resources for these children thus, hampering the regular classroom interaction. In an informal discussion with a Headmaster of a Special School for Blind in Karnataka, he critically commented upon the possibility of integrating the Children with Visual Handicap in regular schools – “our efforts to integrate Children with Visual Handicap in regular classroom remains questionable as recently a child with visual handicap was referred back to the special school owing to his failure to keep pace in using
Braille and further, the teacher was unable to provide sufficient support to meet his needs. Incidents like such forces us to question: is it worth considering the option of integration without the education system geared to meet its special demands?" Though support services like provision of special teacher/itinerant teacher are recommended, however does not yield the expected result of instructing Children with Visual Handicap at par with the Sighted. Thus, the debate on educating the Children with Visual Handicap in integrated setting or in special school continues. With the emergence of continuum-based model of inclusive education, Children with Visual Handicap can benefit from both the ends of the pole and can be successfully integrated not only socially but also educationally into a system that is common to all.

Considering the recent developments in the education of the Visually handicapped in India, it could be observed that there is an increase in school enrolment, training of teachers for Children with Visual Handicap and the implementation of integrated education for the disabled in a number of general schools.

1.2 Development of Arithmetic Skills

In the previous section (1.1. Supra), the special educational needs of children in general and children with visual impairment in particular have been highlighted. In this section development of arithmetic skills (operational definition vide Section 3.4 Infra) among Sighted and Children with Visual Handicap have been discussed with due weightage to the importance of arithmetic skills, the -
Emphasizing on the compulsory curricular areas (i.e. language, mathematics, science and social science) of education at lower primary, National Curriculum Framework 2005 (2005) states - The teaching of mathematics should enhance the child's resources to think and reason, to visualise and handle abstractions, to formulate and solve problems. This broad spectrum of aims can be covered by teaching relevant and important mathematics embedded in the child's experience. Succeeding in mathematics should be seen as the right of every child (p. ix).

Knowledge of mathematics and proficiency in basic operations of numbers is very essential in everyday life. It is essential that learning of content takes place in a context wherein the knowledge will be used. Thus, mathematics which focused on rote learning and knowing facts devoid of context and application has been replaced with one in which mathematics has some purpose and application, and where becoming numerate is conceptualised in a broad way (e.g. Department of Education Training and Youth Affairs (DETYA), 2000). Such a vision considers mathematics and becoming numerate in the context of societal and individual expectations.

Developing children's abilities for mathematisation is the main goal of mathematics education. The narrow aim of school mathematics is to develop 'useful' capabilities, particularly those relating to numeracy—numbers, number
operations, measurements, decimals and percentages. The higher aim is to
develop the child's resources to think and reason mathematically, to pursue
assumptions to their logical conclusion and to handle abstraction. It includes a
way of doing things, and the ability and the attitude to formulate and solve
problems (National Curriculum Framework, 2005)

Underlining the importance of Mathematics Curriculum, National Principles
and Standards for School Mathematics, NCTM (2000) highlights that
mathematics is a highly interconnected and cumulative subject. The mathematics
curriculum therefore needs to introduce ideas in such a way that they build on
one another. Instead of seeing mathematics as a set of disconnected topics,
students should perceive the relationships among important mathematical ideas.
As students build connections and skills, their understanding deepens and
expands.

The curriculum must also focus on important mathematics. Mathematics
that is worth the time and attention of students and that will prepare them for
continued study and for solving problems in a variety of school, home, and work
settings. The relative importance of particular mathematics topics is likely to
change over time. Topics such as recursion, iteration, and the comparison of
algorithms have emerged and deserve increased attention because of their
relevance. Students should have opportunities to learn increasingly more
sophisticated mathematical ideas as they progress through the grades. They
should not spend a significant part of their instructional time reviewing
mathematics content. A well-articulated curriculum is necessary for teachers at each level to know what mathematics their students have already studied and will study in future grades (NCTM, 2000).

Current study focused on the basic skills of numeracy – numbers and basic operations using numbers. Therefore, development of arithmetic skills in the context of this study is limited to the discussion of Mathematics in general and arithmetic in particular. As most of the policies, papers and recommendations by practitioners of this field are in terms of Mathematics, hence the terms arithmetic and mathematics have been used loosely to connote the basic skills of counting, addition, subtraction, multiplication and division. In this section, the concept of arithmetic is initially discussed in general and then the discussion focuses on its development among Children with Visual Handicap.

1.2.1 Importance of Arithmetic Skills at Primary School Level

Children’s interests, physical skills, linguistic capacity, and ability for abstract thinking and generalisation develop over the span of schooling, from the pre-school period through higher secondary school. This is a period of intensive growth and development, and also of fundamental shifts and changes in interests and capabilities. Hence, it is an important dimension of determining the approach to, and selection and organisation of the areas of the curriculum. The creation or recreation of knowledge requires an experiential base, language abilities, and interaction with other humans and the natural world. Children entering school for the first time have already begun constructing knowledge of the world. Everything
they learn later will be in relation to this knowledge that they bring into the classroom. This knowledge is also intuitive. School provides opportunities to build on this in a more conscious and engaged manner. At the early stage of learning, from pre-school to the primary school years, an important place must be given to language and mathematics in all activities across the curriculum. The division into subjects is not very significant, and the knowledge areas discussed above can be totally integrated and presented to children in the form of learning experiences of the environment. This should include an enriching interaction with the natural and social environment, working with one’s hands, and understanding of social interactions, and developing one’s aesthetic abilities. These early integrated experiences of the natural and social environment would later become demarcated into science and the social sciences in the middle school years (National Curriculum Framework, 2005, pp. 33-34).

Emphasising on the need and importance of numeracy in early years of a child, Dole, Yelland, Latham, Fehring, Wilks, Faulkner, Lee, Masters, Lowrie and Glynn (2005) states that the importance of developing a numerate populace who can function effectively with the practical mathematical demands of everyday life in the 21st Century has been recognised worldwide (e.g., Australian Council for Educational Research, 1990; Department of Education Training and Youth Affairs [DETYA], 1999, 2000; Her Majesty’s Inspectorate, 1998; National Council of Teachers of Mathematics [NCTM], 1998). The process of becoming numerate is ongoing, and the years from birth to eight years of age represent a time of unparalleled growth (Anning & Edwards, 1999; NCTM, 2000) when the
foundations of skills and concepts are established. It also represents a time of opportunity to develop positive attitudes towards mathematics, which will contribute to the use of mathematics in everyday life.

Inferring the importance of numeracy experiences at lower stages of school education Dole, et al. (2005) suggest "it is particularly important that children acquire a good foundation for numeracy in the early years in a context that is supportive of all their efforts so that they feel positive about mathematics. This latter point is important since it is at this time that young children create beliefs and attitudes about what mathematics is, and the ways in which it is relevant to them".

Kamii (2000) has revealed that such beliefs will influence not only performance, but also the ways in which children perceive and make decisions about studying mathematics later in their lives. With this in mind, it is imperative that early childhood mathematical experiences engage children with concepts in ways that are conducive to the creation of a positive attitude to learning in the subject. This has been noted in official documents from the UK, such as the Implementation of the National Numeracy Statement (DfEE, 1998) which states that "it is clear that early learning can have a lasting and beneficial effect on children's later development" (p.15), and further that: One of its most important purposes is to prepare children to learn when they enter primary school. This means developing social skills, confidence, memorization skills and powers of concentration, (p.15).
Highlighting the importance of learning numbers, in Principles and Standards for school mathematics, NCTM (2000) states: Number pervades all areas of mathematics. Central to the Number and Operations Standard is the development of number sense. Students with number sense naturally decompose numbers, use particular numbers as referents, solve problems using the relationships among operations and knowledge about the base-ten system, estimate a reasonable result for a problem, and have a disposition to make sense of numbers, problems, and results. Computational fluency—having and using efficient and accurate methods for computing—is essential. Students should be able to perform computations in different ways, including mental calculations, estimation, and paper-and-pencil calculations using mathematically sound algorithms (NCTM, 2000).

In India, importance of teaching arithmetic at the primary school level has been highlighted in the objectives of mathematics outlined in the document on Minimum Levels of Learning (Dave et al., 1999) in mathematics. According to MLL, mathematics curriculum at the primary stage should, therefore, be directed to achieve the following objectives:

- Ability to perform computations, with speed and accuracy
- translate verbal statement(s) in mathematical form using appropriate symbols, and (b) diagrammatically
- make reasonable good approximations and estimate measurements
• apply mathematical concepts and skills to solve simple problems of day-to-day life
• think logically
• recognise order and pattern.

In this regard Maheshwari (1998) emphasises the identification and teaching of essential competencies, which have a practical bearing on the development of basic life skills. An exercise conducted at the District Institute of Education and Training [DIET], Bikaner, Rajasthan (1998) made teacher trainees identify such essential terminal competencies at the end of first five years of schooling, as they would be able to develop in each child irrespective of the inadequacies in the schools where they worked. Numeracy related essential mathematics competencies as identified by the teacher trainees are: Each child will be able to –

• read and write numbers in digits and in words
• use the basic operations of addition, subtraction, multiplication and division correctly and apply them in solving problems from daily life.

"Mathematics can provide children with ways to understand and appreciate the world around them and enrich rather than narrow children's experiences, Richardson, (2000)." Children begin to develop some sense about numbers long before they begin to count with their daily living skills. Such experiences are called Prenumber Experiences (Robert, 1998). Different steps
are involved in developing prenumber concepts that will lead eventually to meaningful counting skills. Each child based on the available experiences takes a different path to attain the prenumber concept. However, the basis of arriving at prenumber concept can be broadly summarised as development of classification, patterns, comparisons, group recognition and making connections. Following Figure 2 depicts the order of development of various skills necessary for early number development.

![Early Number Development Diagram]

**Figure: 2 Hierarchical development of prenumber concept**

Classification is fundamental to learning arithmetic and can be done without numbers. Young children learn to distinguish between cats and dogs, toys they enjoy and those they never use. Classification allows us to reach general agreement on what is to be counted. According to Payne and Huinker (1993) classification is a very important step in developing number sense and early counting skills. Exploring patterns, comparisons, phenomena...
conservation and group recognition are pre-requisites to counting and complex operations using counting.

Computation requires an understanding of addition, subtraction, multiplication and division and knowledge of basic facts for each operations. By using the facts, plus an understanding of place value and mathematical properties, a child can perform addition, subtraction, multiplication, or division with whole numbers.

![Diagram of Whole Number Operation]

Figure: 3 Basic facts for understanding whole number operations

One-to-one correspondence is the most basic arithmetic process. Counting one step ahead of one-to-one correspondence, the process of matching objects with the names of numbers, is the second simplest arithmetic process. The numbers that are used for counting—one, two, three, and four and so on - make up a special class of numbers and are referred to as a class by several different terms. They are called counting numbers, whole numbers or positive integers. They are also referred to as natural numbers because they
were the first kinds of numbers that occurred to people. Using numbers, major arithmetic operations involve:

- **Addition**: The process of combining two or more numbers to find the quantity represented by them altogether is addition.

- **Subtraction**: It is not a distinct process compared to addition. It is just the reverse of Addition. Subtraction basically answers two types of questions - When a number of things are taken away, subtraction answers how many things are left? And if two quantities are being compared, subtraction answers how many more are needed to make them equal or what the difference is between the two?

- **Multiplication**: It is a shortened form of addition, in other words multiplication is repeated addition.

- **Division**: It is the shortened form of subtraction, in other words division is repeated subtraction

Kennedy (1970) illustrates the relationship that exists among the four fundamental computational operations as:
Research into how children develop number sense makes it clear that the more varied and different experiences the more likely it is that they will abstract number concepts from their experiences (Payne & Huinker 1993).

Stressing the need for providing enriching mathematical experiences at an early age for a child, National Principles and Standards for School Mathematics, NCTM (2000) states: Developing a solid mathematical foundation from pre-kindergarten through second grade is essential for every child. In these grades, students are building beliefs about what mathematics is, about what it means to know and do mathematics, and about themselves as mathematics learners. These beliefs influence their thinking about, performance in, and attitudes toward, mathematics and decisions related to studying mathematics in later years. Children develop many mathematical concepts, at least in their intuitive beginnings, even before they reach school age. Infants spontaneously recognize and discriminate among small numbers of objects, and many preschool children possess a substantial body of informal mathematical knowledge. Adults can foster children's mathematical development from the youngest ages by providing
environments rich in language and where thinking is encouraged, uniqueness is valued, and exploration is supported. Children are likely to enter formal school settings with different levels of mathematics understanding, reflecting their opportunity to have learned mathematics. Some children will need additional support so that they do not start school at a disadvantage. Early assessments should be used not to sort children but to gain information for teaching and for potential early interventions (NCTM, 2000).

Thus, it is clear that development of Arithmetic Skills form an integral part of compulsive education for a child, and efforts must be concerted towards making the experience of a child with numbers as simple, interesting and curiosity generating one particularly at primary stage of education. This will lay the foundation for learning more complex operations of numbers and smoother transition into various other branches of mathematics.

1.2.2 Development of Arithmetic Skills among Children with Visual Handicap

Discussing the unique educational needs of children with visual impairment Education Work Group (2005) identifies that Students with visual impairments are limited in acquiring information through incidental learning since they are often unaware of subtle activities in their environment. Even though teaching of mathematics is one of the key areas in the schooling program, due to lack of opportunity for incidental learning (to identify, numerate, add, subtract in the environment) become passive without proper motivation to learn these basic
skills. A Sighted child may learn to count by seeing the pictures of objects eg: 1 candle, 2 balloon, 3 toys etc. These objects are naturally available around the child and the teacher/parent has to merely instruct the child to count a particular object. However, due to limitations imposed by visual impairment, a child with visual handicap will not be able to interact with the environment in a similar way. The teacher/parent will need to give specific objects to the child and create an atmosphere of learning for the child to develop concept of counting. An opportunity to learn incidentally for a Sighted child is available naturally and is a matter of exploration by the child using his sight. However, for a child with visual handicap, such an opportunity is missing and will need to be deliberately created for him to explore. Elaborating on the reduction in the range and variety of experiences for a blind child, Mukhopadhyay, Jangira, Mani and Raychowdhary (1987) comments, "as vision is the major mode of acquiring information, the visually impaired child learns in a fragmentary way. He has to have time to put these bits and pieces together to form a concept which is not exactly like that of Sighted but which is sufficiently like ours to enable us to communicate (p 64)". Hence, provision of rich experiences that may to a certain extent compensate the incidental learning is a prime requisite for teaching Children with Visual Handicap.

In the context of India, “the need for learning Mathematics differs to a great extent between the special schools for the blind and the Integrated Education Programmes. While teaching mathematics in a special school, some specific areas, which are treated as complicated, are omitted by the teacher. This
mass omission may not bring any discrepancy among the students in learning that subject. Generally, an average student of the regular school is getting more information in Mathematics than a student of the special school" (Mukhopadhyay et al., 1987). This is because of the curriculum framework, times resources and materials required to provide equitable teaching-learning experiences to Children with Visual Handicap. Time required for the child with visual handicap to understand the meaning of the concept without tactual experiences and once learnt to record it using a brailler and/or nemeth code is enormous. Hence, teachers in regular class setting tend to avoid difficult concepts for the child with visual handicap. Such concepts are considered to be dealt by the special resource teacher. However, not all schools have specialist resource teachers and further, the continuity of learning is disturbed as the child has to wait for the resource teacher to make him understand the concept. Thus, “the child with visual handicap will be in disadvantageous position if he is not provided the necessary content with some extra attention to cope up with the Sighted children in integrated setting”, Mukhopadhyay et al. (1987).

When an analysis is made regarding the mathematics teaching by the teacher and the mathematics learning by Children with Visual Handicap, various factors seem to be important for facilitating the children to learn mathematics effectively (Mani, 1984). Conducive learning environment, appropriate curriculum, effective learning process are some of the major factors influencing the acquisition of Arithmetic Skills among Children with Visual Handicap.
Curriculum and learning process as factors contributing to the development of arithmetic skills among Children with Visual Handicap are discussed below.

1.2.2.1 Curriculum

Curriculum is a vital part of education. It is constantly evolving and is a continuous process of constructing and modifying the information to meet the needs and expectations of the people. In a period where uncertainty, fluidity, flexibility and empowerment are the themes, educationists need to look for new theoretical framework that will illuminate key issues at different levels of curriculum development (Cheng-Man Lau, 2001). Various models guide the development of curriculum at any given time. Postiglione and Lee (1997, p. 2) suggest: ‘Schools do not exist in a vacuum They are a part of the society that surrounds them’. According to socialist approach, education not only responds to social changes, but also can act as a leading force for change. According to Cheung (1997), ”major changes in curriculum planning at the system level should not be seen merely as changes in methods of education. They are, as it were, changes in the wider society translated changes in within the educational system” (p. 127). Modernistic perspective differs entirely from the socialistic approach to what the curriculum should contain. According to modernists, curriculum development is a manifestation of the power distribution in the society. The Tyler (1949) Rationale is the most famous modernist model of curriculum development. The model has four main components of the curriculum: purposes, experiences, methods and evaluation. The four components resonate amply with the four management functions, advocated by Drucker (1974): planning,
organising, leading and controlling. Grundy (1987) argues that the modernist curriculum demonstrates the technical interest of the society. Education becomes a product-oriented manufacturing process view of curriculum process.

More recently, a post modernistic approach to developing curriculum has gained momentum and seems to free the development of curriculum from being response to the external demands and assigning educationists the responsibility of evolving the curriculum and involving the students in self-organising the learning experiences. Within this postmodernist context, Doll (1993) proposes a postmodern perspective on curriculum arguing for a more interactive approach in which learners are empowered to self-organise and transform. Unlike modernist perspective, which places power at the top, postmodernist curriculum advocates the decentralisation of power to where the learning is actually taking place.

Deciding which curriculum materials to use is one of the most important professional judgments that educators make (Project 2061, 2002). As a general rule (Teacher, personal communication, July 30, 1998), curriculum designed for the average Sighted student is advocated for Children with Visual Handicap. Stating the curriculum adjustment for Visually Impaired Children, it is mentioned: “Visually impaired children are expected to cover the same syllabus as their Sighted peers. In the absence of adapted curriculum to their needs, sometimes the curriculum is diluted or they are restrained from learning certain subjects” (Mukhopdhyay et al., 1987, p. 176). Means of achieving the educational goals prescribed may vary due to the learner limitations, environmental factors, and
technological factors and to a certain extent social and cultural factors. Limited research work in the area of curriculum has led practitioners to follow the same curriculum and methodology over the years with little or no change.

Discussing the factors contributing to the learning of Mathematics, Mukhopadhyay et al. (1987) state "It is said that in India mathematics textbooks are not generally available in braille for visually handicapped children. Moreover, this practice of providing a mathematical text should start directly from the beginning. Often, children who have already learnt mathematics just orally without a transcribed Braille text will encounter lot of difficulties when they are asked to read a mathematics textbook". Also, the right selection and usage of appropriate devices (eg: taylor frame, abacus etc.) is a must for mathematical calculations (p. 205).

Generally, there is no single way but many individual ways in developing mathematical skills in blind children. This is especially relevant to developing basic arithmetic competence. Blind children do not pass through the different stages of understanding i.e ways of handling numbers and the meaning and understanding of numbers, in a graduated, ordered and compulsory manner. On the contrary, their experiences are interwined and children shift between the different methods according to their interpretations and to the structure of the content (Ahlberg & Csocsán 1997, 1999).

The need for a plus curriculum based on the common goals of achieving the arithmetic competence equally for Sighted and children with visual
impairment is warranted. Concretised experiences at the lower levels leading to more formal and abstract experiences at higher levels will help the Child with Visual Handicap to acquire the arithmetic competence at a comparative level to his Sighted peer.

1.2.2.2 Learning Process

Mathematics, for the student who uses Braille (details vide Section 1.2.2.3:A Infra), commences in the early grades with an emphasis on the use of a variety of concrete, functional manipulatives. Gradually the Braille Write (also called Perkins), to record data, and the Abacus (details vide Section 1.2.2.3:B Infra) and talking calculators to compute problems are introduced and become major tools at the elementary level. The introduction of the Nemeth Code (details vide Section 1.2.2.3:D Infra) starts in kindergarten and its mastery is a focus right through to graduation. At all levels of instruction from kindergarten to graduation the student who uses Braille takes longer than his or her Sighted peers to read and record information (Visually Impaired Resource Guide, 2000). Mathematics learning process can be broadly discussed under the heading of learning experiences and that of mathematical understanding.

A. Learning experiences

Concepts grow out of the perceptual process and become enriched as the child develops language. The breadth of concept development is dependent in large measure on the breadth of the perceptual experiences. Because the blind child lacks one source of sensory input, his perceptual processes are deficient.
Highlighting the impact of perception on ability to remember and the difference between the Sighted and the blind in their ability to remember, Ericsson and Chase (1982) states that ‘in order to perform many tasks, blind persons must consult memory for information that seeing persons acquire by direct perception of the environments in which the tasks are performed while those tasks are in progress. If blind persons are to perform such tasks well, the information they need must be there when memory is consulted. Sometimes it is not there, for the reason that they did not remember to remember; that is, they did not remember that, in order to perform a particular task more skillfully the next time it must be performed, it will be necessary to commit certain information to memory. Consider this simple example - When moving into a room in an unfamiliar hotel, a blind person should remember the route leading from the elevator to the room (the sequence of turns, the distances walked between turns, etc.), in order to know how to return to the elevator. However, many blind people forget to do this, and as a result, when they step out of their rooms, they are lost. Blind children need training both in identifying the information that should be remembered and in remembering that information. This training should be continued until remembering has become a habit and they no longer have to remember to remember (Ericsson & Chase, 1982).

Remembering to remember what is learnt has implications for the visually impaired in learning of mathematical concepts and skills as well. Children with Visual handicap will need to remember on how to use various learning aids eg: Abacus, Taylor Frame and Brailler. Further, they also need to remember the
Braille codes specific for numbers. Arithmetic ‘types’ and ‘types’ for algebra that are used on Taylor Frame are different and while using the Taylor Frame they will need to remember the various rotations of the ‘types’ and the directions into which they fit. A ‘type’ with a specific end in a particular direction is assigned a number on Taylor Frame (Note: Details on Taylor Frame is given in section 1.2.2.3:C Infra).

The pedagogical significance of learning mathematics consists in its providing a structure for organising the experience of the child. Although the mathematical experience is founded on the physical and the psychological experience yet it is not identical with them or wholly dependent on them. Through the mathematical concepts and ideas human mind does not merely mirrors or pictures the material physical world but resonates with it. Mathematics deals with such general and abstract notions as elements belonging to a class, ordering, separating, combining, succession etc. The sensations from the various senses can be organised or structures with them. The mathematical relations developed refer not to the particular characteristics of the objects but to those operations which are independent of the nature of any particular object or doing them.

The constraints put by visual impairment result in restricting the richness and extent of physical experience both as a major precise source of sensations and precision with which form, colour and spatio-temporal organisation of objects is accessible through sight is not available through other senses. However, the elements of structural organisation are available through other modes of
sensations also can be fruitfully used to provide the mathematical experience to the Children with Visual Handicap.

"Children should arrive at an intuitive grasp of the mathematical concepts through experience with concrete and semi-concrete material adapted for their use. The order of complexity of arrangement of material should be conducive to a sequential learning of the concepts. For example, in teaching the concept of place value one should use counters, using a bigger or tactually different counter for every tenth object to be counted. This can be followed by use of a ten base abacus and only after this crammer abacus should be used. The same idea of place value can be given by Dienes apparatus consisting of cubes, long, flat and bigger cube. The flow of activities is from concrete exploratory activities leading to abstracting and intuitively grasping the concept to its application to other situations aided by language to generalising and use notations and symbols" Chander (1992, pp. 243-244).

The four Arithmetical operations can be taught using concrete and structured materials like number track, number board, unifix cubes etc. The structural properties and inter-relations among the four operations can also be conveyed by the use of these materials. Depending upon needs and situations the activities may take various forms. They may be manipulatory or exploratory, functional or operational, constructive or creative, drill activities or problem solving and remedial or enrichment. They may require successive modification or organisation of learning material or aids but the purpose is to enable the children
to comprehend the structure of mathematical forms by leading him through situations of increasing complexity. The structural isomorphism of various sensations ensures the mathematical experiences to the Visually Handicapped Children by appropriate adaptation of the learning material (Chander, 1992).

**B. Mathematical understanding**

Persons with visual impairment employ the same perceptual and cognitive processes as do those who see; but, for much of the information that regulates their interaction with their physical and social environment, they must consult different sources of information and acquire different sense data. Because this is so, there are important differences in the learning by which they become able to interpret the world around them accurately and respond to it appropriately. Our knowledge of human perception and cognition clearly suggests a number of differences in the methods, procedures and materials that are appropriate to the education of blind children (Foulke & Hatlen, 1992).

Perceptual experience is however not the only problem in mathematics-learning. There is another also, the symbolics-abstraction of the abstracted experience. In that regards, mathematics is a language in itself, having its own system of expressions. The learners have encountered the challenge of symbols without understanding them and therefore have dreaded symbols, and for that reason, mathematics. The problem is universal, not restricted to a particular group; not the least any more for the group of visually handicapped children. The problem involves learning to register mathematical terms, their symbols and
using them in expressions. Beyond the mathematical sense-experience lies therefore the language of mathematics, which requires instruction per se: instruction in the symbolic and the principles of generating expressions (Gupta, 1992, pp. 251-252).

Provision for concrete experiences is however a necessary, but not sufficient condition for success in learning mathematics. Beyond those provisions, the teacher has to lead the learners toward accommodation and assimilation of new meanings into their existing structures. Activity based approaches enables the child to internalise the concept thus leading him through the process of accommodation and finally assimilation.

1.2.2.3 Learning Resources

Over a period, various devices have been developed and more aids are being created to help children with special needs to gain access to education. Various assistive devices used by the blind can be broadly categorised into Assistive devices for the visually impaired can be divided into the following six categories: Educational Devices, Mobility Devices, Vocational Devices, Daily Living Devices, Low Vision Devices, Psychological Tests for Vocational Assessment and Training (Punani & Rawal, 2000). Educational devices include reading and writing tools like Brailler, Abacus, Slate and Stylus to list a few. Below an overview of some of these assistive devices and aids is given.
A. Braille

Braille is a tactile approach to reading and writing for the visually impaired in which the letters are formed by a combination of raised dots in a cell. The cell consists of six dots, which can be arranged, in 63 combinations or characters. The Braille system is classified as Grade I, Grade II and Grade III levels. Complexity of reading and writing increase with each grade. Grade I is prescribed for basic readers and is word specific. Grade II has more contraction of Braille characters and is prescribed for all learners with visual impairment. Grade III is highly complex and is could be considered as a ‘short hand system’ for learner with visual impairment, this is very rarely used by Visually Handicapped and is not prescribed in the regular curriculum for teaching Children with Visual Handicap (Mukhopadhyay et al., 1987).

How does a Child with Visual Handicap read and comprehend Braille? The finger tips posses sensitive nerve endings, which make touch reading possible. The area covered by light pressure of the finger tips on paper gives the necessary information to the child to discriminate between different configurations of Braille letters, written within the Braille cell, which is a approximately 6 mm vertically and 3.6 mm horizontally. For effective Braille reading, a proper Braille mechanism needs to be developed. Children, who do not follow the accepted method Braille mechanism, become slow Braille readers. Braille mechanism emphasises the efficient flow of hands over the Braille line with proper hand and finger position.
Mousty and Bertelson (1985) state that since the information obtained by the reader is the basically the same but is acquired by a perceptual system with widely different characteristics, the comparison of tactile and visual reading may provide a sort of converging operation. The hands, for example, explore the text in a serial, letter-by-letter fashion, in clear opposition to the discrete character gaze fixations, each of which makes a window of text simultaneously available. Another important difference concerns the spatial arrangement of the sensory field. In visual reading, the division of function between central and peripheral vision is largely determined by anatomical factors responsible for the differences in acuity between the two regions of the visual field and for their constant spatial relationship, while the hands have, in first approximation, the same tactile capacities, and could in principle adopt any exploration pattern that would be convenient for understanding the text. However, systematic studies in this area has revealed that results obtained from varied studies have not been as expected.

Mukhopadhya et al. (1987) emphasizing the learning of Braille among Children with Visual Handicap states: reading ability has been acknowledged to be the most critical/factor in the educational progress of visually impaired children. Apart from the child’s physical readiness, his emotional and psychological readiness also contributes to his success in reading. Owing to the slow pace of Braille reading and its fatigue factor, Children with Visual Handicap and additional poor motor abilities tend to overlook touch reading and rely upon the auditory and verbal instruction and auditory and electronic appliances. Touch
reading is of paramount importance (p. 168). Activities should be planned to improve the reading ability among them and opportunities must be provided through the right type of material.

Children with Visual Handicap use special devices for writing. Braille Type Writer, Slate and Stylus are the most widely used devices. Slate and Stylus is the oldest, most portable, and most dependable tool for writing Braille. It has been compared to the Sighted person’s pen or pencil (Schroeder, 1989). It allows blind person to function independently in any environment. While writing, the child has to punch the dots from the right to the left side of the slate. After this, the child should reverse the paper and read it from the left to right. Sighted people may find it difficult to learn to write in Braille using slate and stylus because they think of it as writing backwards. Though this process looks strange, Children with Visual Handicap are attuned to these changes. Iannuzzi (1999) wrote a note about this on the Blindkid listserv on August 25, 1999, she said: when a study was done by giving a 3D object to blind people and Sighted people and asking them to describe the top and bottom of the object. The blind people felt the top of the object and the bottom of the object without moving the object. The Sighted people (who were blindfolded) felt the top of the object and turned the object over and felt the bottom of the object (now on top). Sighted people find writing Braille with a slate and stylus confusing because they visually turn over the Braille and ‘see’ it as upside down. A blind slate and stylus user will picture writing Braille with a slate without this problem.
In order to write Braille effectively, the child should possess the following skills:

- Finger manipulation skills
- Fine motor coordination and control of muscles
- Competency to read familiar Braille words

Unfortunately, use of the slate and stylus is often seen as difficult and unnecessary. Technological advances such as the Perkins Brailler and the various electronic Braille input device are seen appropriate replacements for the slate and stylus. Teaching of the slate and stylus is neglected. However, in developing countries owing to factors listed below, slate and stylus takes precedence over the mechanical device

a). It is cheap. Perkins Brailler cost several hundred rupees, and Braille input and output technology cost thousands. Most slates and styluses can be purchased for under Rs. 70 from National Institute of visually Handicapped, Dehra Dun.

b). It is portable. Slates come in various sizes and are handy to carry.

c). It is quieter than other Braille output devices. Using slate with typing paper results in fairly quiet writing, and using it with Thermoform makes it absolutely silent.

d). It never breaks down.
e). The slate can be used to write on little cards, labelling tape, or even in a
check register.

When teaching a child to use the slate and stylus, it is important to build a
positive attitude as well as skills. Willoughby and Duffy (1989), Mangold and
Jones (1995) suggest the teacher to adopt inductive approach of teaching with
increasing complexity of writing using the slate and stylus. They propose a
lesson plan to be developed on the lines of first introducing the slate and styles,
allowing the child to examine it and explaining its use, progressing to writing a
line of easy letter to that of higher level of writing original sentences. Mangold
and Jones (op cit) suggest that two to five minutes is a good amount of practice
time for beginners. As students become more confident and proficient in suing
slate and stylus, they will be able to handle longer practices and, with good
motivation, they will be able to use the slate and stylus to take notes in class and
complete assignments.

The International Braille conference in Paris in March 1950 gave birth to a
universal script to be called Braille and provided a broad definition for it. World
Braille aimed at:

a). Achieving, as far as possible orthographic uniformity between ink print
Braille and Braille Scripts;
b). Attempting complete uniformity between languages with common scripts;
c). Seeking closest affinity between linguistically related languages; and
d). Attaining maximum possible closeness between various linguistic groups.
The government of India accepted the recommendations of the Paris conference and presented a tentative code to the board at a regional conference. The board suggested some changes, which were consequently implemented, and the final common code for India to be called 'Bharathi Braille' was approved by the government and adopted in April 1951 (S. Sharma, 1992).

As per the Persons With Disabilities (Equal opportunities, Protection of Rights and Full Participation) Act, 1995 (Persons with Disabilities Act, 2002), a coordination committee has been appointed by the Government of India to monitor the work of Braille book production, and it was noted by the Conference of managers of Braille Presses in January 1998 that Braille Presses in India remained under utilised. The Science and Technology support some new projects aiming to develop cost-effective assistive devices in mission mode under the Ministry of Social Justice and Empowerment.

Despite the appearance of gadgets providing speech outputs, Braille will continue to be used in India as the chief medium of reading and writing for the blind for a long time to come. Hence, it is essential that appropriate teaching methodology is adopted to build this important skill which is a driver to the education of people with visual handicap (Bahuguna et al., op cit, p. 200).

**B. Abacus**

For a child with visual handicap, use of the Abacus is fundamental component of math instruction. The Abacus is one of the tools that is widely used for introducing counting and concepts of place value. Currently, the usage of the
Abacus over or along with talking calculator for Children with Visual Handicap is greatly debated. The Abacus provides semi-concretised experience to the Children with Visual Handicap in learning various concepts related to number and numerals. It is argued that use of both the Abacus and calculator is equally important. The Abacus serves as a good placeholder. It can be used for fractions whereas the calculator cannot. With the Abacus, the students have a better understanding of adding and subtracting whereas with a calculator it is just typing buttons. Involved steps in adding are not known and hence, the child might have poorly developed carryover and borrowing concepts. Use of the Abacus fosters development of detailed arithmetical concepts and makes mental arithmetic easier. Special schools in India still use the Abacus for introducing the skill of counting and to a certain extent the concept of place value.

C. Taylor Frame

However, in recent years, the Taylor Slate or Taylor Frame has taken more importance, and teachers prefer to introduce Taylor Frame to a child who is good at motor skills. Taylor Frame is a system that was specifically developed for blind students to solve arithmetic problems and represent the numbers with pieces of movable ‘types’ on a special board that held type in 8-sided holes, which existed in rows on the slate. Punani and Rawal (2000) describes Taylor Frame as "the surface of this aluminum frame is divided into star shaped holes with eight angles, thus allowing the double-ended metal ‘types’ to be placed in different positions according to a set system. This frame is suitable for teaching arithmetic to visually impaired persons" (p. 211).
The advantage of using Taylor Slate is that one could work problems all day and not use any consumable materials such as paper. Further, it also allows student to get a clear feel of the steps involved in problem solving. However, as a negative aspect, the types get frequently spilled by children and higher math operations are considered problematic. Further, as the cost of metallic types is reasonably high, teachers avoid giving ownership of the Taylor slate and metal types to children. Hence, the practice of using this device for learning mathematics is limited to the classroom usage only (Teacher, personal communication, November 24, 2004). Thus, in such a school environment, a child with visual handicap misses out on the self-practice that a Sighted child has access to. In the integrated setting learning of using Taylor Slate is attributed to the plus curriculum and hence, limited to the special classes dealt by the special
teacher of the blind. (For a Guide for How to Write Arithmetic on Taylor Frame is see Appendix - V)

D. Nemeth Code

The Nemeth Code, a system of Braille code specifically designed for instruction of mathematics is an important skill a child with visual handicap needs to be proficient in. Introduction of Nemeth Code to Children with Visual Handicap begin as early as in Grade III. However, not all children have well developed motor skills and further, handling too many mediums for learning a concept might be very confusing to the child, therefore, greater emphasis on learning Nemeth Code is laid only from grade V onwards. Recording the problems solved as well as reading and writing the mathematical codes is emphasised from this grade level onwards. Gaining proficiency on the Abacus and use of Nemeth Code is an ongoing process that spans many years. (See Braille Mathematics Code for India, 1989, Appendix - VI)

E. Other assistive aids and technology

Punani and Rawal (2000), have listed the following mathematical devices that are available for children with visual impairment to assist in learning mathematics

i). Arithmetic and Braille Writing Slate: This has a Arithmetic frame on one side and a Writing slate on the other. It also has reversible type clamp and two guidelines supplied with a wooden stylus.
ii). Talking Calculator: Audible calculator in synthesized speech. Useful for
calculation, clock, alarm and calendar.

iii). Primary Mathematics Kit: specially designed for the visually handicapped
children to comprehend mathematical concepts. It contains:

1. a plastic box
2. slide strips
3. number boards
4. fractional strips
5. Braille clock
6. geometrical shapes - geometrical figure tray
7. magnetic board, and
8. geometrical devices.

iv). Spur Wheel: A serrated wheel revolving in a plated metal handle. It is
used for making continuous embossed lines on the reverse side of the
paper.

v). Compass Set: It includes a foot ruler, a protractor and a set square in
nylon and a spur wheel. It enables visually impaired students to use the
same techniques as his Sighted counterpart. The foot ruler and set square
have embossed markings for their convenience. The compass has a
removable component fitted with a toothed wheel for drawing embossed
dotted lines on the reverse of the Braille paper.

vi). Geometry Mat: A sheet of rubber for use as a base in conjunction with the
spur wheel and Braille paper for making geometrical drawings.
vii). Opisometer: A bell rings each time the disc moves a distance of one meter. Useful for mapping and understanding mathematical problems in length and perimeter.

viii). Other mathematical devices are:

1. Three-in-one: Arithmetic Frame, Writing Frame and Abacus
2. Composite Braille Slate: Abacus, Arithmetic
3. Frame, Rubber Mat and Wooden Frame
4. Graded Abacus
5. Fraction Boards
6. Counting Device
7. Hundred, Tens Units Board
8. Arithmetic as well as Algebraic Types
9. Geometric Shapes and Solids (pp. 211-213)

From the above discussion on various learning resources that are available for Children with Visual Handicap, it is imperative for the teachers of Children with Visual Handicap to be aware of the availability of various learning resources and further that they need to be utilized appropriately to enhance the learning of mathematical abilities. However, as the learning resources vary in their structure and form, teaching the skills to use the materials before imparting the curricular content becomes a pre-requisite. Mukhopadhyay et al. (1987) aptly points that “in the spectrum of education of the visually impaired child there are two stages, viz, the development of skills and the development of knowledge as emphasized at primary and secondary level respectively” (p. 76). Also, the
selection of resources appropriate to the curricular content area is very important. Any overemphasis on the development of skills related to a resource material may dilute the interest of the child in learning the content area. Thus, the presentation of material for fostering the learning experiences needs to be carefully selected and utilized for the education of Children with Visual Handicap.

1.2.2.4 Assessment of learning

Continuous assessment of learning provides teacher feedback on improving the teaching-learning experiences through adaptations and modifications of learning strategies and materials. Various formal and informal evaluation procedures and tools can be employed to gauge the learning of a student, e.g.: questioning, periodic testing – teacher made tests, norm referenced, criterion referenced, systematic observation are some of them. However, unless adjustments and adaptations are made in the procedures of evaluation, feedback on teaching-learning may not provide the feedback, that a teacher is looking for. Mukhopadhyay et al. (1987) states “The adjustment and adaptation of evaluation and examination procedures can be viewed from the point of view of the medium of presentation of test items and the modalities of answering by the visually impaired children. The guiding principle is that the procedures should be as close to the practice with Sighted children as handicap permits. As in the case of curriculum, in evaluation and examination procedures also, substitution and omission are the last resort. The purpose of adjustment and adaptation is that the visually impaired child should not be at disadvantage in evaluation and examination due to his handicap” (p.284). Some of the alternative and preferred
modes for evaluation suggested by Mukhopadhyay et al. (op cit) include – questions in braille and self answering in braille, use of scribe, audio recorded questions - audio recorded answers, oral questions - oral answers.

As in curriculum and its transaction, adjustments and adaptations in evaluation and examination procedures can improve opportunity for the visually impaired child to demonstrate his learning just like others. It will increase their self-confidence and credibility of their achievement recorded in evaluation and examination, concludes Mukhopadhyay et al. (op cit).

Mukhopadhyay et al. (1987) aptly sums up the teaching of mathematics for visually impaired as “with proper material, with a good resource regular teacher coordination and with a thorough follow up of learning, mathematics could be made possible and easier of visually impaired children in the integrated education programmes” (p. 211). Therefore, from the above account, it is seen that the learning of mathematics for a child with visual handicap is not difficult, but it is a long process, which makes the child and the teacher feel it is difficult (Mukhopadhyay et al., 1987, p. 211).

1.2.3 Evaluation of Arithmetic Performance – Role of Diagnostic Approach

The assessment of academic skill areas for handicapped pupils is difficult even under the most ideal circumstances. Summative or formative assessment are generally performed to determine the level of ability in the skill areas being assessed and the second is to ascertain the best method of remediation once deficits are pinpointed (Mercer & Ysseldyke, 1977). The later aspect of
assessment is subjected diagnostic evaluation of the performance to identify the gaps and plan the remedial measures. Hence, a test that is specifically designed to yield diagnostic results is a preferred tool when compared to formative or summative assessment. Ramaa (2002) justifying on the use of diagnostic test states that the purpose of diagnostic test is to rectify and aim at remedy of the basic deficiencies that the students have in acquiring the required minimum levels of learning in any discipline. In order to achieve this goal the areas of deficiency must be identified first. Suitable test items should be constructed with care and intuition. This ascertains the learning deficiency of the child in the specific area. A diagnostic test differs from an achievement test in the following ways: include reference

- A diagnostic test is a formative test, whereas an achievement test is a summative in nature.

- A diagnostic test identifies the strengths and weaknesses, the achievement test measures the level of achievement.

- A diagnostic test deals at the pre-requisite, concept and subconcept level, achievement test focuses on the realisation of objectives.

- The diagnostic test need not centre around the curriculum on the other hand achievement tests are curriculum based.

- Appropriate remedial programmes can be planned based on the performance of the child in a diagnostic test while remedial programmes cannot be planned based on the performance of the child in an achievement test. Mention it
depends on how the test is constructed and role of each item on the achievement test.

- A diagnostic test has to be administered individually but the achievement test is generally always a group test. An achievement test can be administered individually however, interpretation of results is done by comparing the achievement score of a child with another achievement score of a group for which the achievement is designed and administered. Padmini (2002) emphasising the specification of instructional objective for diagnosis summarises the advantages as:
  
  - Allowing for individualisation in the planning of educational goals for children with special needs.
  - Allowing an evaluative component to be built into the instructional objectives.
  - Allowing students to understand what is expected of them.
  - Specifying proficiency needed to reach the objective.

Thus, instructional objectives lend themselves to instructional sequencing in the process of diagnosis. Such sequencing represents the precise, systematic ordering of the curriculum by the teacher. Further, reiterating the advantages of diagnostic evaluation in planning remedial programmes, Padmini (op cit) points that a diagnostic test is analytic in the full sense of the term. It seeks to disclose the exact nature of the errors and the cumulative deficiencies in learning so that
the teacher could plan remedial programmes to suit the learning level of the backward pupils.

The information from diagnostic analysis does not solve the learning-problems but reveals the exact nature of non-learning of the subject, eliminating one possibility after another so effectively that the teacher can proceed to discover reasons why he fails in particular elements of the subject. However, the teacher needs supplementary evidence for identifying the underlying causes for the pupil learning. The following table gives the major steps in Diagnostic Evaluation and the nature of Remedial Programmes. (The list of Remedial Programme is not exhaustive, but illustrative)
Thus, it is clear from the above account that diagnostic tests are helpful in planning appropriate remedial programme for a child. For providing meaningful education to children with visual impairment it is very important to plan the educational program around the specific diagnostically identified deficits so that
the remediation will yield results that are applicable to a content strand e.g., Mathematics and broadly to their complete education process.

1.3 LEARNING AND COGNITION – PIAGET’S THEORY OF COGNITIVE DEVELOPMENT

Having discussed the educational needs of Children with Visual Handicap, importance of arithmetic skills and its development among Children with Visual Handicap in previous sections (1.1 and 1.2 Supra), in this section an attempt is made to provide an overview of learning and its relation to cognition. Further, Piaget’s Theory for Cognitive Development is discussed with specific focus on development of contemporary mathematics- arithmetic in particular at lower primary level in focus.

Learning forms an intrinsic process of education. Learning theories have been formulated to explain the process of learning and various theories of cognitive development have been put forward to help educators to design the learning experiences of a child. Many attempts have been made to define ‘What is learning?’ Pick up a standard psychology textbook - especially from the 1960s and 1970s and you will probably find learning defined as a change in behaviour. In other words, learning is approached as an outcome - the end product of some process. It can be recognized or seen. This approach has the virtue of highlighting a crucial aspect of learning - change. It’s apparent clarity may also make some sense when conducting experiments. However, it is rather a blunt instrument. For example:
• Does a person need to perform in order for learning to have happened?
• Are there other factors that may cause behaviour to change?
• Can the change involved include the potential for change? (Merriam & Caffarella 1991, p.124)

Questions such as these have led various learning theorists provide myriad of answers. One of the significant questions that arise is the extent to which people are conscious of what is going on. Are they aware that they are engaged in learning - and what significance does it have if they are? Such questions have appeared in various guises over the years - and have surfaced, for example, in debates around the rather confusing notion of 'informal learning', (Smith, 1999). Debate about learning and development has energized the fields of cognitive and developmental psychology and education over the distant and not too distant past. Theorists' positions about learning and development result from the various stances taken with respect to the following issues: origins (i.e., With what do infants come into the world?), how what infants are born with changes over time, relations between the individual and the environment, and domain-general versus domain-specific knowledge (Strauss, 2000).

In an attempt to answer the behaviour of learning, Rogers (2003) sets out two contrasting approaches: task-conscious or acquisition learning and learning-conscious or formalized learning. Considering as a mix, acquisition and formalized learning as forming a continuum, Rogers (op cit) suggests: at one extreme lie those unintentional and usually accidental learning events, which
occur continuously as we walk through life. Next comes incidental learning - unconscious learning through acquisition methods which occurs in the course of some other activity. Then there are various activities in which we are somewhat more conscious of learning, experiential activities arising from immediate life-related concerns, though even here the focus is still on the task. Then comes more purposeful activities - occasions where we set out to learn something in a more systematic way, using whatever comes to hand for that purpose, but often deliberately disregarding engagement with teachers and formal institutions of learning. Further along the continuum lie the self-directed learning projects on which there is so much literature. More formalized and generalized (and consequently less contextualized) forms of learning are the distance and open education programmes, where some elements of acquisition learning are often built into the designed learning programme. Towards the further extreme lie more formalized learning programmes of highly decontextualized learning, using material common to all the learners without paying any regard to their individual preferences, agendas or needs. There are of course no clear boundaries between each of these categories" (Rogers 2003, p. 41 - 42). Merriam and Caffarella (1991) sums up four different orientation to learning as a process, in the following Table 9
Table 9

Four Orientations to Learning

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Behaviourist</th>
<th>Cognitivist</th>
<th>Humanist</th>
<th>Social and situational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning theorists</td>
<td>Thorndike, Pavlov, Watson, Guthrie, Hull, Tolman, Skinner</td>
<td>Koffka, Kohler, Lewin, Piaget, Ausubel, Bruner, Gagne</td>
<td>Maslow, Rogers</td>
<td>Bandura, Lave and Wenger, Salomon</td>
</tr>
<tr>
<td>View of the learning process</td>
<td>Change in behaviour</td>
<td>Internal mental process (including insight, information processing, memory, perception)</td>
<td>A personal act to fulfil potential.</td>
<td>Interaction /observation in social contexts. Movement from the periphery to the centre of a community of practice</td>
</tr>
<tr>
<td>Locus of learning</td>
<td>Stimuli in external environment</td>
<td>Internal cognitive structuring</td>
<td>Affective and cognitive needs</td>
<td>Learning is in relationship between people and environment.</td>
</tr>
<tr>
<td>Purpose in education</td>
<td>Produce behavioural change in desired direction</td>
<td>Develop capacity and skills to learn better</td>
<td>Become self-actualized, autonomous</td>
<td>Full participation in communities of practice and utilization of resources</td>
</tr>
<tr>
<td>Educator's role</td>
<td>Arranges environment to elicit desired response</td>
<td>Structures content of learning activity</td>
<td>Facilitates development of the whole person</td>
<td>Works to establish communities of practice in which conversation and participation can occur.</td>
</tr>
<tr>
<td>Manifestations in adult learning</td>
<td>Behavioural objectives Competency -based education Skill development and training</td>
<td>Cognitive development Intelligence, learning and memory as function of age Learning how to learn</td>
<td>Andragogy Self-directed learning</td>
<td>Socialization Social participation Associationalism Conversation</td>
</tr>
</tbody>
</table>

Of the above four orientations, cognitivist orientation to learning has had strong impact on the process of learning and teaching. Hartley (1998) has usefully drawn out some of the key principles of learning associated with
cognitive psychology. As he puts it: 'learning results from inferences, expectations and making connections. Instead of acquiring habits, learners acquire plans and strategies, and prior knowledge is important' (1998, p.18). The principles of learning that he identifies are:

- Instruction should be well-organized. Well-organized materials easier to learn and to remember.

- Instruction should be clearly structured. Subject matters are said to have inherent structures - logical relationships between key ideas and concepts - which link the parts together.

- The perceptual features of the task are important. Learners attend selectively to different aspects of the environment. Thus, the way a problem is displayed is important if learners are to understand it.

- Prior knowledge is important. Things must fit with what is already known if it is to be learnt.

- Differences between individuals are important as they will affect learning. Differences in 'cognitive style' or methods of approach influence learning.

- Cognitive feedback gives information to learners about their success or failure concerning the task at hand. Reinforcement can come through giving information - a 'knowledge of results' - rather than simply a reward.

Cognition involves the capacity to make sense of the self and the world, through action and language. Meaningful learning is a generative process of
representing and manipulating concrete things and mental representations, rather than storage and retrieval of information. Thinking, language (verbal or sign) and doing things are thus intimately inter-twined. This is a process that begins in infancy, and develops through independent and mediated activities. Initially, children are cognitively oriented to the here and now, able to reason and act logically on concrete experiences. As their linguistic capabilities and their ability to work in the company of others develop, it opens up possibilities of more complex reasoning in tasks that involve abstraction, planning and dealing with ends that are not in view. There is an overall increase in the capability of working with the hypothetical, and reasoning in the world of the possible. Conceptual development is thus a continuous process of deepening and enriching connections and acquiring new layers of meaning (National Curriculum Framework, 2005). Thus, all teaching and learning activities should be designed to create meaningful learning experiences that build upon the existing knowledge of the child. Such experiences at the early stages of education is very important as it forms the basis of future learning at higher stages of education. Though various cognitive development theories has been put forward based on which learning theories have been developed, one of the significant theory of cognitive development proposed by Jean Piaget and has gained wide acceptance in the field of education worldwide.

Piaget (1970a) suggested that children proceed through a series of four separate stages in a fixed order that is universal across all children. He maintained that these stages differ not only in terms of the quantity of information
acquired at each stage, but in the quality of knowledge and understanding as well. Taking an interactionist point of view, he suggested that movement from one stage to the next occurred when the child reached an appropriate level of maturation and was exposed to relevant types of experiences. Without such experiences, children were assumed to be incapable of reaching their highest level of cognitive growth. Piaget suggests that the child’s development from a dependence upon the stimulus characteristics of situations to a dependence upon ideas takes place by four processes: physical maturation; experience; social transmission; equilibration. The child can be regarded as an open system that needs to be in equilibrium with its environment. It might achieve a certain set of strategies for dealing with the environment and thus attain such equilibrium – but then an adjustment might be needed so that a more effective equilibrium is achieved. Development takes place through the achievement of states of equilibrium that are progressively more stable, more mobile and wider in application (Williams, 1971).

According to Piaget (1970b), this development takes place by two complementary processes: (a) assimilation; (b) accommodation. At any point in his development, the child has certain strategies for dealing with the environment (which Piaget calls ‘schemata’). When he comes across a new situation, he can either sort it out in terms of these strategies (this is what Piaget means by ‘assimilation’) or modify them so that they are more appropriate to situations of this kind (what Piaget calls ‘accommodation’). Thus, by employing those schemata that are appropriate and extending or replacing those that cannot be
made to fit new experiences, the child develops strategies that are less likely to need replacement, that he can do more with and that have a wider field of application. The recognition of the invariant and sequential nature of cognitive development with contents and structure and qualitative changes in processes as well as capabilities marks a clear difference between the traditional concept of intellectual functioning and cognitive development, though they are not mutually exclusive. Intelligence has a two-fold connotation. One of its usage refers to intellectual capacity as an innate power, and as a measure of individual differences, and the second to the acquisition and application of knowledge. It is the latter usage emphasising the qualitative and functional aspects of intelligence that is predominant in Piaget’s theory as he does not accept intelligence as a pure ‘measurement construct’ with a quantitative approach.

Thus, logical analysis of qualitative changes in cognitive structures arising from continuous cognitive functioning and inferred through cognitive contents shows that cognitive development proceeds in a certain direction through irreversible, invariant, sequential stages. The change or modification would occur because of the interaction between the individual and his world – physical or social.

1.3.1 Piaget’s Stages of Cognitive Development

The four stages of Piaget’s theory are:

- Sensory Motor Period (0 to 2 years of age)
• Pre-operational Period (2 to 7/8 years of age)
• Concrete-operational Period (7/8 to 11/12 years of age)
• Formal operational period (after 11/12 years of age)

Piaget’s stages as summarised by Mandarvalli (1990) is given below:

A. **Sensory Motor Period (0 to 2 years)**

During this period - between birth and two years of age, environmental stimuli and the child’s perception of them elicit motor response and actual manipulations of concrete objects. This stage is divided into six sub stages namely – Basic Reflexes, Primary Circular Reactions, Secondary Circular Reactions, Coordination of Secondary Circular Reactions, Tertiary Circular reactions and Invention of New Means through Mental Combinations. The child passes from exercising only the reflexes present at birth to a phase characterised by the emergence of the capacity to respond to or think about objects and events that are not immediately observable, and to invent new means of accomplishing goals through 'mental combinations'. To attain these sensory-motor characteristics the child should develop the coordination of reflexes and responses anticipate consequences, differentiate means from ends through active experimentation, exploration, variation and modification of behavior.
B. Pre-operational Period (2 years to 7/8 years)

This is the next phase of Piaget's categorisation of cognitive development, which extends from the end of sensory motor stage i.e., 2 years to the age of 7 years or 8 years. This stage is divided into two substages:

i) Pre-conceptual period (2 to 4 years)

ii) The intuitive stage (4 to 7/8 years)

(i) Pre-conceptual period (2 to 4 years)

In this period the child develops his symbolic function, imagery, and genuine representation. He begins to distinguish between words and images, and the things, which perceptually absent. This connection is intervened in the development of imitation, play, and cognitive representation. As a result of these developments, the child is no longer restricted to overt actions dealing with real objects but can think about the objects and activities manipulating them symbolically. The child reasons but 'transductively' – from particularity to particularity without any apparent logical connection.

(ii) Intuitive period (4 years to 7/8 years)

During this period, the child conceptualises more and elaborate his concepts, and constructs increasingly complex representations of thoughts and images. His ability to classify objects according to his own perception of similarity grows. It thus gains some notion of class membership and the objects included in the particular class. Further logical operation such as arranging items along a continuity of increasing or decreasing values (seriation), returning to the original
point in thought (reversibility) are gradually acquired. But its ability to draw logical
conclusions is still extremely limited. The child is still largely restricted to its own
perceptions and its comprehension of objects or situations is still based on single
salient perceptual aspects of the stimulus.

This is a ‘transitional’ stage between the pre-conceptual period and the
conge-operational stage through which the child develops an increasing ability
to deal with concepts such as number, space, time, quantity and substance,
marked by the development of ‘conservation’. The concept of conservation
according to Piaget is the ability of an individual to be aware of the invariant
properties of objects in the phase of transformation. Three sub-stages, non-
conservation, transitionary-conservation, and complete conservation are
identified to attain concrete operational stage. The sub-stages of conservation
are applicable to a number of concepts such as number, distance, length, area,
quantity. Thus, mental operations would be integrated into a cognitive system.

C. Concrete-Operational Period (7/8 years to 11/12 years)

During this period, i.e. from 7/8 years to 11/12 years of age, the richness of
the child’s supply of words, concepts and rules increases gradually and this
change is accompanied by a decreasing tendency to rely on images in problem
solving. In this stage of concrete operation, the child could acquire an important
set of rules that he did not possess in pre-operational stage. There is a clear
indication of manifestation of conservation during this period. At the base of
conservation is what Piaget calls the logical structure of groupings. The five
conditions of grouping which form a logical-mathematical scheme are identity, reversibility (as negation and as reciprocity), closure, associativity and interaction. He believes that length, mass, weight, and number remain constant despite superficial modifications in their external appearance.

In Piaget's studies the principle ages of transition are reported to be from 7/8 years of age to 11/12 years of age approximately. By changes at around the age of 7 years in the child's manner of using, measuring instruments and in his performance of number of tasks, demanding conception of or reasoning about spatial relations the operations of spatial and class interpretations make their appearance. According to him the appearance of propositional operations is attested at the age of 11/12 by the child's performance on a variety of reasoning tasks.

Though the pre-adolescent child is capable of deductive reasoning and dealing with relational terms, class inclusions, serialisation and the principle of reversibility and conservation, the sophistication of his reasoning is still quite limited. He can reason out the things with which he had direct personal experience. More than two variables cannot be taken into account in a systematic way for he lacks the operational system of such situations. This is the fundamental deficiency of concrete operational thought.

D. Formal Operations (after 11/12 years of age)

In this stage the child thinks rationally and systematically. He seems to reflect upon the rules he possesses and is aware of his own thoughts, and is
conscious of what he knows. He becomes concerned with the hypothetical, the
future and the remote. Piaget believes that this pre-occupation with thought is the
principle component of formal operations.

Thus, the cognitive development in an individual process through these
four main stages. These stages should not be taken strictly in terms of
chronological ages, but, must be considered as 'succession of stages' in the
process of development.

1.3.2 Significance of Piaget's Stages of Cognitive Development - General

Piaget's model of cognitive development characterised by sequential
stages as explained in the previous section offers an effective liaison between
the developmental status of the child and the curriculum of the school. These
aspects correspond to curriculum content and timing considerations in the area
of educational application in general. They provide three points of contact
between Piagetian research and the educational field:

e). 'When' a certain content or subject area should be taught,

f). 'What' content subject matter is most important and,

g). 'How' it may be best presented to the pupil (Hooper, 1968).

Current research in cognitive development shows that people's reasoning
and decision-making strategies are deeply grounded in contexts of use.
Reinforcing, above statements by Hooper (op cit), Piaget (1969) and Vygotsky
(1978) attributed varying roles to direct and mediated experience in the process
of moving beyond the concrete. Yet both shared the commonly held view among developmentalists that higher forms of reasoning emerge from people’s ability to separate what is known from how it came to be known and where it may best serve. Consistent with this view, research methods themselves have become ‘disembodied’. Experiments designed to study people’s reasoning or logical capabilities are carefully stripped of the messy dynamics inherent in actual situations of use, and children’s achievements are gauged by their conformity to logical norms or logico-mathematical canons at the expense of their pragmatic or functional relevance, (Blaye, Ackermann & Light, 1999). Three dimensions of ‘When’, ‘What’ and ‘How’ of subject matter is presented to the children has major implications to the educators designing curriculum and strategies of teaching-learning.

Conceptual changes in children, like theory changes in scientists, emerge as a result of people’s action-in-the-world, or experience, in conjunction with a host of ‘hidden’ processes at play to equilibrate, or viably compensate, for surface perturbations (Carey, 1987). Ackermann (2002) lists implications of a such a view for education as trifold:

1. Teaching is always indirect. Kids don’t just take in what’s being said. Instead, they interpret what they hear in the light of their own knowledge and experience. They transform the input.

2. The transmission model, or conduit metaphor, of human communication won’t do. To Piaget, knowledge is not information to be delivered at one end, and
encoded, memorized, retrieved, and applied at the other end. Instead, knowledge is experience that is acquired through interaction with the world, people and things.

3. A theory of learning that ignores resistances to learning misses the point. Piaget shows that indeed kids have good reasons not to abandon their views in the light of external perturbations. Conceptual change has almost a life of its own (p. 3).

Keeping in view the connection between developmental theory and educational applications on the one hand and the research findings generated by Piaget’s ideas for normal children on the other, the present study with its emphasis on attainment of cognitive capabilities (operation definition vide Section 3.4 Supra) among Children with Visual Handicap constitutes an effort to trace the developmental trend in attaining concrete operational stage. The implications and relevance of this stage for elementary education are significant since Piaget offers a developmental framework within which considerable curriculum innovations can be derived. According to the research conducted and theory developed by Piaget and his co-workers there is no evidence of true logical thinking until the age of 11 or 12 years and even then it is only the beginning of the stage of ‘formal’ operations. Prelogical and concrete thinking are limited largely to the ages of 4/5 to 11/12 years. This range corresponds roughly to the elementary school levels. Children’s thinking at this age is generally ‘pre-casual’ in nature, and largely tied to his/her perceptions and thinking. Thinking at this
level is facilitated primarily through ‘action on objects’ rather than words and pictures and diagrams. Conservation is a central prerequisite for the acquisition and subsequent development of logical thought. Among the concepts and mental operations involved with pre-logical and concrete-operational thinking are classes, series, ordinal and cardinal number, length-area-volume relationships, spatial relations, concepts of geometry, quantity, time, motion and general ideas associated with physical causality. Thus, various concepts and mental operations that are to be developed to attain concrete operational stage as described by Piaget are relevant not only to the subject areas of primary school education, but also the age-period set for primary school.

Table 10 gives a summary of the concepts of operations to attain concrete operational stage, as reported by Good (1973).
<table>
<thead>
<tr>
<th>Concepts and Operations</th>
<th>Attained at age range (approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Classification</strong></td>
<td></td>
</tr>
<tr>
<td>a). Intensive-extensive coordination</td>
<td>7-9</td>
</tr>
<tr>
<td>b). Stable classification criteria</td>
<td>7-9</td>
</tr>
<tr>
<td>c). All-some relations</td>
<td>8-10</td>
</tr>
<tr>
<td>d). Class inclusion</td>
<td>9-11</td>
</tr>
<tr>
<td><strong>Seriation</strong></td>
<td></td>
</tr>
<tr>
<td>a). Simple series</td>
<td>5-7</td>
</tr>
<tr>
<td>b). Insert elements into series</td>
<td>7-9</td>
</tr>
<tr>
<td>c). Analyse elements using whole series shape</td>
<td>9-10</td>
</tr>
<tr>
<td><strong>Number</strong></td>
<td></td>
</tr>
<tr>
<td>a). Conserver</td>
<td>6-8</td>
</tr>
<tr>
<td>b). Coordination of ordinal and cardinal properties</td>
<td>7-9</td>
</tr>
<tr>
<td>c). Singular class</td>
<td>8-9</td>
</tr>
<tr>
<td>d). Null class</td>
<td>9-11</td>
</tr>
<tr>
<td>e). Multiplicative classification</td>
<td>10-12</td>
</tr>
<tr>
<td><strong>Concepts of Geometry</strong></td>
<td></td>
</tr>
<tr>
<td>a). Straight line construction</td>
<td>7-8</td>
</tr>
<tr>
<td>b). Water-level conservation</td>
<td>9-11</td>
</tr>
<tr>
<td>c). Area conservation</td>
<td>8-11</td>
</tr>
<tr>
<td>d). Metric proportions</td>
<td>12-16</td>
</tr>
<tr>
<td><strong>Length and Distance</strong></td>
<td></td>
</tr>
<tr>
<td>a). Conservation of distance (empty shape)</td>
<td>7-8</td>
</tr>
<tr>
<td>b). Conservation of length (filled space)</td>
<td>6-8</td>
</tr>
<tr>
<td>c). Iteration length</td>
<td>8-9</td>
</tr>
<tr>
<td>d). Subdivision of straight lines (staggered but equal)</td>
<td>7-9</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td></td>
</tr>
<tr>
<td>a). Conservation of continuous quantity</td>
<td>8-10</td>
</tr>
</tbody>
</table>
Wood, Smith and Grossniklaus (2001), discussing the Piaget's stages of cognitive development, enumerate its implications for education. According to them – An important implication of Piaget's theory is adaptation of instruction to the learner's developmental level. The content of instruction needs to be consistent with the developmental level of the learner.

The teacher's role is to facilitate learning by providing a variety of experiences. 'Discovery learning' provides opportunities for learners to explore and experiment, thereby encouraging new understandings. Opportunities that allow students of differing cognitive levels to work together often encourage less mature students to advance to a more mature understanding. One further implication for instruction is the use of concrete "hands on" experiences to help children learn. Additional suggestions include:

- Provide concrete props and visual aids, such as models and/or time line
- Use familiar examples to facilitate learning more complex ideas, such as story problems in math.
- Allow opportunities to classify and group information with increasing complexity; use outlines and hierarchies to facilitate assimilating new information with previous knowledge.
- Present problems that require logical analytic thinking; the use of tools such as "brain teasers" is encouraged, (Wood, Smith & Grossniklaus, 2001)
The above listed educational implications of Piaget's theory are applicable to all children undergoing the process of education. As the current study aimed to probe the cognitive capabilities among the Children with Visual Handicap, hence it was necessary to understand the implications of Piaget's theory for education of Children with Visual Handicap.

1.3.3 Significance of Piaget's Theory for Cognitive Development - Children with Visual Handicap

The process of growth and development for any individual child is at the same time similar to and different from that for any other child. It is similar because growth is sequential, with identifiable stages through which all children progress; it is different because each child progresses at his own unique rate because of his own individual needs. This principle applies to visually handicapped children as well, and in general their similarities to and greater than their differences from the Sighted children. Visual impairment has either direct or indirect influence on the rate of growth and development of blind children. Direct influences are those, which result immediately from the visual impairment in a cause – effect relationship and which generally have a handicapping effect on the development of the individual. For example, the impact of the visual impairment on cognitive development. The indirect influences are more difficult to define but it plays a vital role in the developmental process, Pathak (1992).
Advani (1992, pp. 31-36) comments on the effects of Visual Disability on Piaget's stages of cognitive development. His discussion on various stages is given below:

**Sensory Motor Stage:** Piaget has talked of object permanence. A blind infant does not engage as actively in search for objects as does the Sighted child. Search may fail because the blind cannot deduce the displacement of an object in space. The failure of search leaves a blind child with a temporary handicap in cognitive development. He cannot believe that an object exist when it does not manifest itself to him and this conceptual problem becomes temporary barrier to the development of spatial and notion of causality. Thus, although the development of the blind and Sighted infant is quite similar in the early months of Sensory Motor period divergence may be seen at the time at which the Sighted infant normally begins to reach for external objects (3 to 4 months). This and other differences apparently create a definite lag in the later Sensory Motor Stages. Since perceptual interaction with the environment is necessary for cognitive growth, blindness handicaps the child simply by giving him less total information about the world. The fact that vision normally provides the most detailed and specific information is important. But the continuity of visual experience is perhaps is a more critical lack for the blind infant. Further, the blind infant lacks the organizational function that vision normally provides. For the Sighted child vision seems to serve as a means of unifying the perceptual experiences gained via other modalities.
**Preconceptual Stage:** During this stage children gradually construct more complex mental images. But these images obviously depend on the sensory data available to the child. Unless specific efforts are made by parents, teachers and neighbours the sensory data made available to the child is deficient. Therefore, although no definite research is available, it is reasonable to assume that the visually handicapped child crosses this stage later than the Sighted.

**Stage of Concrete Operations:** If range and variety of experience is limited, logic and reasoning of a blind may be affected.

**Stage of Logical (Formal) Operations:** Observations denote that blind children can make mental representation as effectively and at about the same age as Sighted children even if the precise nature of their mental representation is somewhat different.

Various suggestions of Wood, Smith & Grossniklaus (2001) regarding the implications of Piagetian theory though aimed at the education of normal children, the are equally relevant to the education of the Children with Visual Handicap. Piaget’s detailed stage-based theory serves as a framework to select and develop appropriate materials, situations and tasks according to the individual needs. The focus should be on systematisation of experience according to the cognitive level of the visually handicapped. The effectiveness of exposure of the child with visual handicap to perceptual attributes and arrangement, incorporation of symbolic manipulation and abstractive construction
depends upon appropriate sequencing i.e., learning sequences must be suitably
timed and placed.

Piaget has offered a mass of substantive data on the forms of knowledge
and knowledge getting processes compatible with sound educational objectives.
The blind child has special needs as he progresses through the stages of
intellectual development. His visual impairment places him at a disadvantage in
the areas of sensory stimulation, concept formations, and communication. In the
absence of vision, blind child uses remaining sense modality to receive
information, and hence those sources of sensory input must be exploited to the
maximum. The total environment of home and school should be structured so
that each sensory experience will be effective for meaningful learning, (Pathak,

Further, commenting on the concept formation among Children with Visual
Handicap, Pathak (op cit) states - concepts grow out of the perceptual process
and become enriched as the child develops language. The breadth of concept
development is dependent in large measures on the breadth of the perceptual
experiences. Because the blind child lacks one source of sensory input, his
perceptual processes are deficient. He may never grasp some concepts and may
need more experience than the Sighted child to grasp others. Abstractions such
as a concept of color may never be formed, since the child has no possibility of
acquiring a background of sensory input for this concept. (p. 170)
Concepts related to science and maths need much more concretised experiences as development of concepts in these disciplines require manipulation of objects and numbers. Therefore, a Child with Visual Handicap should be introduced with a thorough knowledge of the concepts with suitable operations, with gradation in different subject areas in general and in science and mathematics in particular.

A child with visual handicap is radically different from the visually handicapped adult with respect to his thought and language. The teacher must be cognisant of this and must therefore attempt to observe children very closely in order to discover their unique perspective.

A child with loss of vision is denied the sensory experiences of sight. He should be provided with objects for tactile perception to get at the wholeness of the object need to manipulate things in order to learn. Piaget’s (1972) clinical method offers another fruitful dimension for education of the visually handicapped, as it implies probing of demonstrated action that encompasses the ‘why’ of an unsuccessful activity. Piaget’s (1964) views of group dynamics and social interactions are significant in the education of the visually handicapped. He feels that the child’s social setting (the classroom) should be an integral element for the process of cognitive growth. In his own words:
“When I say ‘active’ I mean it in two senses. One is acting on material things. But, the other means doing things in social collaboration, in a group effort. This implies the need for communication within the group. Cooperation is indeed ‘cooperation’ (Piaget quoted by Ripple & Rockcastle, 1964, p. 4).

Peer relationships should be a means to facilitate the cognitive reorganisation of the participants through the setting of natural conflict forces within the group. Thus, problem solving and discussion situations within the group should be promoted in classroom setting of the visually handicapped.

Suggesting the educational development among Children with Visual Handicap, Bahuguna, Mittal, Singh et al. (1992) concludes that - “the educational needs of the blind children are similar to that of Sighted. A visual impairment should not deprive a child of his rightful access to an educational program commensurate with his needs and abilities” (pp. 173-174).

1.3.4 Significance of Piaget’s Theory for Development of Arithmetic Skills

Emphasising on the aspect of understanding of concepts in Arithmetic, Resnick & Ford (1981) quotes Piaget (1973): “to understand is to invent; to build for oneself. Although children can be helped to acquire mathematical concepts by means of special materials and teacher questions, it is only through their own efforts that they will truly understand” (Resnick & Ford, 1981, pp. 190-191).
Piaget’s work on ‘Child’s Conception of Number’ (1952) has been one of the most significant contributions of Piaget in understanding how a child develops the concept of number and number operations. Jones (2005) in his review on Piaget’s book ‘Child’s Conception of Number’ (1952) notes that - The book traces development from an initial perceptual intuitive conception to a final operational conception of number. Piaget calls the initial state the 1st stage, the final state the 3rd stage and the intermediate phase the 2nd stage. These stages approximately correspond to ages (in Western children at least) up to 7 years at which the child has achieved concrete operational thinking. At the 1st stage the child attends to what is perceived. At the 3rd stage the child is able to think logically (i.e. in terms of reversible operations). At the 2nd, intermediate, stage the child generally attends to what is perceived but is able to self-correct himself means of trial and error. As such the 2nd stage is a phase of conflict. Stage 3 is significant in the child’s construction of the concept of number because it demonstrates “the process of quantification as revealed in the child’s discovery of the conservation of quantities” (p. 23).

To begin formal math instruction, the student should be able to form and remember associations, understand basic relationships, and make simple generalisations. Increased complex cognitive factors are necessary as the student progresses from lower-level math skills to higher-order skills. Moreover, lower-level math skills must be mastered before higher-order skills can be learned; thus, the concept of learning readiness is important in math instruction. In their Twelve Components of Essential Mathematics, the National Council of
Supervisors of Mathematics (1988) highlights the need for students to understand basic facts and operations. Many authorities (Kirby & Becker, 1988; Underhill, Uprichard & Hedens, 1980) claim that failure to understand basic concepts in beginning math instruction contributes heavily to later problems.

Piaget (1965) describes several concepts basic to understanding numbers: classification, ordering, one-to-one correspondence and conservation. Mastering these concepts is necessary for learning higher-order math skills.

Classification involves a study of relationships, such as likeness and differences. Activities include categorising objects according to a specific property. For example, children may group button according to color, then size, then shape, and so on. Most children of 4-7 years old can judge objects as being similar or dissimilar on the basis of properties such as color, shape, size, texture, and function Copeland, (1979).

Ordering is important for sequencing numbers. Many children do not understand order until they are 6 or 7 years of age. They first must understand the topological relation of order. When counting objects, students must order them so that each object is counted only once Copeland (op cit). Topological ordering involves arranging a set of items without considering a quantity relationship between each successive item The combination of Seriation and ordering, however, involves ordering items on the basis of change in a property, such as length, size, or color. An example of a seriation task would be arranging items of various lengths in an order from shortest to longest, with each
successive item being longer than the preceding item. Children 6 – 7 years old usually master ordering and seriation, Copeland (op cit)

Piaget (1962) considers the concept of ‘one-to-one correspondence’ and Conservation as fundamental to later numerical reasoning. One-to-one correspondence is the basis for counting to determine how many, and is essential for mastering computation skills. It involves understanding that one object in a set is the same number as one object in a different set, whether or not characteristics are similar. If a teacher places small buttons in a glass one at a time and the students place the same number of large buttons in a glass one at a time, the glass containing the large buttons soon displays a higher stack. If students respond, “Yes” to the question “Does each glass have the same number of buttons”, they understand one-to-one correspondence. If they respond, “No because the buttons are higher in one glass”, they are not applying one-to-one correspondence and instead are judging on the basis of sensory cues. Most children 5-7 years old master the one-to-one correspondence concept. Initial activities consist of matching identical objects, whereas later activities should involve different activities (Mercer & Mercer, 1998).

Conservation means that the quantity of an object or the number of objects in a set remains constant regardless of spatial arrangement. Mandarvalli (1990) states that conservation of number concept is the earliest in the child’s cognitive development. Conservation is the ability of an individual to be aware of the invariant aspects or properties of objects in the face of transformation; i.e.,
the totality of any system is neither increased nor decreased though there is change in the forms of the system. Two types of conservation is considered primary for the development of basic numerical abilities – conservation of quantity and conservation of number. Conservation of quantity is said to be achieved when the child recognises that irrespective of the change in shape, amount of material remains constant. And, conservation of number is considered to be achieved when the child understands that the number of objects in a set remains constant whether the objects are close together or spread apart. Most children master conservation between the ages of 5 and 7.

With the emergence of neo-Piagetian theories and other cognitive theories, Piaget’s theory is subjected to shoddy criticism based on his failure to address the cross-cultural studies to support his theory. Yet, there is much in his theory that acts as an enabler to inquire into how children develop cognitively in respect to various concepts. From the above account it is very clear that development of arithmetic abilities is highly contingent upon various cognitive abilities, each with specific learning strategies. This is not to ignore other environmental, biological and pedagogical factors that might influence the development of arithmetic abilities. In conclusion, as J. D. Williams (1971) states that Piaget has helped primary school mathematics teacher in the following ways:

a). it has provided him with a model which helps him to think both about the processes underlying the child’s thinking and about its development;
b). it has provided an analysis of the basic logical and mathematical concepts that are required if the child is to understand mathematical activity;
c). it has provided a very useful set of techniques for studying concept development. It has, above all, cast light upon order, the manner, and, approximately the age-range, in which the child should encounter particular kinds of mathematical task.

The above listed implications of Piaget's theory on mathematics instruction in general and arithmetic in particular holds true in the current context as well. It provides a basis for planning the instruction, assessment, diagnosis and remediation of deficits in the development of the basic concepts necessary for development of higher arithmetic thinking skills. Most of the research done related to cognitive abilities in terms of development of arithmetic abilities is in relation to the Sighted population. It is warranted that focus should also be given to inquire into the cognitive development of disadvantaged population who have biological restrictions such as vision, hearing or intellectual abilities.

1.4 CONTEXT OF THE STUDY

As has already been dealt with detail vide sections 1.3.2, 13.3 and 1.3.4 Supra, the current study was conceptualized in the context of the development of Arithmetic Skills among both the Sighted and the Children with Visual Handicap. Keeping in mind the significance and relevance of Piaget's Theory of Cognitive Development to the development of Arithmetic Skills in general and CVH in particular, it was thought appropriate to attempt an indepth comparative analysis
of development of Arithmetic Skills between the sighted and the CVH so that the
lag found if any among the CVH could be analysed to shed light on the arithmetic
curriculum followed for CVH.

As the basic Arithmetic skills form the building block for the development
of higher Arithmetic Skills, hence, the study aimed at probing the development of
basic arithmetic skills (Number, Addition, Subtraction, Multiplication and Division)
among Children with Visual Handicap at Lower Primary level (age range 5 – 11
years; vide Picture 1, p.16). Keeping in mind, the importance of cognitive aspects
necessary for acquisition of mathematics, the various modalities used for
instruction and the given setting in which Children with Visual Handicap are being
taught mathematics, the current study also aimed at investigating the current
curricular inputs i.e. teaching-learning practices in relation to development of
Arithmetic Skills among CVH.

The Next Chapter

Under the context of the present study, chapter 2 presents the review of related
literature in relation to the selected aspects of the study viz. development of
arithmetic skills, development of cognitive capabilities and analysis of curriculum.
Review of literature has been done for both Sighted and Children with Visual
Handicap with focus on lower primary education. Though an attempt is made to
include contemporary research certain studies done in the last few decades have
been carefully reviewed and included considering their relevance to the study.