CHAPTER – II

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

A review of background literature pertinent to the subject of investigation is an essential stage in the research study. According to Walter R. Borg, “The literature in any field forms the foundation upon which all future work will be built”. The search for reference material may be time consuming but a very fruitful phase of the research programme. The researcher needs for any worthwhile study in the field of knowledge, and adequate familiarity with library and its many resources. He / She needs to acquire up-to-date information about what has been thought and done in a particular area from which he intends to take up problem for research. Survey of literature is as crucial as planning of the study and time spent in such a survey invariably is a wise investment. The major purpose of reviewing the literature is to determine what has already been done related to the research topic under investigation. It gives the knowledge of the previous studies undertaken, the latest trend in the field of present investigation, the missing gaps and gives scope for future investigation.

This knowledge not only avoids unintentional duplication, but also provides the understanding and insights necessary to develop a logical frame work into which the research topic fits. As Reguram Singh (1972) points out “The Review of the related literature promotes a greater understanding of the problem and its crucial aspects and ensures the avoidance of unnecessary duplication”. Another important function of the review of the literature is to point out research strategies, specific
procedures and measuring instruments that have been found to be productive in investigating the topic.

2.2 NEED FOR REVIEW

For any worthwhile study in any field of knowledge, the research worker needs an adequate familiarity with the work, which has already been done in the area of the investigator's choice. It is necessary to acquire up to date information about what has been thought and done in the particular area. Review of related literature provides ideas, theories, explanations, hypotheses or methods of research, valuable in formulating and studying the problem. It helps invoking comparative data useful in the interpretation of results. The researcher has made a careful review of literature pertaining to the problem in order to provide a background for the development of the study. In this chapter the studies made in India and abroad related to the study are discussed.

The review of related literature is a survey of what has been done concerning the problem, which is being investigated and hence is an important step in a research work. It helps in the actual planning and execution of any research work. It not only provides access to the accumulated wisdom of the age, but also enables the investigator to carry out his work successfully.

In the words of Good and Scats (1950) “A Systematic canvas of the related literature is the means of determining whether the proposed study unnecessarily duplicates some earlier investigation. The knowledge secured from such headings in terms of source, procedures and results represent essential orientation for the
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2.3 IMPORTANCE OF REVIEW OF RELATED LITERATURE

Review of literature related to the problem is essential in order to determine three things:

i. Whether already existing studies are similar to what the problem we to undertake

ii. Whether existing research provides guidance or sheds further light on the problem and

iii. Whether existing research provides a point of departure or a platform upon which the new research can be built.

The investigations have added much to our knowledge. Thus the knowledge of related literature also enables investigators to define the frontiers of their field.
The aim of the investigation

This investigation is undertaken because it was found that very little work was attempted in this field. The investigator felt the necessity of this study due to the dearth of material available on the topic. The study intends mainly to measure the effectiveness of Technology in teaching visually impaired students over Braille method, which is the traditional method of teaching visually impaired students. The investigator has limited the study to a random sampling of visually impaired students selected from two schools for the blind in Tamil Nadu.

The investigator presents the review of related literature under the following classifications:

1. Studies conducted in India
2. Studies conducted abroad

2.4 STUDIES CONDUCTED IN INDIA

A study conducted by the National Centre for Promotion of Employment for Disabled People (NCPEDP) in 2004 disclosed shocking facts of discrimination against those with disabilities. A survey of 89 schools across the country found that a mere 0.5 percent of the total number of students were those with disabilities, though the Persons with Disabilities Act recommended a reservation of three percent seats in institutions funded by the government. Eighteen of the schools surveyed acknowledged that they did not admit students with disabilities. Twenty percent of the schools polled were not aware of the 1995 Disability Act at all. While girls comprised 41.6 percent of the total student population, among children with
disabilities, the percentage of girls was only 33. In addition to that the study contents, reading materials, use of assistive technology, and individual need based support is lacking.

The same study from NCPEDP 2004 shows that only 0.1% (1635) of disabled persons has been enrolled in higher educational institutions. In many parts of the world including India, this is still the case where institutions of higher education purport to provide equal access and reasonable accommodations, disabled students still face discriminatory policies and practices. In addition, too little is available about inclusive pedagogy and policy in higher education.

Christy, Beula and Nirmalan, Praveen K. (2006) conducted a study to determine the acceptance of the long cane by people who are blind in South India. The long cane costs roughly one to two dollars in India, and is easily available. Participants were recruited from the Department of Low Vision and Vision Rehabilitation of the L.V. Prasad Eye Institute in Hyderabad, South India. The researchers found that less than one-third of the participants had ever been advised to use a cane. The researchers also found that less than one-tenth of the participants had formal training in cane usage, and that less than one-fifth were currently using canes. Several barriers to cane usage were reported, including: (1) fear of stigmatization, (2) the use of sighted guides, (3) reduced physical activity, (4) lack of training, (5) fear of falling, (6) lack of physical support, and (7) lack of training. The authors contend that the results suggest the need for more focused efforts to address the rehabilitation of people who are blind in South India. More efforts can also be made to sensitize health care professionals to the usefulness of canes and to train people who could benefit from cane usage.
Kurian, James and Pillai, P.R. Saseendran. (2009) developed a guidance system for assisting blind and visually impaired people in structured indoor and partially outdoor environments. The system consists of a number of encoded infrared sheet-of-light beacons installed at appropriate locations and a small receiver module attached to the shoulder of the user. It is intended for use in indoor environments such as homes, office buildings, supermarkets, and airports. The Digital Infrared Sheet of Light Beacons (DISLiB) transmit the encoded location information, while an infrared receiver module decodes the data and the appropriate message is retrieved from the corresponding memory in a ChipCorder, a voice record and playback integrated circuit, and delivered to the user through an earphone. The system achieves localization and guidance information with readings from a single beacon in the vicinity, which makes it ideal for corridors and narrow walkways. The DISLiB based support system is simple and cost effective and provides less body gear without much computational burden or significant processing.

2.5 STUDIES CONDUCTED ABROAD

Werner and Strauss (1939) and Strauss and Lehtinen (1947) conducted a comprehensive study with brain-damages children. They found that disturbances in visual perception and visual motor perceptual functioning often accompany central nervous system damage. Their work also fostered the rapid growth and development of several visual motor training programmes by theorists such as Barsch, Frostig, Getman and Kephart.

The interest in visual motor development within the learning disabilities field can be traced to the early work of Strauss and Werner (1941), who studied the
visual-motor problems of mentally retarded students and believed that faulty visual-
motor coordination was a behavioural symptom of brain damage. Werner and
Strauss popularized the notion that adequate conceptual development is dependent
on perceptual and motor development.

Piaget & Inhelder (1956) stated that early sensory-motor experiences are
basic to more advanced mental development. Sherrington (1948) proposed that the
motor system is the first neurological system to develop and foundation for later
perceptual growth. The concern for perceptual-motor development is a recurring
theme in many areas of the history of special education (Lerner, 1985). While this
perceptual-motor framework can be used to discuss all areas of perception that relate
to motor responses – auditory, visual, haptic, olfactory, etc, the relationships
between visual-motor perception and discrimination and learning problems have
received the greatest attention.

Bartley (1958) viewed perception as being either experiential or motor.
Some of the assessment instrument used to measure visual perception are actually
visual-motor copying tasks, for example, the Bender Gestalt Test, the coding subtest
of the Wechsler scales of intelligence, and the developmental test of visual motor
integration, all required motor responses.

Goldstein and Scheere (1959) considered visual-motor and visual motor
and visual – perception deficits as separate entities.

Many studies were conducted to find out the usage of Braille among Visually
Impaired students. They observed that after the adoption of Braille as the official
tactual code, following a prolonged period of experimentation with these different
tactual codes, any student with a visual impairment, regardless of degree of residual vision, was taught to read and write using Braille. It was believed that students with visual disorders should avoid using any remaining vision in order to prevent further deterioration of sight. This practice was known as sight saving, and it reigned as best practice until the concept of visual efficiency, or explicitly training students how to use their residual vision emerged (Barraga, 1963; Harley, et al., 1987; Rex, et al., 1994).

Getman outlines the successive stages of visual-motor integration, including innate response, general motor systems, special motor systems, ocular motor systems, speech motor systems, visualization systems, vision or perception, and cognition. Each of these levels is conceptualized as more precise and exacting than the preceding one, with complete mastery at each stage required before completion of subsequent system can be achieved. Therefore, within this model, academic learning must be preceded by extensive and successful motor learning. This implication is that learning-disabled children need exercise in the base levels of motor and visual-motor development before academics can be addressed (Getman, 1965, Kane & McKee, 1968).

Mercer et al. (1970) reviewed 70 studies, only 15 of which allowed computation of false positives and false negatives. In these studies, screening instruments included the Evanston Early Identification Scale, the Wide Range Achievement Test (WRAT), the Metropolitan Reading Readiness Test, and the Bender-Gestalt, as well as batteries composed of visual-motor, language, gross motor, and cognitive measures. Intervals between administration of the screening and criterion measures ranged from 8 months to 7 years. Median accuracy rates were
75 percent for single instruments, 79 per cent for batteries, and 80 per cent for teacher perceptions. Mercer et al. indicate that developmental history, socio-economic status, and teacher perception of skill deficits are strong predictors of later learning deficiency. They suggest that screening should take place in mid-kindergarten, as this allows intervention to begin at the earliest time that teacher ratings become reliable as predictors.

Studies conducted in US in 1960s and 70s found that there was a steady decline in the number of Braille readers in the United States. (Nolan, 1965, 1969; Nolan & Bott, 1971).

In one study, it was found that Braille readers may be better able to process oral information than large print readers (Brothers, 1971). In a similar study, it was found that reading Braille with the left hand may be more effective than with the right hand (Hermelin & O’Conner, 1971).

Serim (1999) in his study suggested that if corrective steps are not taken, technology may worsen rather than solve equity disparities in multimedia schools.

High emphasis is given on the training of visual – motor perception processes to improve a child’s skills in academic areas such as reading. But there is a controversy surrounding this. Hammil & Larsen (1974) in their study found that there is no evidence to support the assumption that academic learning is dependent on these types of psychological processes. However both the critics and advocates of these training programmes have based their arguments on highly questionable research reports (Hallahan & Kauffman, 1976).
Reducing the number of words in a Braille reading passage may not result in increased speed or comprehension (Martin & Bassin, 1977).

A study found that leaving out words might decrease the amount of time it takes to read, but it does not increase comprehension, although it has a greater impact on news passages than it does on science or fiction passages. (Martin & Bassin, 1977).

A new sensory aid for children who are blind, the Canterbury Child's Aid, was reviewed along with the rationale for the design features of the device (Strelow & Boys, 1979). This study provided useful information for multidisciplinary teams to consider pertaining to the observed behaviors and learning of the students, albeit in a limited fashion without the use of statistically powerful sample sizes or comparison or control groups.

In two similar studies conducted at various times, Miller found that poor Braille quality can slow down reading rate and accuracy (Miller, 1977, 1987).

Anater’s study found that haptic perception is sustained over time, suggesting that concrete hands-on experiences might enhance learning (Anater, 1980).

Gutknecht (1980) reviewed fundamental skills that are needed to use the Optacon and interviewed an instructor-coordinator at a residential school for her comments about students' success with the device.

LaGrow's (1981) examined the effects of a CCTV on the reading rates of six college-bound students who were visually impaired using a multiple-baseline
(across subjects) single-subject research design to control for and demonstrate the effectiveness of the intervention. The study found that the reading rates of each participant increased after systematic instruction. The data that were reported (that is, the mean reading rates) made it possible to measure the effectiveness of the intervention.

Moore (1982) in his study described ways to use new educational materials that were developed specifically for students with visual impairments and additional disabilities. His study included instructional techniques for low vision stimulation kits and prevocational materials.

A study (Koenig & Ashcroft, 1983) investigated the effect of using an electric Perkins Brailler on the participants' writing rates and accuracy. A single-subject design was used on 10 participants, each of whom served as his or her own control. At the onset of the study, none of the students had used the electric Perkins Brailler, but all had used the regular Perkins Brailler. The study found no significant differences between writing methods with the electric and regular Perkins Braille systems. The data that were reported (that is, mean scores, standard deviations, and t-values for the dependent variables) made it possible to measure the effectiveness of the intervention.

Kirk and Chalfant (1984) in their study found that breakdowns in three main areas may have problems in visual-motor perception and discrimination. First a child may have problems with laterality, or lateral dominance. This problem becomes apparent when both sides of the body perform the same act at the same time when that is not part of the task, or when a child uses only one side of his or her
body when two sides are called for. Second, a child may have a directional
disability. They manifest themselves when the child fails to develop an awareness of
basic directions such as right from left, up from down, and front from back. Very
young children will have problems in directionality, but as the child matures, this
problem usually corrects itself. If these difficulties continue, the child may have
problems in learning. Finally, a child is said to have a breakdown in visual-motor
perception when the child’s development is limited to the stage where the hands
leads the eye. As visual-motor perception is refined, the eye should lead the hand.

There were some cost efficient methods to identify the handicapped children
at an early stage. **Finkelstein and Ramey (1985)** conducted a study using the
children’s mother’s age, education, and previous live births now dead; the child’s
birth order, race, and birth weight, and the month in which prenatal care was begun.
The data were used to predict which of 1000 children would be handicapped at first
grade. Handicapped was defined as having scores more than one standard deviation
below the mean on the Peabody Picture Vocabulary Test and on the Myklebust
Pupil Rating Scale. Although using birth certificate data correctly identified almost
all (81%) of the actual handicapped students, only 15% of the group predicted to be
handicapped actually was. This procedure cannot be solely used for early
identification, but it may represent a first screen in a series of ever more extensive
screening tests.

**Ragu et al, (2001)** concluded that females fared better in developing
learning materials; Teaching was an inherent character as they played the role model
of their mothers.
International research data on visual-motor integration or visual-motor association denotes the ability to relate visual stimuli to motor responses in an accurate, appropriate manner. Historically, visual-motor problems have been associated with learning disabilities and within a diagnostic-remedial intervention model, visual motor skills have been taught to learning-disabled pupils as a prerequisite to academic skills (Lerner, 1985).

Braille reading comprehension decreased when other stimuli compete for the student’s attention (Millar, 1988, 1990).

The methods used in visual-motor training are generally developmental and emphasize the importance of early motor learning and visual-spatial development in children. While many of the advocates of visual-motor training programmes have slightly different rationales for their programmes, the basic perceptual-motor orientation and the recommended training activities are very similar. Barsh, etman, Frostig, and Kephart all propose techniques for working with children with learning problems (Myers, & Hammill, 1990).

Koenig, Layton, and Ross (1992) used a case-study approach to evaluate the relative effectiveness that six students with low vision experienced when reading in large print and when reading standard print with low vision devices.

Shapiro (1993) suggested that part of the literacy issue is related to a growing reliance on technology.

Later studies found that the decline in Braille usage was the result of (a) an increase in the number of students who were labeled as non-readers due to
additional disabilities, (b) an increase in the number of students with low-vision who use large print and optical aids, (c) limited availability of Braille materials, (d) the predominant use of an itinerant service model, (e) insufficient teacher training, and (f) negative attitudes toward Braille (Koenig, 1995; Schroeder, 1996; Spungin, 1996; Wittenstein, 1994).

Ryles (1996) suggests that legally blind, Braille readers attain higher education levels, employment rates, financial status, and self-esteem than legally blind, print readers. Since 74% of blind and visually impaired adults of working-age are unemployed or underemployed (Kirchner & Schmeidler, 1997), Ryles’ conclusions are definitely a concern.

Layton & Koenig found that drill and practice in Braille can lead to increased reading achievement, faster silent and oral reading rates, fewer reading errors, and greater comprehension (Layton & Koenig, 1998). Sprenger (1999) in his study found that students with vision impairment tend to use their memory to a greater extent than their sighted counterparts, practical experience is even more crucial to concrete their learning. Students learn by processing materials via different ‘lanes’ to the brain, and experimenting in a familiar and trusted environment allows blind students to use multiple lanes to the brain, including the physical senses, experiences, and emotional reinforcement, aiding comprehension.

Engleman, Griffin, Griffin, & Maddox (1999) provided a guide for communication with students with deaf-blindness. The teaching practice presented in their study included a detailed discussion of assistive technology that was available for students with deaf-blindness.
The National Reading Panel (2000) identified speech access, the use of hypertext, and the use of word processors as promising for the development of literacy.

Research in blindness and low vision faces difficulty in conducting studies with large enough samples to give confidence to the statistical procedures, that have been subject to repeated testing, or that utilize random assignment and control groups. The low-incidence nature of visual disability often limits the research designs that can be utilized and the conclusions that can be drawn. This has led to a research base characterized by single case studies, anecdotal reports, small and heterogeneous samples, and lack of replication. Perhaps because of these difficulties, educational research involving students with visual impairments is notoriously underfunded (Corn & Ferrell, 2000; Mason, Davidson, & Mc Nerney, 2000), and individuals available to design and carry out educational research are often limited to a small number of faculty in less than 30 universities in USA.

Edyburn, Dave L (2001) conducted a Meta analysis of the educational technologies in Special Education literature. The literature review was conducted to determine two main factors: (1) how widely scattered the literature on special education technology is, and (2) what areas are the focus of special education technology literature. Data were analyzed from the table of contents from the 2000 issues of 31 journals in special education technology, special education, and educational technology. The researchers found that out of 906 articles in the journal issues, 197 contributed to the knowledge base on special education technology research and practice. Relevant literature could be found in 29 journals, but a core set of four journals contributed 55 percent of the relevant literature. Content analysis
revealed several areas on which articles often focused, including: (1) Augmentative and alternative communication, (2) Accessibility, (3) Assistive technology, (4) Implementation issues, (5) Internet applications and web resources, (6) Pre-service teacher education, and (7) Technology integration. Implications for further research are discussed.

Two studies found that training in and use of low vision devices increases oral comprehension reading speed (oral and silent), and the amount of reading accomplished (Corn, Wall, & Bell, 2001; Smith & Erin, 2002)

Bauer, Anne M and Ulrich, Mary E. (2002) conducted a study to find out the use of Palm Pilots in a sixth-grade classroom. Twenty-eight sixth graders used the devices; six were considered to have special needs. The program plan was to introduce the Palm Pilots and provide six weeks of training and support. Students were shown how to use the stylus, record assignments, and how to set their preferences. Students were expected to record daily and weekly data on their use of the handhelds on whether they used the handheld for a specific purpose. Weekly averages of usage for boys, girls, students with identified disabilities, and the class as a whole were measured. Parents were also surveyed on their view of the Palm Pilots. Fifty percent felt that the handhelds were interesting and motivating, but that their children's achievement level remained the same. Four of fourteen parents indicated that the handhelds had a positive effect on the learning process. All of the students remained enthusiastic about using the Palm Pilots, while many teachers were concerned about managing the new technology in the classroom setting.

Goodman et al (2002) conducted a study in which 14 college students with disabilities identified factors that influenced them to either adopt or reject assistive technology (AT) for their personal computers in order to assess the effectiveness of
a college course on adapted computer use. A total of 48 items were developed to represent both positive and negative statements in each of the three areas of Scherer's model: (1) milieu, (2) person and (3) technology. The model was modified to include specific statements about the training experience. A series of three interviews were administered to the students following course completion. Results indicated that the participants had a very positive experience. The training program, the technology provided, and the characteristics of the individuals in the class all seemed to be factors that contributed to the success of the students’ experience. A total of 75 percent of the students who took the class adopted at least some of the AT after one year had elapsed. The authors contend that these results support the need for specific training programs and course work for college students with disabilities who are interested in improving their computer access skills.

The National Center for Education Statistics' Early Childhood Longitudinal Study reports that 97% of kindergarten students with disabilities and 98% of first graders with disabilities use computers (Rathbun & West, 2003). It also reports that in first grade, children with disabilities were less likely to have access to home computers than children without disabilities. 87% of the children used their home computers for educational purposes for an average of 3.5 days per week. In the classroom, children used computers most frequently to read, write, spell, learn math, and for fun. It appears that the future is here, but our teaching methodologies have not yet arrived.

Kurzweil, Ray (2004) provides a transcript of remarks at the first technology conference held at the National Federation of the Blind Jernigan Institute on April 8, 2004. Kurzweil is credited as the developer of omni font optical
character recognition, inventor of the first text-to-speech reading machine for people with visual disabilities, developer of the CCD flat bed scanner, inventor of both the first speech synthesizer and a music synthesizer that reproduces the grand piano and orchestral instruments, and developer of the first large-vocabulary speech-recognition system. He is also working closely with the National Federation of the Blind to develop a pocket-sized reading machine that can be used anywhere. In his address, Kurzweil focuses on directions for new technology, what kind of capabilities he expects 20 or 30 years into the future, and the impact that technology will have on people with disabilities and on the world in general.

A study conducted in 2004 found that only nine percent of all legally blind students use braille as their primary reading medium (American Printing House for the Blind (APH), 2004). APH points out that 23% of all legally blind student readers use braille, thus suggesting that a large proportion of the population is considered non-readers. Regardless, the statistics are grim.

The more recent evaluation of the Jordy magnification device, provided ratings that address the usefulness of the device in performing the activities noted in the article (Francis, 2005). The product evaluation ratings of the Jordy magnification device and other similar product evaluations that were identified by the search were based solely on the authors' own observations, interactions, and opinions of the products.

Fenrich (2005) in a study found that by utilizing simulations, active experimentation, discovery learning techniques, questioning with feedback, video, animations, and photographs, practical hands-on skills can be taught virtually. This
may be the case for sighted students; however, vision impaired students do not have the sight needed to access many of these multi-media sources of delivery.

**Marston, James R. and Church, Richard L. (2005)** presents an approach to empirically measure the difficulty of a variety of transit tasks for people with visual disabilities. To measure the effect that limited environmental cues have on travel, the researchers utilized Talking Signs’ Remote Infrared Audible Signage (RIAS), which allows people with visual disabilities to gain identity and directional cues. The application consists of a receiver that allows the user to scan the environment with a hand-held device, and hear the identity of locations that are fitted with transmitters. An experiment was conducted in an urban transit terminal. Thirty people with visual disabilities attempted to make five simulated transfers between three transit modes while using the RIAS. A total of 20 locations were visited, while completion times were compared to those of a sighted traveller to determine a relative access measure. Data indicated that different types of transit tasks and locations had a wide range of difficulty. Tasks such as crossing a difficult street and finding unmarked track doors were often time-consuming and impossible, while tasks such as crossing a standard street and walking to a street corner were performed with relative ease. The authors conclude that the placement of additional cues such as identity, direction, and auditory signage helped to combat uncertainty and time restrictions faced during mass transit use by people with visual disabilities.

**Sharpe, Michael N et al (2005)** conducted a study to examine the state of instructional accommodations and assistive technology (AT) utilized by postsecondary graduates with disabilities. A total of 139 postsecondary graduates were asked to name instructional accommodations and AT they were provided with
throughout the course of their secondary and postsecondary educations. Results indicated that AT and other accommodations are provided at a much higher rate in postsecondary settings, while the majority of graduates learned to use AT on their own or with help from family members. The respondents reported that they were pleased with the AT and accommodations they utilized during their academic careers. Twenty-seven types of AT used by the respondents are listed in table format.

To help students who are visually impaired enjoy the ensemble experience provided by music educators, Siligo (2005) focused on many of the practical tools and information that can make this experience possible. The tools and information discussed by Siligo were intended to enable music educators to fully include students who are visually impaired in the ensemble experience. Although no scientific design was presented in this article, the recommended tools will be of great help to teachers who are looking for ideas for music instruction. It must be noted that Siligo's article and many others contributed to the effective use of assistive technology.

The study conducted by Seisenbacher et al (2005) discusses the prototype 3D-Finger System, which was created to support the education of students with visual disabilities by providing auditory feedback during haptic exploration. The 3D-Finger System was created by researchers at the Research Group on Rehabilitation Technology at the Vienna Institute of Technology in Austria. Using a personal computer, a teacher records descriptions and explanations of tactile graphics or models, though music and sound can be incorporated into the description as well. The descriptions are then assigned to specific areas on the tactile map or
model, and are played back while students explore the areas with their hands. Initial design feasibility studies are discussed, as they have yielded positive preliminary results. The only glaring weakness found during preliminary evaluations was a dependency on constant illumination, as inconsistent lighting tended to reduce accuracy. Implications for future studies with students with visual disabilities are discussed.

Bouaziz, Russier, and Magnan (2005) evaluated the ability of sighted blindfolded children and children who were visually impaired to use raised-line drawings effectively. The study provided remarkable information on the topic. However, it was clear that the participants in the group who received the intervention were not comparable to those in the comparison group. The effectiveness of an intervention cannot be evaluated in conjunction with this contradictory feature of a study.

Results from statewide assessments in Colorado, USA, show disturbing reading achievement levels for students with visual impairments. Only 41% of 10th graders with visual impairments attained proficiency on the reading portion of the 2006 Colorado Student Assessment Program (CSAP). Other states report similar results in grades 3 to 10. It is evident that students with visual impairments are not achieving adequate literacy, and they are not achieving it early enough in their lives.

In their study, Hogan-Royle, (2006) found that the blind lack intellectual power due to challenges to access and participate in educational institutions, with the most significant barriers to inclusivity in education being the lack of inclusive
mindset, lack of knowledge about pedagogy, high teaching loads, and lack of time for instructional development (Moriarty, 2007).

**Stodden, Robert et al. (2006)** conducted a study at the National Center for the Study of Postsecondary Education Supports at the University of Hawaii at Manoa-Center on Disability Studies that focused on the types and frequency of educational supports, accommodations, and services offered to students with disabilities attending two and four year postsecondary educational institutions. The study consisted of one survey distributed twice to a national sample of roughly 1,600 Disability Support Coordinators who were working in postsecondary educational institutions. The second survey was conducted two years following the first. The authors discuss the findings from two sections of the survey: (1) the section that asked the respondents to address their institutions’ capacity to offer assistive technology (AT) supports, accommodations, and services as needed by students with disabilities; and (2) another section that focused on the availability of access to distance education. The survey findings indicated a significant increase in all types of AT supports, accommodations, and services, as well as an increase in distance learning services for students with disabilities. Implications for future research are discussed.

**Sánchez, (2007)** in his study found that education materials in IT-related disciplines traditionally rely heavily on tables and graphics to present essential concepts, methods, and architectures. Blind students cannot see diagrams and low vision students have great difficulty comprehending what is being taught. The challenges of developing learning materials for the vision impaired and interfaces not reliant upon graphics are complex.
Smith, Derrick W and Kelley, Pat. (2007) conducted a survey of universities with teacher-preparation programs for teaching students with visual impairments and deaf-blindness to determine how assistive technology training is integrated into their curricula. Participants were 30 faculty members of the 38 university programs in North America that train teachers of students with visual impairments. The 15-question survey was conducted online using a tool called Select Survey ASP. After completion, the survey data were exported to Statistical Package for the Social Sciences (SPSS), a computer program used for statistical analysis. Of the 18 programs that offered specific AT courses, 3 offered generic or multi-disciplinary courses and 15 provided a specific course for teachers of individuals with visual impairments. The other 12 universities either embedded AT in a course as a unit or integrated it throughout the program. Other survey questions related to the specific competencies covered, and the level of knowledge students were perceived to have at the completion of the programs. AT devices explored were low vision, Braille output, educational access, and independent living devices. The survey found that universities teach different assistive technologies and at different levels.

Cronk, Stan and Parimi, Pardha (2007) conducted a study to compare the tactile length estimation skills of students who are blind with the visual and tactile estimation skills of sighted students, as engineering students are expected to be able to estimate readings from scales and gauges to one significant digit beyond the smallest scale graduation. This study was conducted by researchers at the Center for Biomedical Engineering and Rehabilitation Science at Louisiana Tech University. Twenty-four people with ages ranging from 15 to 25 participated in the experiment.
Eight participants were blind, while sixteen were sighted. Six of the eight participants who were blind were in high school, while two had graduated from college. All 16 of the sighted participants were college freshmen majoring in engineering. They prepared a set of simple full-page graphs in Microsoft EXCEL, with the line length varying horizontally along the x-axis. Each graph was printed first on a laser printer, and then the researchers ran each printed graph through a Reprotronics Tactile Image Enhancer along with a sheet of Flexi-Paper. The participants were expected to use the graphs to estimate distances. The researchers found that the participants who had visual disabilities performed on par with the sighted individuals with only their sense of touch, but were slower and less accurate in task performance.

In Stauffer’s study, keyboarding was used as part of a whole-language approach to teach functional literacy skills to students who are visually impaired with additional disabilities (Stauffer, 2008).

**Alves et al (2009)** conducted an extensive study to find out the usage of assistive technologies in the classroom among teachers and the reasons behind the usage or non usage. Most teachers (61.4%) stated that the use of assistive technology resources has different applicability for blind and low vision students. They also declared that specific programs for students with visual impairment are necessary in schools (98.3%). Concerning the importance of using assistive technology resources in educating students with visual impairment, 84.2% of the teachers declared that the resources were very important to enhance reading and writing skills as well as to communicate with the world on an equal basis (95.8%). In addition, they made information available and the content of the teaching material
more attractive than the traditional resources (93.7%), improving the students’ quality of life, facilitating the learning process (91.7%), and allowing them to rewrite and correct texts (87.5%) with autonomy and privacy (66.7%). The results showed that most teachers (94.8%) did not use information technology with visually impaired students. The reasons were not having previously included in the course program the use of information technology in class (70.4%), the lack of specific programs for students with visual impairment (51.8%), the fact that the school administration did not make information technology available for teachers and students (24.1%), the fact that students with visual impairment did not know how to use the computer, and the belief that the disability did not allow the individual to use the computer (20.4%). Regarding the necessary requirements for using information technology in schools, the teachers indicated the need for enough computers for all students in the class (89.5%), a computer technology advisor to help teachers (75.4%), pedagogical support to use information technology as a learning strategy (74.6%), enough ability to use computers (69.4%), programs for students with visual impairment (68.7%), and Internet-connected computers (59.7%).

**Helen L. Armstrong (2009)** conducted a study imparting advanced IT education for the vision impaired students via e-Learning. She used a quasi experimental design using an experimental group of blind students and a control group of normal vision students. In the first intake both groups of students achieved an average of 91.75%. In the second intake the vision impaired students gained an average of 86.90% compared to 83.99% for the sighted group in the same assessments. The results were closer in the third intake, with the vision impaired students achieving an average of 87.75% compared with 86.30% for the sighted
students. All achieved grades were within the 5% limit set. At no stage over the three intakes did the vision impaired students score grades lower than the sighted students, and in two intakes the average score was slightly higher. The higher scores can be explained by the dedication of the vision impaired students in response to a program specifically designed to improve their skills and employability. These students spent significantly more time reading and completing exercises out of class time than the sighted students.

In an article (Kurzweil, 2009) focuses on the development of the Kurzweil-National Federation of the Blind (K-NFB) Reader, which was created as a result of collaboration between Kurzweil Educational Systems and the National Federation of the Blind. The device consists of an off-the-shelf PDA, which is combined with a digital camera. The K-NFB Reader simply allows the user to snap a picture of a printed page, and then reads it out loud. The software was developed by engineers at Kurzweil Technologies while the NFB tested prototypes, made design suggestions, and produced device documentation. The NFB also gave units to 500 of its members across the country to use in their daily lives, with an overwhelming response. The NFB members who used the device found that it was clearly designed by people who are blind, as it has an easy-to-use interface, clear documentation, and a wide range of images that developers can use for upgrades. The K-NFB Reader was used to snap images of restaurant menus, memos, medicine packages, magazines, credit card bills, and brownie mixes. All images can be saved on compact flash cards for later use.

Rovira and Gapenne (2009) used a case-study approach with three students who were blind to evaluate a device for reading and recognizing geometric line
drawings. This study provided useful information for multidisciplinary teams to consider pertaining to the observed behaviors and learning of the students, albeit in a limited fashion without the use of statistically powerful sample sizes or comparison or control groups.

**Hodges, Brad and Huffman, Lee. (2009)** conducted a study to explore factors affecting learning to use a computer by older people with vision loss and varying previous formal training and experience with the Windows operating system. Seven individuals aged 60 to 88 years participated in the study. Participants completed basic computer tasks using two screen-access programs: Guide, which uses a simple text-based visual design combined with keyboard commands; and System Access to Go, a free screen-reader application compatible with Windows applications. Computer tasks selected included basic navigation, browsing and reading e-mail messages, and finding and reading a headline on the AFB web page. Participants rated themselves on their computer experience and attitudes toward access technology prior to as well as after completing the computer tasks. The major finding of the study was that keyboarding skills or the lack thereof, played the most important role in whether or not a participant could use a computer. Those who had pre-existing computer skills all found System Access to Go to be useful, whereas for those who had relatively poor keyboarding skills and did not use the mouse, Guide was the clear preference. Based on study results, the authors recommend refinements of the Windows setup, including mouse settings, simplifying the desktop, and optimizing Outlook Express and Internet Explorer settings for users with low vision.

**Kelly Stacy and Smith Derrick (2011)** examined the research literature from 1965 to 2009 on the assistive technologies that were used by individuals with visual impairments. Searching 4 electronic databases and the Journal of Visual
Impairment & Blindness and Review, 256 articles were located and subsequently reviewed for evidence based research on assistive technology used for educational interventions by visually impaired students aged 3 to 21 in preschool through 12th grade educational programs. More than half, or 156, of the articles were discussions of theories, beliefs, or practices; product reviews; or product evaluations without research designs or methods. Only 2 articles provided promising evidence based practices. One examined the effects of a CCTV on the reading rates of 6 visually impaired college bound students using a multiple baseline single subject design to demonstrate the effectiveness of the intervention. The other compared the effect of a regular and an electric Perkins Brailler on the writing speed and accuracy of 10 visually impaired participants, where the data reported, mean scores, standard deviations, and t-values of the dependent variables, allowed measurement of the effectiveness of the intervention.

2.6 CONCLUSION

The review of the above studies related to the use of Assistive Devices, Braille, and other ICT related technologies in the education of the visually impaired students helps the investigator to get the required theoretical background pertaining to the objectives of the study, to form the design of the study, sampling technique, tools used for the study and application of suitable statistics by deriving the findings in the researchers conducted by the predecessors.

Most of the foreign studies concerned with assistive technologies are Meta analyses, or the technological usage of assistive devices. Very few studies had been conducted to find out the effectiveness of such technologies. Very few studies had
been done in India in this regard. Most of the studies that are stated in the previous pages have been done at college level. The present investigation carries distinction and novelty over the previous ones by conducting the study among school children adopting a quasi experimental design. To fill the identified research gaps, the investigator has attempted the present study and the same is titled as: “Effectiveness of ICT in the Education of Visually Challenged Children”.