CHAPTER - II

REVIEW OF LITERATURE
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2.1 INTRODUCTION

Research in education is no better than the information upon which it is based. Review of related literature allows the researcher to get acquainted with the current knowledge in the field or area in which the study is conducted. It helps the researcher to analyse the methodology adopted, the tools and instruments used and findings obtained in the previous studies.

In the words of J. Francis, “Research is an endeavour to discover and develop knowledge. It is an intellectual process that has developed over hundreds of years ever changing in purpose and form and always searching for truth” (Aggarwal, J.C. (1996).

The researcher is a specialist rather than a generalist (Best J.W., (1986). Therefore to be a specialist, a researcher has to go through all the related literature and related relevant studies.

Citing studies that show substantial agreement and those that seem to present conflicting conclusion help to sharpen and define understanding of existing knowledge in the problem area and provide a background for the existing knowledge. The literature in any field forms the foundations upon which all future work will be built.

2.2 CLASSIFICATION OF RELATED LITERATURE

This chapter includes the related studies done. It includes studies related to Normal Visual Development, Low Vision Reader, Legibility of Print, Factors

2.3 STUDIES RELATED TO NORMAL VISUAL DEVELOPMENT

Appleton (1975) in his study found that in the first years of life, the progression of normal visual development flows freely from one function to another, merging and overlapping with each other. A specific visual function may appear early or late or reappear periodically before becoming stabilized. The intensity and variation in stimulation for sight, influences development in the visual and visual motor systems.

All neural systems are immature in early infancy, and the optic nerve is incompletely myelinated; peripheral component of the visual system matures earlier than the macula area within the retina. Although foveal vision is functional to some extent at birth, it may be less developed, a fact, which accounts for the suggestion that only movement and gross form are perceived. Infants become aware of many visual sensations and begin to take in lots of visual information.

Hiatt .G (1980) stated that the normal visual acuity of the newborn has been estimated to be 30/440 to 20/150 with accommodation possible at seven and one half inches. In a matter of weeks, the infant begins to attend to novelty and complex patterns, can discriminate mother from a stranger, and a human face brings a smile. MackKeith (1969) concluded that density of pattern and high contrast in objects attract attention for longer periods. Fixation and refixation of
moving objects at about two or three feet with reasonably smooth eye movements is observed, and after binocular vision begins to develop, the eyes follow moving persons.

Segal (1974) stated that accommodation at various distances increases the ability to see moving objects eight to ten feet away. Poor accommodation may reflect limits on sensitivity rather than adaptability and is characteristic of those with impaired vision.

Appleton, et al. (1975) found that reaching toward objects is an indication of discrimination and recognition of the environment and some degree of depth perception is possible at about five inches.

Griffin & Sanford (1976) investigated that babies stare at and examine hands and anything in them with apparent fascination. Eye-hand coordination develops when smaller objects such as pellets are picked up. As the fovea continues to develop, acuity sharpens to about 20/200, and binocular vision and color perception become stabilized. Accommodation permits objects to be pursued visually in depth from near to far. Reaching for a toy with one hand and good aim, looking back and forth from one object to another, and turning the head after dropped objects reflects improved visual motor coordination. Visual motor schema of eye-hand and eye-object are integrated with the tactual motor schema since variations in surface texture, weight, and temperature are also noticed.
New Visual Behaviours, discrimination and recognition of contour, details in two-dimensional pictures, and memory for what has been seen previously are indications of rapidly progressing visual development. Looking and seeing are accompanied by movement and action, as many new visual behaviours begin to emerge, such as: looking for and trying to recover a dropped object; smiling and vocalizing to self in mirror; attention to increasingly smaller sizes and details; watching, scribbling and recognition of partially covered objects. The fovea continues to develop and acuity sharpness reaches approximately 20/100.

Griffin & Sanford (1976), Haith & Campos (1977), O’Brein (1976), Segal (1974) found that body movements in response to visual stimuli increase when accurate convergence is swift. Awareness of position of objects in space and their relationship to another is indication that visual perceptual development becomes more integrated with social and cognitive development. Better integration of spatial information and stability in object constancy is reflected by compensation for distance in size estimation, such as size discrimination of doll’s shoes from one’s own. Normal visual functions in early childhood are constantly changing and expanding. All types of visual games are played, and visual imitation is at its peak. Scribbling is spontaneous, and pictures of familiar objects are found in books and matched to similar toys. Imitation of two-block tower and placement of a square shape in a form board reveal refined eye-hand coordination. Ability to discriminate, recognize and perceive a wide variety of future elements, contrasting areas of figure-ground intensity, near-far perspective, and a logical sequence of action depicted in pictures is now
possible. Expansion of the visual world through independent mobility and experimentation with toys, puzzles, pictures, and books occur rapidly from this point.

Fooks (1969) found that visual acuity and perception depends on the integrity of the whole retina and the cortical connections. Visual development shifts from physiological control of eye movements, accommodation and convergence, and refinement of sharpness and clarity of visual acuity to that of the visual perception.

Lillie & Harbin (1975) stated that visual memory is evident when children look for missing toys, match color cubes, and name pictures of familiar objects. Soon, details in pictures as well as size differences are observed, and pointed appropriately to specifics in pictures when asked “where” and “what” get to be a game.

Vurpillor (1976) stated that during the rapidly expanding period of visual development between three and four years of age, organization of visual perceptions overlap and merge with specific functional refinements. Further development of visual memory facilitates the differentiation and recognition of the whole from a part and vice versa.

Lillie & Harbin (1975), O’Brein (1976) described that by four years of age the child has completely mastered eye-hand coordination, exercising visual control of exploration and manipulation. By five years and beyond, the child is
able to discriminate, recognize, and perceive likeness and difference in abstract figures and representations such as complex designs and numeral and letter symbols. Finding the relationship between abstract figures and real objects or their pictures increases visual interpretation. Subsequently, instantaneous visual association is made between real objects, pictures of them, and the numbers and letters related to them. The use of large symbols makes visual recognition easier, and attention can be directed to analysis and interpretation of the individual numbers and letters. Letters grouped into words and short sentences continue to be recognized, even though their size may decrease. Copying symbols indicates the refinement of visual motor or eye-hand coordination necessary for handwriting, a fact that is true also for those with low vision.

2.4 STUDIES RELATED TO LOW VISION

In the past low vision children were not considered as a separate category. They were considered as totally blind. But now in most countries these children are considered as a separate category since they have problems of their own, which are different from the problems of the blind. According to Nolan, C.Y. (1959) these children are "quite heterogeneous in regard to visual disability, visual acuity and other characteristics". Faye, E.E. (1970) stated that there is a wide variance in the degree and kind of functional loss among low vision children resulting from different pathological conditions.

Newell, F.W. (1965) stated that the accommodative power of a low vision person's eye is a matter of particular interest to a consideration of appropriate
print size. Accommodation is the process by which the refractive power of the lens in the eye is adjusted so that both distant and near objects may be distinctly imaged upon the retina.

Maintz, M.J. (1965) found that the available power of accommodation becomes significant when the reader holds materials closer in order to increase the retinal image. Fonda, G. (1970) indicates that the eyes fatigue more easily when a person is expending maximum accommodation and interpreting a blurred retinal image. The relative amount of accommodation present would seem to be an important factor in limiting the reading distance.

However clear and well presented reading material may be, there can still be problems in its use, particularly for pupils who need to use it at a very close distance from the eye. A spontaneous way to affect magnifications is to bring reading material close to the eye. As Lindstedt (1986) explains "there is a simple correspondence between the distance of a focused object from the eye and the size of its image on the retina. If the distance is reduced to the third, the image becomes three times larger and so on. Morris (1972) stated that when visually investigating objects for details, the visually Impaired child as a rule, 'peer close' (i.e.) brings the object close to the eye or the close to the object. By this method the detail of the object will be seen in a wider visual angle and the retinal image will be magnified with greater part of retina thus being activated.

These children previously were referred as partially sighted or partially blind. Garrison, K.C. & Darey, G.F. (1965) studied that partially blind is defined
as visual acuity between 20/200 and 70/700 (Snellen) in the better eye after best possible correction. This definition is used in India. Partially sighted have a measured visual acuity of 20/70 to 20/200. Hathaway, W. (1965) points out that such criterion have proved to be inadequate in describing children for educational purposes. Bateman (1980) confirms this view and suggests that more adequate criteria need to be established.

Reading for all persons has two major aspects; discrimination and recognition of the symbols and giving meaning to the thoughts represented by the symbols. Learning to read visually when impaired vision makes it difficult to discriminate and recognize the symbols may raise many questions to these students. So, they will avoid to see print and use braille. Barraga, N. (1980) stated that they need lot of encouragement and readiness activities should be started from preschool.

According to Scholl, T.G. (1986) every low vision individual need to be encouraged to do as many visual tasks as possible, including reading. When an average learner's ability to read print is not in keeping with his or her demonstrated mental ability, then supplementing visual learning with tactual learning and braille may be appropriate. Teachers need to be sure that the reason to use braille to supplement visual reading is because of the Learner's inability to see the print rather than general lack of readiness to learn to read. Learners below average intelligence with useful vision should have much emphasis placed on visual learning and print reading since few will be able to use tactual learning or braille very efficiently.
Henderson (1976) advocates optimum use of print even when there is a very small degree of vision. If a learner tries to look at materials including braille then print is a more feasible medium for that learner, at least at that time. He further suggested that a combination of both print and braille media may be appropriate to try with some low vision learners especially those who are interested in looking and are eager to use their vision. Reading both print and braille may increase overall learning efficiency and functional capacities. Sykes (1971) suggested that the inability of some learners to read print as rapidly and efficiently as teachers expect may be due to cognitive immaturity, lack of verbal skills, a death of social experiences, true learning disabilities, and insufficient exploratory and movement skills.

Barraga, N. (1980) concluded that rather than continuing to engage in argument in an attempt to establish the superiority of one type of material or one means of enlarging reading material over another, a more reasonable approach, is to try all materials and devices that might facilitate a higher level of visual functioning in all visually handicapped children.

2.5 STUDIES RELATED TO LEGIBILITY OF PRINT

Legibility of print as defined by Tinker, M.A. (1967) is concerned with the case, accuracy and efficiency of perceiving print symbols while reading with understanding. In comparing legibility of varying print materials one wants to know to what extent the typography fosters ease, accuracy and speed of reading Spencer, H (1969).
The first consideration for legibility gives them individuality. Printed materials and prepared graphics have many characteristics that affect their readability.

Typeface refers to the symbols, which appear on the printed page. All type is divided into families, each family being composed of several "type faces".

The basic requirement for a typeface suitable for use in a running text such as a book, magazine or newspaper is readability. Every "type face" is a particular design given to each of the characters of the alphabet. Some are very ornate, and light others quite plain and bold. A number of type faces are designed with "serifs" - "little feet the letters stand on". They are the little protrusions to be seen at the tops and bottoms of letters. This type faces will be used only with older children and adults.

"Sans serif type" faces often used in advertising, is designed without the fine cross strokes. These alphabets are quite versatile since they come in a variety of "weights" from quite light to very bold and black. Because of their resemblance to the print script of the primary grades, sans-serif types are very familiar to younger readers.

Type sizes are designated in "points". A point has been defined as 1/72 of an inch with twelve points equal to one pica or 1/6 of an inch. In typography, point size indicates the vertical dimension of the body type. Print size only to the height of the letters, not their width. Prince, J.H. (1957) had made the important
observation that much can be done to make print legible even for some individuals with uncorrectable visual acuity. He has given some useful guidelines to be considered in the preparation of books for visually impaired readers, noting that research is needed in these areas of printing.

(1) Type size
(2) Type style and proportions
(3) Interletter spacing
(4) Interword spacing
(5) Interline spacing
(6) Line width
(7) Contrast of type with paper

The actual face of the type will be somewhat smaller because of the space occupied by the shoulders on each side of the face, which produces a blank space between the letters and the lines. If the lines are to be separated further this may done by "leading". As a rule, leading improves readability when used judiciously. A certain amount of white space between lines is more comfortable; too much and the text falls apart and eye movement from one line to the next becomes less and easy and natural. The bigger the type more leading will be needed Barraga, N. (1980).

Morison, S. (1967) found that "Leads" are blank pieces of type metal which may be two, four, eight or twelve may be two, four, eight or twelve points in thickness inserted between the lines of type. In the letterpress process, type
body size was fixed through standardization but type face size could vary with in
the same body size. The introduction-offset lithography has contributed to some
confusion in the area of type measurement. By this method any book, which is
optically enlarged, may be labelled as large print edition. Eakin, W. and Thomas,
L.M. (1960) concluded that this form of labelling has brought about a situation
where there are "large print" books in existence whose actual print is smaller than
the print in the regular edition of other books. To avoid confusion inherent in the
lithographic process, Nolan has recommended a scale for measuring the height
of the capital letters as they appear in print. By this scale, seventy-two, forty-
eight, twenty-four, eighteen and twelve point have capital letters whose
respective heights are .750, .500, .250, .188 and .125 inches.

2.6 STUDIES RELATED TO READING OF LOW VISION CHILDREN

Eakin (1960) found that visually impaired youngsters may be able to
handle a variety of print sizes depending on such variables type style, spacing,
contrast, use of optical aids, lighting, glare and length and difficulty of task.

Lighting and illumination are major factors that should be considered in
reading. Illumination is used to refer to the amount of light, its diffusion,
distribution and direction. Appropriate illumination is a prime requisite for effective
seeing. Seagers (1969) suggests that, since visual acuity increases markedly
with an increase in illumination, additional light is sometimes set to act as a
magnifier". When surroundings are too bright or too dark the ability to see may be
reduced. Legible printing on matte paper with good lighting provides optimal
conditions for reading. To provide ultimate contrast for any task, the light should be concentrated on the task or material, and should be at a level of intensity than the surrounding illumination. High levels of foot-candle power in diffused light may be acceptable for less precise tasks, but most ineffective for visibility of detail.

Tinker (1965) suggests that illumination for sustained readings by visually impaired persons should have a minimum brightness of forty-foot candles. Many Visually Impaired persons require a higher level of illumination for reading, than persons with normal sight. It is also known, however that certain eye defects necessitate reduced levels of illumination for reducing visual efficiency.

Reading is a highly complicated process. The fact that authorities, in this field have never agreed on one definition of reading, attests to its complexity.

Heilman, A. (1961) indicates that reading always involves the simultaneous application of a great number of mechanical and comprehension skills, all of which are influenced by the reader's attitudes, knowledge and the past experience.

Barraga, N. (1980) stated that Reading has been defined as "the process of construction meaning through the dynamic interaction among the reader's existing knowledge, the information suggested by the written language, and the context of the reading situation".
The process of reading depends on the interactive; knowledge and skill of the author and of the reader; constructive: the meaning must be actively created in the mind of the reader based on previous knowledge and dynamic: the process is variable and must adapt to the demands of the reading experience. Scholl, T.G. (1956).

The skills or abilities stressed in reading instruction are (1) Comprehension, (2) Vocabulary, (3) Speed and (4) Accuracy. Each of these factors is obviously related to other three. The development of one involves others to a greater or lesser extent.

Scholl, T.G. (1956) indicates that five important skills that belong to any reading process with special emphasis are:

(1) Broadened experimental base to compensate for difficulties with incidental learning; accompanying vocabulary.

(2) Visual efficiency skills including tracking skills attention to critical features of symbols and pictures; closure; figure-ground, systematic search patterns for pictures, charts, maps, diagrams, headings.

(3) Specific reading skills such as ones to sight vocabulary, orthographic, syntax and context dues. Structural analysis and phone dues, reference skills. Finn (1985), Wixon & Peters (1983).

(4) Appropriate use of optical and non-optical aids.
(5) Flexibility with a variety of printed materials. Low vision reader will also benefit from special attention to working conditions for reading tasks. The low vision student must exert considerable energy during the reading process. Therefore, effort, time and fatigue must also be considered. Extra time must be allotted for some visual tasks.

2.7 STUDIES ON PRINT SIZE

The original purpose of large print was to enable people to read print at the regular reading distance because it was believed that holding the text close to the eye was injurious Fonda, G. (1970). Initial research on print size began in Cleveland Ohio in 1913 and Irwin (1962) investigated 18, 24, 30 and 36 point sizes in seven styles of type According to his findings 24 point type was popular among teachers and pupils. Large part was recommended for partially sighted persons. So that 18 to 24 point type could be read 14 to 30 inches from the eye. This notion is no longer held rather full use of residual vision at whatever distance is encouraged and in considered necessary if maximum visual efficiency into be attained.

Eakin, Pratt and McFarland (1961) made an attempt to compare the readability of twelve, 18 and 24 point type. The subjects in this study we re divided into groups, but the matching of the groups was not well established and all groups did not receive the same stimulus. Reading distance was held constant at 14 inches however illumination was not standardized. The
investigators were unable to come to statistically significant conclusions although they did suggest that the 24 print size was preferable since more children were able to read it at fourteen inches.

Richard J. Muller (1968) conducted a research to determine the attitudes of visually impaired persons of any age to large print materials. A questionnaire mailed to registrants with the New York public Libraries, however revealed a strong interest in large print book services. Since the introduction of large print titles, circulation has grown steadily, many readers apparently turning to large print to lessen visual fatigue and obtain case of reading, rather than because of limited vision.

Fonda, G. (1970) notes that the demand for books in large type is great because of custom and tradition. The belief is that if type is larger it must be easier to read and therefore better for the eyes. Muller (1962) found that "large type may be of little help to the child with a vision better than 20/200.

In a differential diagnosis of sixteen partially sighted children, ranging in age from seven to fifteen, Karnes, M.B. and Wollershein (1963) found that the children in their study performed significantly better on sixteen point than on ten point print and concluded that it would be advisable to provide these children with reading materials in large print, "if for no other reason than that they may read with more comfort and find reading less fatiguing".
Large print can be resorted to if a person’s vision fails or if he can’t see standard print clearly enough. There were 4 studies prior to 1961 dealing with type size and style which have been analysed by Eakin, Pratt and McFarland concluded that:

(i) 24 point type is better than thirty point type.

(ii) Significantly more partially sighted children can read twenty four point type than can read type sizes smaller than twenty four point.

(iii) Average reading speed did increase slightly, but not significantly so, with the larger type sizes.

(iv) Accuracy of reading was small among all type sizes.

(v) There was no significant difference to prove eighteen point type read any faster than twenty four point type.

(vi) Serif type was read faster than sans serif type face and

(vii) Partially sighted children read faster than legally blind children.

Birch, J.W. and his associates (1966) undertook a most thorough and comprehensive study dealing with school achievement and effect of type size on reading in visually handicapped children. He found that “no one of the type sizes used can be considered superior to others with respect to optimum accommodation of partially seeing children in performing reading tasks.

The research on print size is limited. Objective evidence is limited regarding that large print may be preferable at the elementary level, but that is
not necessarily needed at the secondary level. Objective evidence is also lacking regarding the extent to which personal preference may be useful guide in selecting appropriate print size for Visually Impaired print readers. Still lacking of information regarding respect to the relative importance of large print in facilitating the reading skills of visually impaired print readers.

2.8 STUDIES RELATED TO VISUAL ACUITY AND VISUAL FUNCTIONING

Woodruff (1973) found that sensory deprivation in the first years of life due to visual impairments may inhibit structural and functional development of the retina and the visual pathways to the brain. Likewise the visual receiving area in the brain remains underdeveloped since maturation of the total visual system is dependent on visual experiences.

Barraga (1976) concluded that the lack of maturation and development of the visual systems might result in a reduction of visual information usable by the low vision person of any age. The quantity and quality of incidental visual learning is limited and the range and scope of visual functioning is restricted without extensive teaching. Persons with low vision may receive many visual impressions, but without seeing a person, valid visual perception cannot be organized and remembered.

A large population of children with severe visual impairments who were enrolled in an early childhood program were studied by O' Brein (1976). The children were said to come to the educational setting fearful, under stimulated, and with limited individual learning experiences and personal skills. The children
with clinical reported acuities from light perception up to 20/200 distance acuity were those who needed and profited most by the visual stimulation provided.

Hatfield (1975) conducted a survey of school children who were visually handicapped and found that less than one third had no useful vision; one third had 20/100 distance acuity; the other one third had varying levels of useful low vision. More than one half of those who were “legally blind” could be considered primarily as sighted children for educational purposes. More than two thirds of these low vision children were thought to need assistance in making maximum use of their residual vision.

When studying the visual motor integration of low vision children, Kraetsch Heller (1976) found that their greatest difficulty in visual perception was associated with disproportionate features in space, position in space, three-dimensional representations, and composite forms. A group of low vision children were studied by Carroll and Hibbett (1973) to determine any possible relationship between clinical acuity assessments at both near and distance and visual perceptual ability. No significant relationships were found for either, although there was a slight correlation between visual perception and near vision. The major conclusion was that the greater the impairment, the earlier the child needed special educational services and visual stimulation.

Aple & May (1971) stated that the visual aspects most difficult to perceive by low vision persons of all ages are those which relate to depth, movement, objects or materials against similar backgrounds, objects in poor light, distinctive
Visual Acuity and Visual Functioning carried different meanings and should not be considered as one as some believe. Visual acuity is concerned only with central acuity, but Dreyer (1974) says that when we confine the term "visual acuity" to "central visual acuity", only a fraction of the total visual capacity is being considered.

Visual acuity has been exaggerated in importance according to Faye (1976), who says there is no precise measurement of functional acuity, and that it is the crucial concern for the person with low vision. To test only distance acuity and to ignore near acuity is to do the person disfavour since the ability to recognize letters of a given size at a distance bears little relation to practical life situations. She advocated that children who could read the 20/20 line at one foot or at six inches should be recorded as having 20/20 acuity at a particular distance. Not only does such an assessment foster a more positive attitude in the parents and the child, but also is a more accurate indication of a person’s functional vision. Diagnosis tells little, if anything about the visual capabilities in a young child.

Near vision assessment when impairments are present was emphasized also by Dekkers (1976) who found that there was no correlation between distance vision and ability to use a low vision aid in adults; however, a strong
relationship was shown between reading vision and patient success with low vision aids.

Seidenbrug (1975) stated that assessment of visual functioning in young children with impairments is difficult, but a fairly accurate estimate can be made by rotating an optokinetic drum in front of the eyes and noting the motion of the eyes, which gives indication of the presence of vision. Unless there is absolutely no indication of visual response, the child should be considered to have low vision and be examined regularly.

A functional evaluation made by teachers prior to clinical assessment of multi-handicapped children was advocated by Langley and DuBose (1976). Such an evaluation by the teacher gives an indication of where to begin in planning education programs, and minimizes the fear, inattentiveness and inconsistent responses shown by the children. After some instruction and support in learning activities to which they can be successful, a clinical assessment could be more reliable and give more definitive information upon which to base future planning for possible prescriptions of lenses or low vision aids.

Barraga (1976) found that visual functioning and efficiency are contingent on physiological, psychological, intellectual, and environmental factors, they are likely to be unique to each person. Hence they "cannot be measured or predicted clinically with any accuracy by medical, psychological, or education personnel".
Farrar (1971) and Fagestrom (1971) found that magnifying devices and prescriptive optical aids have received increasing attention from both clinicians and instructors as a valuable means of increasing the use of functional vision and efficiency in both near and distant visual functions. Numerous non-prescription magnifiers may be useful to various students, teachers selecting magnifiers for classrooms may find several considerations helpful:

1. The distance from the material, the aid will focus
2. Possible distortions near the edges
3. The number of letters or words that can be seen in succession

Studies of various magnifying devices have indicated both advantages and disadvantages of most of them, but what is considered a positive factor by some students may be viewed as a negative factor by others, so that no conclusive statements can be made.

Prescriptive optical aids for near and distance use are receiving more and more consideration for school-age low vision students. Friedman (1976) feels that the use of distance aids in the classroom may be of more crucial concern than use of near prescriptions or magnifying devices because they put the child in touch visually with more of his environment both in the classroom and on the playground. This prevents some of the visual experiential deprivation often related to developmental lag found in many visually handicapped children.
Working with students in using magnifying devices and prescribed optical aids, Carpenter (1976) found that the self-image of students changed from that of a blind person to that of a sighted person; reading medium changed from Braille to print; students changed from listeners to readers; and actions changed from dependence to independence.

Guth (1971) stated that controlled levels of lighting with low vision students has not received objective study, but empirical evidence suggests that lighting needs and visibility varies with individualism, the nature or artificial light conditions, and the type of task being performed. When surroundings are too bright or too dark the ability to see may be reduced. Legible printing on matte paper with good lighting provides optimal conditions for reading. To provide ultimate contrast for any task, the light should be concentrated on the task or material, and should be at a higher level intensity than the surrounding illumination. High levels of foot candle power in diffused light may be acceptable for less precise tasks, but most ineffective for visibility of detail.

2.9 STUDIES RELATED TO VISUAL EFFICIENCY

According to Ashcroft (1936) the clinical recording of acuity as measured by the standard Snellen E distance chart is known as distance acuity.

Near visual acuity was measured by the Guibor near vision chart. The symbols on the chart coincide with the size letters, which the person with normal vision is expected to read at a distance of 14 inches. 1f at 14 inches the person
can read the symbol with the normal eye, he is said to have 14/14 nearer visual acuity or the equivalent of 20/20 near vision and 100% visual efficiency.

In both medical and psychological literature, semantic confusion and conflicting theories have been prevalent in the undifferentiated use of such forms as visual acuity, visual efficiency, and visual perception. Harvey (1959) presented a comprehensive review of the diverse psychological theories concerned with visual acuity and visual perception. According to Allport and Postman (1955) visual perception and learning are interdependent phenomena in determining the degree and nature of the visual efficiency of individuals. In the case of children with low degrees of vision the concern should be with visual efficiency and not with visual acuity and it is in this area that research appears to be most fruitful.

According to Ehlers (1953), visual acuity have no one true value, but is determined by the mental capacity of each individual. Visual efficiency is thought to be a matter of learning. Julia E. Lancaster, (1949) stated that the degree of visual efficiency may be affected by restriction in development of any one of the following phases. a) Attention in order to bring the stimuli within visual range. b) Awareness and recognition factors. c) Response as an indication that learning is occurring. d) Satisfaction, an emotional component, which determines the success or failure of the learning process. 5) Repetition, the means by which learning patterns are fully established.
Sykes (1971) stresses that visual acuity is unreliable in predicting visual performance. Although higher acuity tended to enable subjects to read both standard and large print faster, it did not facilitate comprehension. Rather than rely on acuity, emphasis should be placed on an individual appraisal of each visually impaired student to ascertain his functional use of vision.

Prior to 1960, there were many reports in the literature that some so-called "blind" people could actually see and were doing such remarkable things as reading and holding jobs requiring the use of vision. Jones (1961) presented evidence that about 60% of the "legally blind" children registered at the American Printing House for the Blind in 1960 were using print as a primary reading mode. In the United States, legal blindness is defined as "visual acuity for distance vision of 20/200 or less in the better eye with best correction or field vision no greater than 20 degrees" (National Society for the Prevention of Blindness, 1966.

When the book Increased Visual Behaviour in Low Vision Children was published by Barraga (1964), the educators began to attend to the capabilities of children with low vision to develop their students' visual efficiency skills. Through scientific research, it was established that learning to use impaired vision was developmental in nature and could be taught through a series of sequentially specific visual tasks. After the publication of the book every effort was made to provide teachers and other professionals with assessments and instructional materials and techniques to ensure that all students with low
vision in the educational system had every opportunity to make efficient use of their vision for both functional and educational purposes.

Eakin, Pratt & Mc Parland (1961) stated that greater numbers of children were reported able to read 24 point type than could read smaller type sizes. However, style and size of type made no significant difference in the speed and accuracy of reading providing the type was of sufficient size.

Eaking, et.al. (1961), Nolan, 1959) and Prince (1959) explored a process of photographic printing designed to control size, inter letter, and interline spacing in various type styles. Superior typeface plus wider spacing was chosen by all with low visual acuity as most desirable for ease in reading.

The first research findings documenting that visual efficiency could indeed be improved in children with seriously impaired but remaining usable vision through a planned learning program were published by Barraga in 1964. Basic facts were organized from many disciplines, such as perceptual psychology, learning theory, medicine, and education. Synthesis of these ideas with classroom observations and experiences led to conceptualization of the possibility of a process of visual perceptual development in visually handicapped children approximating the pattern found in children without impairment. Replications of the original study using a variety of commercial and teacher-made materials, with school age children have verified the effectiveness of planned learning experiences to promote efficiency in visual functioning. Ashcroft, Halliday, & Barraga (1965), Holmes (1967) and Tobin (1973).
2.10 STUDIES RELATED TO VISUAL STIMULATION AND LOW VISION

Gesell (1950) stated that in the newborn infant, the motor system is developed to the point where the eyes move together and are capable of briefly and monocularly fixating on objects of interest. As the maturational process continues, other optical functions come into being: at about 8 weeks, the eyes can simultaneously converge upon a target; at 16 weeks visual curiosity is evident as searching and moving the eyes from hand to target or target to target takes place. Finally, at 28 weeks, the child is able to reach for and tactually manipulate objects. This is a major developmental step. Once the tactual and visual systems begin to work together, they are intimately intertwined and their development as individual systems is difficult to trace. Reaching for things, holding them, tactually and visually exploring them, manipulating them and effecting changes in their position all contribute to bringing visual development out of the purely physiological sphere into the perceptual one. "During this stage, progress is centered on the integration of the biologically given patterns of the infant into habits. Much of this progress depends on vision. In progressing from the stage of merely waving his arms to grasping a particular object, vision is primary stimulus. Barraga (1980) also comments on the interplay of vision as a developing Sensorimotor system and the perceptual awakenings in the child.

Both optical and perceptual functions are interdependent with each other in development of vision. Rather than thinking of these functions as
occurring sequentially, it is more logical thinking of them as interacting with each other continuously as specific visual tasks are performed. As optical functions become smoother and more stabilized, perceptual interpretation is enhanced. As discrimination and recognition (interpretation) begin to develop, looking becomes more intense, and the more looking, the more refined and skilled the optical functions become. As more and more discriminations are made, recognition of people begins to occur. As soon as visible objects / people are recognized, the visual memory function begins, and identification (naming) follows shortly. The involvement of the motor system in (a) movement while looking or (b) watching moving objects facilitates spatial perception. Interaction with visible objects by handling, manipulating, and positioning them fosters important function of visual motor coordination.

Park & Burri (1943) and Robinson & Huelsman (1953) found that independent movement, recognition and identification, spatial awareness and overall refinement of the visual motor system develop through the child’s active exploration and intentional manipulation of and experimentation with objects in his/her world. Sufficient experience in all these areas leads to a perceptual leap. Symbolic representations such as pictures now make sense to the growing child. The ability to match picture to picture.

The dearth of educational research regarding the effects of visual impairment reveals a serious problem to all those concerned. Some suggestions and a few reported findings may be considered applicable to the multiplicity of
concerns which confront visually impaired children and their teachers. Both eye specialists and educators Dorman (1949), Esbin (1957), Fonda (1956) and Lowenfeld (1955) suggest that diagnostic findings and the degree of visual acuity reveal little about the individual which can be the true determinants of a child’s ability to improve the visual functioning.

Bateman (1962) delineated some of the behavioural characteristics of visually impaired children in her study. She made an extensive investigation of the relation of the reading achievement and psycholinguistic abilities of more than 90% of the children in classes for partially seeing in the first four grades in Illionois excluding Chicago. About 20% of her sample had severe visual defect (visual acuity less than 20/2000), but had significantly higher intelligence test scores than the children with mild or moderate defects. As a group, the children showed significant deficiencies on visual decoding, motor encoding, and visual motor association subsets of the Illinois Test of psycholinguistic Abilities. The severely visually impaired groups contributed the major portion of these deficits.

Arnheim (1974) stated that refinement of visual and perceptual skills continues and "interpretation and organization of visual information becomes the major challenge" for the growing child. This concern incorporates a sense of order with regard to the visible world. The child will be interacting with the environment and seeing things in relation to each other. "No object is perceived as unique or isolated. Seeing something involves assigning it a place in the whole: a location in space, a score on the scale of brightness or distance". And
this order he/she gives to the environment will serve his/her functioning, making it more efficient and freeing him/her to learn from the experience of it.

Gasell (1950) found that the child’s patterns of visual behaviour go through progressive stages of maturity correlated with his changing postural control, his manual coordination, his intelligence and even his personality.

The development of the visual system in low vision persons is seldom, if ever, automatic and spontaneous Barraga (1980). It is upon this understanding that the rationale for vision stimulation rests, for it proposes that “even when impairment is present in the visual system, the sequence of development in functioning is known to be compatible with perceptual/cognitive development and maturational factors in each individual”. The vision stimulation program is designed to “escort”, in a sense, the impaired visual system through the stages of optical and perceptual development by providing systematic and sequential training. Concentration is first placed upon those motor functions of the optical system that are present in the infant: awareness of visual stimuli, attention to following an object of interest and reaching to grasp the object of interest.

The vision stimulation programme includes stimulation of the perceptual functions. These ideas are not exclusive to the impaired system. Gibson (1966) writes: The perceptual systems are clearly amenable to learning. It would be expected that an individual, after practice, could orient more exactly, listen more carefully, touch more acutely, smell and taste more precisely, and look more "perceptively than he could before practice.' The education of the senses' has
often been the aim of those concerned with child development. Special educators have been interested in the improvement of discriminative capacity or sensitivity of low vision children. They note the almost inexhaustible curiosity of children in looking, listening, touching, poking, prying, feeling, and sniffing, and they argue that a rich environment should provide the child with opportunity for obtaining stimulation of all sorts. By the education of the 'senses' they mean what would here be called the education of perceptual systems.

And so it is the belief of educators in the vision field that discriminative capacity in the visually impaired can also be heightened. The intent of training at the perceptual level is to refine the optical functions, teach discrimination and recognition (beginning with basic shapes), construct a visual memory, give the child awareness of space and develop visual-motor coordination. These are all aspects of the perceptual system that would be developing in a child with an unimpaired visual system after "reach-on-sight."

During this time, the transition from recognition of three dimensional objects to two-dimensional representations takes place. A visual perceptual system that is able to recognize and name sense of pictorial representations of those shapes and objects develops during this stage. For the child working with an impaired system, this perceptual leap may be more difficult to achieve. The particular impairment and all the variables affecting it have to be given appropriate consideration. Yet, these factors considered, picture recognition will be within the scope of achievement for some low vision children and can be used
to provide information about the environment, as well as being used as tools to "foster increased visual interpretation" Barraga, (1980).

The vision stimulation program continues from this point to visual skills that are related to organization and cognitive abilities. Recognition stays within the two-dimensional realm with activities centered on interpretation of pictures, puzzles and actual numbers, letters and words.

At an advanced point in the vision stimulation sequence, there is a progression from the perception of tangible concrete objects to representations of those objects. Gibson describes perception as a process of learning what to attend to, both overtly and covertly. For the perception of objects, it is the detection of distinctive features and the abstraction of general properties. This almost always involves the detection of invariants under changing stimulation. In this case, the "invariants" would be those distinguishing features that are depicted, while the "changing stimulation" would be the shift from perception on a three-dimensional level to perception on a two-dimensional level. There is an aspect of perceptual psychology that is concerned with pictorial representations. Within this area, investigations have been made into the processes that work to glean information from pictures. In particular studies cite that picture perception (a) is an unlearned ability, (b) develops with age, (c) is facilitated by previous tactual experiencing of or encountering with the pictured object and (d) is cross cultural.

Kennedy (1973) says that "picturing, at heart, is a means for informing people about visible things" and it is a perceptual ability that develops rather than
early in the normally sighted child. The Hochberg and Brooks (1962) study was
designed to determine whether a child who had been taught his vocabulary
solely by the use of objects, and who had received no instruction or training
whatsoever concerning pictorial meaning or contrast, could recognize objects
portrayed by two-dimensional line drawing and photographs". Their study
involved only one subject raised to the age of 19 months (at which time the task
of withholding pictorial or other two-dimensional representations from him
became too emotionally taxing for his parents) without being shown any pictures
or ever being told the name or meaning of any picture or depicted object. He was
tested at that point and was able to identify almost all the pictures of familiar
objects that he was shown, leading the researchers to conclude. At least one
human child is capable of recognizing pictorial representations of solid objects
without specific training or instruction. At the very least we must inform that there
is an unlearned propensity to respond to certain formal features of lines on paper
in the same ways as one has learned to respond to the same features of lines on
tin the same ways as one has learned to respond to the same fea tures when
displayed by the edge of surfaces.

Kennedy (1973) points out that despite the fact that picture recognition
seems to develop without any educational prompting or intellectual
sophistication, "it seems reasonable that there should be some development in
the skill ... whether or not it needs tutoring". There is agreement with this
statement in the findings of Hackworth & Burner (1970) who investigated the
scanning patterns of 20 adults and 20 six-year-olds presented with a series of
pictures. Their study showed "reliable differences between adults and children", with adults being more skilful at effectively searching for visual features. These children could not examine details centrally and simultaneously monitor their peripheral fields. These findings would certainly support the need for some type of "efficiency" training or practice for any children in order to facilitate a more skilful method of pictorial interpretation.

Gregory (1966) cites the case of a 52-year-old blind who underwent a successful corneal transplant. When vision was restored, he was able to recognize capital letters and numbers but sight without any special training. Which showed very clearly that he was not able to use his previous touch experience for his new-found vision. This type of finding reinforces the practice of coupling the exploration of objects with the visual stimulation sequence. Another fact that would indicate this is that the subject, when asked to draw, was unable to draw anything he did not earlier touch experience, and that for a long time his vision was very largely limited to what he already knew.

The tactual sense, as Gibson (1966) points out, is similar to the visual sense in that it perceives objects through a succession of stimuli. "Each perceptual system according to Gibson, has its own peculiar mode of attention, but these two are especially capable of sampling in discrete arts". This process of episodically piecing together a visual target place on an unconscious level for the fully sighted person. For the low vision person being trained to interpret visual stimuli, the process is on a much more conscious level and, therefore, much
more dependent on having previously encountered objects tactually, along with instruction in naming features. Awareness of distinct features of objects both tactually and visually can serve to implant the image more concretely in the brain.

Vision is an unimpaired system progresses through a logical sequence of development. The new born infant is able to monocularly fixate upon objects. The maturing child grows to be able to recognize and identify two-dimensional representations of objects and symbols. The total range of this development spans approximately seven or eight years, after which time the person continues to develop in the area of becoming more adept at visual skills.

The vision stimulation program is designed to provide deliberate and purposeful stimulation to facilitate the development of visual skills. These skills are on the optical, perceptual and visual perceptual levels. It involves activities conducted in a sequential manner to a low vision person's visual system to achieve developmental milestones. Like the functions that a normal system progresses through, the impaired system is trained to grow from initial awareness of a stimulus, to finally being able to identify and interpret two-dimensional representations and symbols. Between this beginning and end stage is a point in development at which the switch from recognition of three-dimensional shapes takes place first, moving on to recognition of simply pictured objects.

Goins (1958) made an extensive study of the relation of visual perceptual abilities and early reading progress in first grade children in public school. “Visual sensory efficiency” according to her, is a pre-requisite to acquisition of
skill in the perception of printed symbols. She found a wide range of perceptual abilities and various distinct "types of perceivers". Two factors of visual perception were isolated, speed of perception, and strength of closure. Little relationship was found between perceptual speeds and reading progress but a strong positive correlation was noted between strength of closure and reading progress.

Goins (1958) reports that the visual perceptual ability involved perception as a primary mental ability or aspect of intelligence, which was more important at the learning to read stage than at later stages. This conclusion relates directly to Montessori and Piaget's discussions in regard to intellectual development in children, and also pertains to Sell's and Fixott's suggestion that perceptual training resulted in improved visual efficiency.

According to Smith & Dechant, (1961) the child who brings the most to the printed page will get the most from his reading. The degree and accuracy of the perceptions will be dependent upon the number and variety of the child’s experiences. Logically, children who suffer from lack of sensory or perceptual stimulation require a concentrated and lengthy period of readiness development before the introduction of reading as such.

A justifiable conclusion appears to be that an eye defect alone need not reduce reading efficiency to a marked degree, yet any one of the several defects combined with other causes may reduce reading ability as reported by Fames, 1948, 1959.
Smith & Dechant (1961) found that reading performance will be affected only when the severity of certain defects reaches or exceeds critical points.

2.11 STUDIES RELATED TO MAGNIFICATION AND READING OF LOW VISION LARGE PRINT:

T.B. Singh (1989) has suggested that preparation and research on large print materials is needed to determine the size of print required for acceptable reading on the part of the visually impaired child. Fazelboy (1988) indicates that the number of people with partial vision in India is five times greater than the number of people identified as legally blind and many of them can indeed use print as a learning medium.

Stephen and Jack (1969) emphasis on “sight utilization” as opposed to “sight saving” also creates interest in the use of large print materials.

Karnes and Wollersheim (1963) found that visually impaired children performed significantly better in reading on a large print and came to the conclusion that “It would seem advisable to provide these children with reading materials in large print. They also pointed out that the children use the large print with more comfort and less fatigue”.

Fonda (1965) states that large print is useful in the following situations:

1) When distant vision ranges from 2/200 to 10/200.
2) When twelve point print type cannot be read at two inches from the eye.
3) When a greater reading distance is mandatory, for example, for mathematics and accounting.

4) When a patient insists that large print is more comfortable and easier on his eyes.

Mansfield, J.S. (2003) stated that normal and low vision reported print sizes close to the acuity limit, choice of font could make a significant difference in both normal and low-vision reading performance.

Sykes, K.C. (1971) found that large print was marginally faster to read but offered little advantage in an incurred reading distance subjectively determined preference for any print size had little bearing on how the subjects performed. Sykes, K.C. (1972) claims that large print offered a more marked advantage to certain subjects was in reducing eye fatigue. “It could be that it is less fatiguing for some individuals to read standard print with the help of optical aids.

Jackson, M.D., et.al. (1979) study on Processing determinants of reading speed reported that skill allowing fast readers to capture more information from each reading fixation is faster access to letter codes from large print.

Sykes, K.C. (1971) found that large print offered little, if any, advantage to his/her subjects and he concluded that "standard print is as effective as large print in facilitating the reading skills of comprehension and reading speed for both legally blind & partially sighted. Sykes found that large print was marginally faster to read but offered little advantage in an increased reading distance. One area
where Sykes claims that large print offered a more marked advantage to certain subjects was in reducing eye fatigue. It would be that it is less fatiguing for some individuals to read standard print with the help of optical aids. Sykes stresses that visual acuity is unreliable in predicting visual performance. Although higher acuity tended to enable subjects to read both standard and large print faster, it did not facilitate comprehension.

Fonda (1970) lists four circumstances in which the use of large print is indicated. They are: 1) when distance vision ranges from 2/200 to 10/200, 2) when 12 point type (pica typewriter) cannot be read at 2" from the eye, 3) when a greater reading distance is mandatory (e.g.) for accounting, 4) when a patient insists that larger large is more comfortable and easier on his eyes.

Nolan (1959) investigated combinations of ink and paper colors that has found no significant differences among combinations of colors in relation to reading performance. Glossy paper lessens contrast under certain lighting conditions. It is stated that type style illumination, contrast, focal distance width of line and particularly the spacing of letters, words and lines may for some, be more important than type size. Nolan (1959) found no significant differences in reading speed between 18 point and 24 point. Birch, Tisdall, Pea body, and Sterrett (1966) studying the relationships of type size to achievement of partially seeing children, found that no one type size can be considered superior to others.
Eakin and Mc Farland (1961) reported several studies which indicate that 24 point type was the most acceptable to visually impaired subjects. Encoding in visual and auditory sequential memory tasks and its relationship to reading disabilities in young children again casts doubt on the off claimed positive correlation between reading achievement and visual discrimination.

MAGNIFICATION:

Faye and Gerald Fonda (1970) found that partially sighted children are reported as gaining considerable benefit while using magnifiers to record standard print. Ortiz A, et.al. (1976) study on reading with a magnifier reported that magnifier such as CCTV can support good low-vision reading performance, the restricted range of magnification may limit the usefulness of the device as a reading magnifier for people with very low acuity.

Tubin, G.S. (1992) study on reading without saccadic eye movements reported that on indication that the programming and execution of saccadic eye movements impose an upper limit on conventional reading speed. Magnifier aided reading speed in low vision reported that a standardized clinical reading test can give a valid prediction of the reading speed, a low vision patient is likely to achieve with a magnifier.

CLOSED CIRCUIT TELEVISION (CCTV):

The earlier enlargement systems for partially sighted people were used with a screen. CCTVs have proved useful to many people, and a number of models are now available (De Witt, Schreier & Leventhal, 1988). Early studies of
the use of CCTVs found that reversing the persons with albinism and other conditions (Newman & Lax 1972), although the contrast is usually considered to be more important (Gardner, 1985). Later research reported that some clients express a preference for certain color combinations and a dislike of others (Jacobs, 1990).

Systems that have given large-character terminals (Barber & Stenmack, 1982, Morrissette, 1984) a totally customized large chatter computer (Morrisette, 1984) or a specially written large character program for a standard micro computers (Mayer & Mckinless, 1987). In some cases, the larger characteristics were provided to supplement specially written talking programs (Vincent & Turnbull, 1984). Today larger-character systems are normally for Micro Computers. They generally consist of a combination of hardware and Software or something are just software (Denton, 1991; Dewitt, Schreies, Leventhal & Myers, 1988) that provide access to standard applications running on computers. Initially, such systems simply enlarged characters; although an increasing number are able to enlarge graphics screen (Nuttall, 1987; Spiry, 1987) they are still commonly called large character access systems.

Most current screen enlargement systems have a number of facilities that typically deal with the control of the system the mode of presentation, the fonts and styles for the large characters, and cursor tracking. It should be pointed out that in each case, unless explicity started to the contrary these facilities refer to large character systems operating with standard applications that have not been
specifically modified to work in an enlarged manner and that use the computers screen to display the enlarged images.

One of the advantages of using computer systems is that the size and style of characters can be readily changed to suit the needs of the individual. Many large character access systems provide difficulties to select not just the font and its magnification, but the thickness of the font and the inter character and interline spacing.

Chandra .M Harrison (2003) found that video magnifiers provide people with low vision a means to maintain a degree of independence, by helping them to read and write. The design of these machines has remained essentially unchanged for 20 years despite advances in computer technology. Designing reading aids with increased technological complexity and added functionality requires an understanding of the specific needs of this user group. The research described in this paper determines aspects that need to be considered and analyses comparative performance on a simple reading task between an existing Closed Circuit Television (CCTV) video magnifier and a more complex low-vision reading aid (my Reader™), under development in New Zealand. Performance, comfort ratings and preference results suggest my Reader provides a more pleasurable reading experience than traditional CCTVs. Common error analysis highlight aspects of my Reader that should be altered to improve the experience by eliminating actions that cause errors and resulting negative emotions.
Douglas, G.G.A., Grimley, M., Hill, E.W., Long, R.A., Tobin, M.J. (2003) explored a three year research project to develop standardized reading scores for children with low vision. 476 children (278 boys, 198 girls; 5 - 17 years) drawn from 39 schools in the UK were tested. The Neale Analysis of Reading Ability was used which assesses children's reading in terms of speed, accuracy and comprehension. A linear regression was undertaken to describe the relationship between reading scores and age (accuracy $\beta=.47$, $R^2=38.1$; speed $\beta=.50$, $R^2=28.1$; comprehension $\beta=.22$, $R^2=39.8$), and to generate standardized reading scores. Comparing these scores to that of normally sighted children demonstrate that partially sighted children's reading lags that of their sighted peers. Importantly, this lag increases with age in all aspects of reading (accuracy, speed and comprehension). Multiple regression analyses were carried out which explored other key variables. The following variables were found to be predictors of reading ability: age, reading distance, age by visual acuity, and age by reading distance. Together the predictors accounted for 42.4% (accuracy), 34.3% (speed), and 43.8% (comprehension) of the variance. English, as an additional language did not significantly predict any aspects of reading. The research team has developed a teacher's manual that presents standardized scores and the influence other variables have on reading. This enables teachers to better assess partially sighted children's reading and make more informed judgments about teaching intervention. This large sample provides a very rich data set facilitating further analysis (e.g. investigating impacts of different types of visual impairment, and different reading errors).
Ortiz, A, Chung, S.T, Legge, G.E, Jobling, J.T. (2003) compared the effectiveness of a head-mounted video magnifier, low-vision enhancement system (LVES), with CCTV and large print as a device or means of improving reading performance in people with low vision. The reading performance of ten low-vision participants was assessed in two ways: (1) By measuring reading speed as a function of print size with LVES and without LVES, and (2) by comparing reading speed and comprehension of news articles using the LVES vs. a popular non-head-mounted video magnifier, the CCTV. Maximum reading speeds with LVES matched the maximum reading speeds with unaided vision attained by enlarging print. The critical print size (the smallest print size that could be read at maximum reading speed) improved significantly for all participants using LVES compared with unaided vision. When comparing reading performance using LVES and CCTV, we found that reading speed and comprehension for the two conditions were equivalent. The two low-vision participants with lowest acuities (20/640 and 20/960) could not read the 10-point newspaper articles with LVES, even with an 8D auxiliary reading lens that permitted a very close reading distance. Head-mounted video magnifiers, such as LVES, can support good low-vision reading performance, but the restricted range of magnification may limit the usefulness of the device as a reading magnifier for people with very low acuity.

Claude Vincent, Claire Dumont, Danièle Bouchard, and Françoise Lespérance (2003) stated that the Assessment of Computer Task Performance
was developed to evaluate the performance, both in terms of speed and accuracy, of children with low vision when using sequences of actions that result in a computer command. The results with 22 students aged 4–12 showed that four standardized tasks in the test have a high degree of reliability, and one has a moderate degree.

Ian L. Bailey, Amanda Hall Lueck, Robert B. Greer, Kuang Mon Tuan, Valerie M. Bailey, and Helen G. Dornbusch (2003) found that conceptual models of relationships between print size and reading speed and preferred viewing distances. These models illustrate how various factors can influence reading behaviors and influence decisions about the optimal angular size of print and resolution reserve.

Amanda Hall Lueck, Ian L. Bailey, Robert B. Greer, Kuang Mon Tuan, Valerie M. Bailey, and Helen G. Dornbusch (2003) describe that experiments designed to investigate reading speed and working distance for students with low vision. Six fourth grade students were asked to read unrelated words and continuous text ranging in print size. This article also discusses methods to maximize reading efficiency of students with low vision.

Elaine Gerber (2003) found from four focus groups of assistive technology computer users, how individuals who are blind or visually impaired gather information about assistive technology and the kinds of information needs that they may have. Qualitative findings are reported on what the focus group participants considered to be the benefits of and barriers to computer use. This
article further underscores the importance of accessibility and usability as being helpful concepts for exploring the role of technology in people's lives.

Jennifer Bevan; Jan Lovie-Kitchin; Brnwyn Hein; Eric Ting; Paul Brand; Monique Scott and Paul Fotkou (2003) stated that reading is an important aspect of child development. Determining the appropriate method of magnifying text for children with low vision thus becomes an important issue, to ensure that difficulties in reading do not impede progress in educational, vocational and recreational activities. In the current study conducted by researchers based in Queensland, Australia, 46 children with low vision (27 male, 19 female), ranging in age from 6.9 to 18.7 years, were drawn from the database of the multi-disciplinary Pediatric Low Vision Clinic in Brisbane. The subjects' low vision resulted from disorders such as: oculocutaneous albinism, rod monochromatism, optic atrophy, retinitis pigmentosa and high myopia. The children's reading skills were tested using a series of cards, based on the Minnesota Low Vision Reading Test, each one containing a sentence made up of 56 characters (9.3 standard words) over four lines or 14 characters per line. The study concluded that while large print gives faster reading rates, it is impractical for all reading tasks. It is therefore of long-term practical advantage for children to learn to use magnification devices to read normal-size print. Moreover, self-esteem may be enhanced if children are able to read the same books as their classmates. The researchers recommended that while children with low vision are learning to read, large print should be used. Once reading skills are acquired, training and practice in reading with optical devices becomes imperative.
Douglas, G., Grimley, M., McLinden M, Watson L. (2003) studied that previous research has shown that, on average, children with low vision lag their sighted peers in general reading development (in terms of speed, accuracy and comprehension). This study sought to examine this apparent lag by comparing the reading profiles of 25 normally sighted readers (mean age 8 years 8 months) with 25 low vision readers. The children were tested using a reading test (the Neale Analysis of Reading Ability, NARA) and were matched on the reading accuracy score produced by the test. Therefore in terms of the reading accuracy scores (and reading ages) derived from the NARA both groups were the same. The low vision readers were on average older than the normally sighted children (mean = 10 years, 5 months). When the reading profile (i.e. accuracy, comprehension and speed) was examined in the same analysis no significant effect was revealed [d.f. = 1, 48; F = 0.05; p > 0.1], but a general lag for these children is suggested (in keeping with previous research). However, a closer analysis of the reading error profile revealed the most common reading errors made by all readers in the analysis were either mispronunciations or substitutions. The low vision readers were more prone to making substitution errors than mispronunciations and the reverse was true for normally sighted readers [d.f. = 1, 48; F = 7.1; p < 0.05]. This indicates that the reading strategies adopted by low vision readers may differ from those of normally sighted readers of the same apparent reading ability.
David B. Elliott, Bhavesh Patel and David Whitaker (2003) suggest that optimal reading speed is unaffected by cataract, yet is significantly reduced in age-related macular degeneration (ARMD). This raises the question of whether a reading speed test could be developed to assess potential vision after cataract surgery. Nineteen subjects with cataract, 15 with ARMD, and 13 control subjects with normal, healthy eyes read Bailey-Lovie word charts aloud, and subsequently, critical print size and optimal reading speed were calculated. Measurements were also taken with the charts in reversed-contrast polarity and after pupillary dilation. Although the subjects with cataract had reduced word acuity and increased critical print size, optimal reading speed was similar to that of the control group at a mean of approximately 100 wpm. Optimal reading speed in the subjects with ARMD was substantially worse (mean of 39 wpm). Reversing the contrast polarity of the charts slightly increased the word acuity and optimal reading speed of the subjects with cataract. The results suggest that optimal reading speed would be useful as a potential-vision test. The proposed test would use text size of at least 1.32° (1.2 log minimum angle of resolution [logMAR]), and pupil dilation would be unnecessary. A reading test with black letters on a white background would be adequate, because charts with reversed-contrast polarity made minimal difference in reading speed.

K. Fellenius, (2004) stressed that a study of the reading competence of 25 visually impaired pupils in Sweden, who were followed from 1988 to 1991. Neither visual acuity, reading media, optical aids, nor reading distance were clearly related to reading competence. Rather, good readers were pupils who
scored higher on verbal cognitive tests and had a greater interest in reading as a leisure activity. In Sweden, most pupils with visual impairments and no other disabilities attend school with fully sighted students in the regular public school system, and those with multiple disabilities are educated primarily in special schools. Thus, the majority of visually impaired pupils who do not have additional disabilities are educated, by teachers who lack training in meeting the special needs of visually impaired pupils, in normal classrooms of about 25 pupils each.

In-service training for classroom teachers is provided by the Tomteboda School Resource Centre (formerly the special school for the blind). Consultant teachers from the National Swedish Agency for Special Education act as liaisons among the pupils, their families, and the official habilitation effort and arrange further training for classroom teachers locally. However, since they concentrate on providing services for a large group of visually impaired pupils on a regional basis, they have little time to follow the reading development of individual pupils. Rather, their main task is to give advice and support to visually impaired pupils and classroom teachers, not to teach these pupils. To obtain some information on the reading skills of people with visual impairments, Mats Myrberg, of the Stockholm Institute of Education, initiated the project, Reading Skills, Reading Training and Technology for the Visually Handicapped, in 1988. In the first phase of the project, the situations of three groups of visually impaired persons-pupils, professionally active adults, and older people-were documented on the basis of records from low vision clinics (LVCS) (Myrberg & Bäckman, 1993). The pupil group consisted of 246 children and adolescents, aged 5-19, who were enrolled
in either a compulsory, comprehensive school or an upper secondary school (gymnasium). Significant differences in reading performance were found for the three groups, with the pupils demonstrating the highest performance.

Another investigation, conducted at the same time, mapped the pupils' reading ability on the basis of journals kept by the consultant teachers. However, these two sources of information proved inadequate for determining all the aspects of the pupils' reading ability. The records of the LVCs yielded information on the medical and optical prerequisites for reading, whereas the consultant teachers' journals contained mainly administrative information (Fellenius & Myrberg, 1993). To obtain a clearer picture of factors that are important for developing and maintaining a functional reading capability from both the medical-optical and educational perspectives, the second phase of the project was begun in 1991. In this phase, two main issues were explored: 1) the pupils' development, in terms of medical factors and optical rehabilitation from 1988 to 1991, and 2) the pupils' reading needs and the demands on their visual and reading abilities, both at school and at home, in 1991.

Susana T.L. Chung, J. Stephen Mansfield and Gordon E., Legge (2003) stated that reading in peripheral vision is slow and requires large print, posing substantial difficulty for patients with central scotoma. The purpose of this study was to evaluate the effect of print size on reading speed at different eccentricities in normal peripheral vision. We hypothesized that reading speeds should remain invariant with eccentricity, as long as the print is appropriately scaled in size-the
scaling hypothesis. The scaling hypothesis predicts that log-log plots of reading speed versus print size exhibit the same shape at all eccentricities, but shift along the print-size axis. Six normal observers read aloud single sentences (~11 words in length) presented on a computer monitor, one word at a time, using rapid serial visual presentation (RSVP). We measured reading speeds (based on RSVP exposure durations yielding 80% correct) for eight print sizes at each of six retinal eccentricities, from 0 (foveal) to 20 degree in the inferior visual field. Consistent with the scaling hypothesis, plots of reading speed versus print size had the same shape at different eccentricities: reading speed increased with print size, up to a critical print size and was then constant at a maximum reading speed for larger print sizes. Also consistent with the scaling hypothesis, the plots shifted horizontally such that average values of the critical print size increased from 0.16 degree (fovea) to 2.22 degree (20 degree peripheral). Inconsistent with the scaling hypothesis, the plots also exhibited vertical shifts so that average values of the maximum reading speed decreased from 807 wpm (fovea) to 135 wpm (20 degree peripheral). Because the maximum reading speed is not invariant with eccentricity even when the print size was scaled, reject the scaling hypothesis and conclude that print size is not the only factor limiting maximum reading speed in normal peripheral vision.

2.12 SYNTHESIS

Fonda (1970), Sykes (1971), Barraga, N. (1980), School, T.G. (1986) conducted studies on the needs of low vision children. They found that low vision
children need lot of encouragement and readiness activities, which should be started from pre-school.

Prince J.H. (1957), Morrison (1967), Fonda (1970) advocated that large type may be of little help to the low vision children with a vision better than 20/200.

Batman (1962), Barraga (1976) and Amanda Hall Lueck (2003) conducted studies on visual functioning and visual efficiency are contingent on physiological, psychological, intellectual and environmental factors, they are likely to be unique to each person.

Faye and Gerald Fonda (1970), Dewitt et.al. (1988), Jar Lovie-Kitchin (2003), Chandra M. Harrison (2003) stated that once reading skills are acquired, training and practice in reading with optical devices becomes imperative.

Nolan (1959), Kares & Wollershein (1963), Sykes, K.C. (1972), Ian L. Bailey (2003) and Amanda Hall Lueck, et.al. (2003) conducted studies on models of relationships between print size, reading speed and preferred viewing distances. They claimed that large print offered a more remarked advantage to certain people in reducing eye fatigue.

Research has been conducted on print size, visual efficiency, legibility of print, reading level of low vision children in regular print, large print, CCTV, computer separately. But very few studies were on reading efficiency of low
vision children in all the print medias together and there is no study on reading efficiency of low vision children in various print media using Tamil Font.

The researcher identified the need to develop suitable Tamil Font in enhancing the reading efficiency of children with low vision. In the following chapter the investigator tries to present a conceptual framework on the topic reading efficiency of children with low vision in various print media in Tamil Font.