Reading Acquisition in Pupils with Visual Impairments in Mainstream Education

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av
Kerstin Fellenius

Institutionen för individ, omvärld och lärande
Lärarhögskolan
S-100 26 Stockholm
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Abstract

Key words: pupils, visual impairment, reading acquisition, reading environment, braille display, cerebral visual impairment

This thesis is based on five empirical studies of pupils with visual impairments, their reading ability and processes of reading acquisition within the framework of mainstream education in comprehensive schools.

The aim of the thesis is to increase our understanding and knowledge of reading acquisition in pupils with visual impairments in mainstream education. A further aim is to find factors, which influence reading acquisition from an individual, as well as an environmental, perspective. Developmental theories regarding the individuals' possibilities to acquire an optimal development in interaction with their environment offer a theoretical framework for the thesis.

Different research designs, descriptive and explorative, have been used to fulfil the purpose. The studies have revealed a heterogeneous group of readers with visual impairments bearing in mind functional visual ability, reading media (print and braille) and reading ability. As a result of these studies, it was possible to divide the readers into three groups with regard to reading performance. About one quarter of the population was average or high achievers, another quarter extremely low achievers, irrespective of visual acuity, reading media or reading devices. In most cases, additional impairments, intellectual impairment or language problems caused low achievement. The largest group, about half of the population, consisted of readers who were able to read but demonstrated difficulties in other ways. Visual acuity and reading media varied greatly in this group. There were uncertain readers, readers with low reading rate but good comprehension, readers with less stamina and readers who did not use their reading ability except for schoolwork. The pupils were well equipped with optical devices, lighting and special desks but seldom used the facilities for reading. In general, the pupils with visual impairments read less compared with their sighted peers. Nor were they exposed to text in natural situations in society, which decrease their incidental reading training. Consequently, a large group of readers with visual impairments need an adapted reading program in order to stimulate reading from the start and to use their potential ability. Competence in the school and home environment is necessary for compensating lack of training and preventing the visual impairment being the reason for reading difficulties.

Reading disabilities due to biological factors were significant for a smaller group. Visual impairment as a reading handicap is, in this thesis, identified when a person, able to read, does not have access to the text in an appropriate reading medium or format, reading and writing tools are missing or reading must be performed in a badly adapted environment. Increased knowledge and effective environmental measures could reduce a reading handicap caused by a visual impairment for a larger group of children and young people.
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Stockholm Institute of Education Press
(Special Education)
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The aim of the thesis is to increase our understanding and knowledge of reading acquisition in pupils with visual impairments in mainstream education. A further aim is to find factors, which influence reading acquisition from an individual, as well as an environmental perspective. Developmental theories regarding the individuals' possibilities to acquire an optimal development in interaction with their environment offer a theoretical framework for the thesis.

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LIST OF ORIGINAL PAPERS

This thesis is based on the following articles, which will be referred to by Roman numerals I – V.


FOREWORD

This thesis is the collected results of many years of work together with pupils, teachers and advisers for pupils with visual impairments as well as colleagues at Tomteboda School Resource Centre (TRC), SPRIDA computer resource centre and several low vision clinics. As a former “teacher for the blind” in the 1960s at the special school, as educator at TRC and adviser for pupils with visual impairments in ordinary schools in 1970s and 1980s, it has been an exciting work obtaining a picture of today’s pupils with visual impairments and their reading in mainstream education. I have visited many pupils and schools during these years, from Pajala in the north to Malmö in the south and from west to east. It has been a fantastic and exciting journey, sometimes in snowstorms, sometimes in the warming spring sunshine. Even so, the most fantastic has been the warm reception I have felt and the tolerance I have been met with when I have “encroached on” pupils, parents and teachers working lives. Without you it would not have been possible to present this picture. It is my hope that it will increase understanding of the situation you handle on a daily basis and so conscientiously make the best of. I hope as well that my picture will increase the opportunities for you to obtain the right support in the teaching and learning environment in the home and at school.

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Stockholm in September 1999
Kerstin Fellenius
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INTRODUCTION

Background

In Sweden today pupils with visual impairments without severe additional impairments are taught in ordinary schools in their local district. This means that the regular teacher in the local authority’s school has responsibility for the educational development of these pupils in all subjects. An important basis for acquiring knowledge, as well as supplying it, is the printed word. It falls, therefore, on the teacher to provide the pupils with the means for this educational development - the ability to read and write. Earlier, children with profound visual impairment or blindness who would learn braille were taught in a special school, Tomteboda School in Solna. Tomteboda School was successively transformed during the large-scale integration movement of the 1970s and 1980s to a resource centre and, in 1986, the permanent school section was discontinued. The regular teacher, therefore, teaches even pupils with profound visual impairment or blindness to read braille today. For pupils who are partially sighted and who, with optics and low vision devices, manage to work with ordinary teaching materials, there existed earlier some special teaching groups - so-called “sight classes” - in Stockholm, Gothenburg and Malmö. Currently there are a few pupils left in “sight classes” in Stockholm which also include a few braille readers.

The teaching environment for pupils with visual impairments has, thus, changed during recent decades. At the same time modern technology offers new ways of making text accessible and communicable for pupils with visual impairments. The new possibilities, which the computer opens as a reading and writing device, are perhaps most dramatic and prominent for braille readers. However, they are also opportunities for pupils with low vision to acquire better reading and writing development with text presented in a format which is readable for him/her. Technology and education must, therefore, meet in the classroom in order to increase the opportunities for learning. Another competence is required in teaching pupils with visual
impairments than the traditional kind from special school and "sight class" era.

Earlier insights and knowledge have been deepened by studying the many faceted relations between pupils' reading and writing ability in relation to sighted classmates' in the new learning environment. In project works, deeper knowledge about active processes in the classroom where pupils with visual impairments are taught have been achieved. The absence of a special school as an alternative teaching form for pupils with visual impairments without additional impairments in a country is rather unique. The Nordic countries have been pioneers in this development. The inclusive system also means that there is no special curriculum for pupils with visual impairments in mainstream education. The possibility exists, therefore, that a class teacher in an ordinary Swedish school can, during his/her time of service have the task of teaching a pupil with a visual impairment within the framework of the ordinary class and curriculum. This makes studies of these pupils' school successes even more interesting and urgent.

Scope of the thesis
This thesis builds on five different studies of the reading ability of pupils when they have a visual impairment. A main purpose has been to raise the level of knowledge about the pupils reading ability and put this in relation to reading environment and demands on reading in mainstream education. In addition to this, factors that affect reading acquisition from individual, as well as environmental perspectives have also been focused.

Measured visual acuity, which is generally one of the predictors when selecting reading medium and reading devices where visual impairment is involved, constitutes an important basis for the divisions of reading categories in the analysis and processing of the results in four articles (Paper I, II, III and V). The medical background of the visual impairment, the diagnosis of the pupils, has not been in focus for the processing of the results in more than one article (Paper V).

Reading and writing ability can usually be carried out together as they often go hand in hand when learning to read. In English language literature
both concepts are gathered under a single name – literacy - which also speaks for reading and writing ability being closely related in a development perspective. For pupils with visual impairments, most research has traditionally focused only on reading ability. When ordinary text is not available to the reader due to a visual impairment, the problem is initially concentrated on finding alternative ways of making it accessible. For example, enlarged text can be presented for those who have usable residual vision, or it can be converted to braille for those who are severely visually impaired. In the latter case, visual ability is no longer decisive when confronted with text. The method of writing is a direct consequence of the choice of reading medium and reading device. The goal with writing has, above all, been that the pupil with visual impairment should be able to re-read his own text. Reading and writing has, for example, with certain traditional writing devices for braille, not been possible to carry out simultaneously, which could also explain the approach of earlier research on, above all, reading. How the writing process functions together with the reading process during reading acquisition when visually impaired is still an area where more research is needed. The significance of writing for reading development has not been focused on or evaluated in the studies covered by this thesis either, but is discussed in two of them (IV and V) when it is closely associated with the pupils reading results.

New trends within reading and writing education, where the significance of the writing process for learning to read for sighted children is emphasised, have now also reached special teachers for children/pupils with visual impairments mainly in Australia and the USA (Rex, Koenig, Wormsley & Baker, 1994). Access to new technology as reading and writing tools will make it possible to study the interaction of reading and writing processes in reading acquisition for pupils with visual impairments.

The framework of this thesis considers three areas of knowledge:

- the reading process and reading acquisition
- visual impairment and reading
- educational conditions for pupils with visual impairments.
After definitions of visual impairment, an historical and current overview of the educational prerequisites will be presented as a background to the general purposes of the studies. The theoretical framework of reading acquisition in the thesis is presented in the following chapter before the overall aim and research questions are specified. The next chapter deals with the functions of the visual system and its relation to reading, followed by an overview of various theoretical perspectives of the reading process and how a visual impairment can interfere with reading. Alternative reading media such as braille and the selection of other appropriate reading media and devices for different groups of individuals with visual impairments, are then described. The multiple methods used and methodological and ethical considerations are then discussed before the articles and general findings are summarised. The framework will be concluded with a general discussion about the three areas of knowledge mentioned above.

**Definitions of visual impairment**

The definition of visual impairment varies in the literature within different scientific disciplines and in different countries. Within medicine and legislation the basis is often found in visual functions (visual acuity and visual field) and their measurable values while educationalists usually use more qualitative definitions of visual ability (functional vision) as in the quote below:

"The general term visual impairment can refer to any condition in which eyesight cannot be corrected to what is considered "normal". In this book, the term is used to refer to a loss of vision that makes it difficult or impossible to complete daily tasks without specialised adaptations." (Holbrook, 1995, p. 2)

"The generic term visual impairment is used to describe the continuum of sight loss. Where a distinction is necessary, the term blind is used to describe children who rely predominantly on tactile methods in their learning while the term low vision is used with reference to children who are taught mainly through methods which rely on sight." (Mason & McCall, 1997, p. XV)
Among ophthalmologists it is also possible to find descriptions that use functional vision (visual ability) besides values measured in tests of visual functions.

"An alternative functional definition favored by the authors is loss of vision sufficient to prevent one from being self-supporting in an occupation, making the individual dependent on other persons, agencies, or devices in order to live." (Vaughan & Ashbury, 1980, p. 340).

The effect of the visual impairment for the adult’s independence is emphasised often in order that the person with visual impairment should gain access to society’s services in the form of rehabilitation and technical devices. Choice of device and assistance varies depending on the degree of visual impairment. In Sweden, the rules regarding prescription of technical devices generally follow WHO’s definition in 1980 (WHO, 1994), which are based on visual acuity with the best correction and the size of visual field. The same rules are mostly practised for children as for adults. Visual acuity is expressed with different numerical expressions depending on the system adopted in each country. In the Nordic countries a decimal system is used where 1.0 is the expression for “normal” visual acuity (the possibility of seeing better than “normal” exists). In Anglo-Saxon countries normal visual acuity is expressed by 6/6. The numerator gives the distance in metres at which the symbol on the sight test board is read and the denominator gives the distance at which a “normal” eye can read the same line (or 20/20 expressed in feet). Persons with visual impairments are divided into three different categories according to WHO (1994), based on degree of impairment: moderate, severe and profound visual impairment or blindness (Table 1).

In this thesis pupils with visual impairments have been studied on the basis of these three categories in relation to reading medium and way of reading. Pupils mentioned as having extremely low vision in Paper I are in the same group as pupils with severe low vision according to Table 1.
Table 1.
WHO terminology for visual impairment

<table>
<thead>
<tr>
<th>Category of vision</th>
<th>Degree of impairment</th>
<th>Best corrected visual acuity</th>
<th>Alternative definition</th>
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<tbody>
<tr>
<td>Normal vision</td>
<td>None</td>
<td>≥0.8 (6/7.5; 20/25)</td>
<td>Near normal</td>
</tr>
<tr>
<td></td>
<td>Slight</td>
<td>&lt;0.8</td>
<td></td>
</tr>
<tr>
<td>Low vision</td>
<td>Moderate</td>
<td>&lt;0.3 (6/18; 20/60)</td>
<td>Moderate low vision</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>&lt;0.12 (6/48; 20/160)</td>
<td>Severe low vision</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Counting fingers at 6m or less.</td>
</tr>
<tr>
<td>Blindness</td>
<td>Profound</td>
<td>&lt;0.05 (3/60; 20/400)</td>
<td>Profound low vision or moderate blindness. Counting fingers at &lt;3m</td>
</tr>
<tr>
<td></td>
<td>Near total</td>
<td>&lt;0.02 (1/60; 3/200)</td>
<td>Severe or near total blindness. Counting fingers at 1m or less or hand movements at 5m or less</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>No light perception (NLF)</td>
<td>Total blindness</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(including absence of the eye)</td>
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**Impairment – Disability – Handicap**

The use of the concepts impairment and disability are often misleading. Both concepts refer to the individual.  
**Impairment** is a disorder interfering with an organ function, a loss or abnormality of psychological, physiological or anatomical structure or function, a bio-medical status.  
**Disability** is the lack, loss or reduction of an individual’s ability to perform certain tasks. Disability reflects the consequences of the impairment, the functional performance and activity by the individual. (Faye, 1976; WHO, 1994).

**Handicap**, on the other hand, is a social phenomenon. Handicap represents the social and environmental consequences for the individual stemming from the presence of impairments and disabilities. It concerns with the disadvantages experienced by the individual in the interaction with the individual’s surroundings (WHO, 1994).
EDUCATIONAL PREREQUISITES

History and current situation

Pupils with visual impairments only

The first step towards educating young blind people in Sweden was taken in 1807 when Pär Aron Borg taught a young girl at his home and the year after allowed her to take the public exams. He then expanded his work to include teaching the deaf and, in 1809, he opened the Institute for the Deaf and Dumb and the Blind. The school was financed partly by government grant but also with funds from the general public. The Royal Family functioned as the Institute’s patron. Up until 1817, the school educated ten blind pupils. After that the intake of blind pupils stopped completely until 1846 when they were once more taught together with the hearing impaired. A special institute for only blind pupils was established first in 1878. Ten years later in 1888, the school could be moved to its new building - the Royal Institute for the Blind - at Tomteboda. The first law regarding compulsory education for blind children was passed in 1896, just over fifty years after the school reform of general elementary schools in Sweden in 1842. Education at the Institute for the Blind was now completely free from school fees.

Since the 1870s the written language for the blind in Sweden had been Braille’s alphabet made up from patterns of dots, which was used in parallel with an earlier system of raised characters - the Moon alphabet - based on raised lines and angles instead of dots. The pupils learnt, however, to write ordinary print as well with an “ingenious technical device” (Gissler, 1964, the author’s translation). In 1925 ordinary typewriting was introduced into the timetable but otherwise the new teaching plan, which had been in use in elementary schools since 1919, was used. As there were also partially sighted pupils at the school, special reading training of ordinary print was introduced for these pupils in 1932. In the same year a braille library was established at the school.

A new curriculum for theoretical subjects was introduced year 1954/55, when compulsory school for blind children was also extended to eleven years.
In accordance with the constitution of the school for the blind from 1960, it was decided that eight of these eleven years should be theoretical and three years should include vocational training or vocational practice. The curriculum still more or less followed the one used in regular, comprehensive schools but new subjects such as domestic science, mobility and long-cane technique were also introduced in order to adapt the pupils to a future independent life. During the 1960s, theoretically gifted children began to transfer more regularly to ordinary secondary schools after the theoretical eighth or ninth year at the Institute for the Blind. They were considered then to be able to cope with reading and writing in braille by themselves and, with the help of an ordinary typewriter, perform their assignments. Their study material in braille and technical devices were obtained from a special library at the Institute for the Blind, founded in 1956. This was converted to Tomteboda National Centre for Educational Devices for the visually impaired in 1965 and is the origin of the present state educational devices production - SIH Educational Materials - which is lead today by the National Swedish Agency for Special Education (SIH).

Similarly, the origins of the state organisation for special educational advisers also had its origins in the Institute for the Blind. The first itinerant teachers for pupils who had left secondary school were created by the Institute for the Blind and were appointed in 1958. The organisation of the advisers is now incorporated within SIH and consists of about 30 posts serving pupils attending compulsory education.

The integration of pupils from special school to ordinary schools continued during the 1960s and 1970s at an ever-increasing rate while, at the same time, the permanent school section of the Institute became smaller. In accordance with the new special school decree of 1965, the special school, with its new name “the Tomteboda School, special school for pupils with visual impairment”, now offered a 10-year compulsory education. The new curriculum for the compulsory school introduced in 1969 covered now the special school but with some additional areas e.g. sensory training, extra time for art and design, physical training and handicrafts at the primary level.
Consequently, pupils in special schools had more hours of classroom teaching per week than the corresponding classes in ordinary schools, as well as a tenth year at school.

Pupils with visual impairments and additional impairments

In 1886 "The School-Home for Blind and Deaf Mutes" was opened in Skara with the help of a State grant and money which had been collected from the general public. Thereby the ground was laid for a teaching institution especially for the deaf and blind (Jarl, 1995). The State was at its head when the work expanded and in 1922 it moved, with its 142 pupils, to "Nursing home in Lund for blind with complicated defects". At the end of the 1950s, the demand for places for multiple disabled was so great that the need for a completely new school arose. In 1965 the new school, Ekeskolan, was inaugurated in Örebro. According to the special school decree, this school should also be a special school for the visually impaired with a 10-year compulsory education but mainly for pupils with additional impairments who could not be taught in ordinary schools or in special schools for mentally retarded. The most common additional impairments were, and still are, mental retardation, hearing impairment and physical disability. During the school year 1997/98, the school had 43 pupils, 35 of whom had an additional impairment (SOU 1998:66). Besides the school there is also a resource centre (Ekeskolan's Resource Centre, ERC) where investigations and training visits as well as external courses for the child's/pupil's family and staff are carried out. According to a recent proposal of the government the permanent school section will be discontinued in some years (Prop. 1998/99:105).

Pre-school

There have never been institutions for blind, pre-school children without additional impairments in Sweden. The insight about the importance of getting into touch with the children and their parents before starting school existed, however, at the Institute for the Blind at Tomteboda. In 1952 the Institute introduced the service of a school nurse who visited families. The first state, special education adviser post was established shortly afterwards in
1954 and was followed by a further two such posts under the management of the Institute of the Blind. As well as home visits, the pre-school advisers arranged summer courses for parents in order to make the transfer from home to boarding school as smooth as possible (Gissler, 1964). The pre-school advisers also worked to get the children admitted into “ordinary nursery schools, day-care centres, rhythm and dance groups” (ibid., p. 28, the author’s translation) in the area where the child lived with successful results. The activities of the pre-school advisers expanded and in 1978 there were 9 posts which served about 500-600 pre-school children with visual impairments and additional impairments (Ds U 1979:11). This meant that each family could receive a visit twice a year at the most. Today there is an adviser organisation for children with visual impairments under SIH that includes about 30 posts.

From special school to inclusive education

Special School

The number of pupils at the Institute for the Blind already began to reduce in the 1930s from over 200 pupils to about 130 pupils during the 1950s. Those pupils with low vision, or partially sighted as they were also called, and who could use ordinary print, had disappeared from the school. They were now taught in their local schools or in special low vision classes, which were established in 1956 in Stockholm and Gothenburg and in Malmö in 1959. When, in 1965, Tomteboda School began the ten-year compulsory education for the visually impaired, there were about 140 pupils. During the 1970s the number of pupils decreased rapidly and in the school year 1978/79 there were only 40 pupils registered as attending the special school. The age at which the pupils were integrated to the ordinary comprehensive school in the pupil’s municipality had now become lower. The idea that the pupils should be able to cope with braille well by themselves before the step was taken to ordinary classes still prevailed. An experienced teacher of the visually impaired, responsible for teaching braille, was considered a pre-condition for beginners when the first potential braille reader started directly in the municipality in
1978. Many parents now began to demand that their children should attend a local school in order to avoid placing them in a boarding school. Efforts were made to meet these demands and in 1986 there were only seven pupils left in the special school. The school section was then discontinued and Tomteboda School had been converted into a resource centre (TRC).

Suggestions for support

As a consequence of the rapid integration of braille reading pupils, a need arose for further education in the local schools. In 1977 the National Board of Education appointed a working group - the Tomteboda Group - with the task of proposing a new organisation in order to maintain the resources and competence that existed among the staff at Tomteboda. The Tomteboda group should also make proposals about the amount of support, which should be provided for the municipalities. In order to give local municipality sufficient support, the group proposed that the number of advisers should be increased to 30 within each area. This was to ensure that “the integrated, pupils with visual impairments should receive an equivalent standard of education as the sighted” (Ds U 1979:11, p. 29, the author’s translation). The group also proposed that the advisers for pre-school and itinerant teachers should work closely together in order to prepare the transfer from pre-school to school. An itinerant teacher who had a basic training as a junior schoolteacher should visit the braille beginner once a week during the first year. In classes at the junior level where blind or pupils with profound low vision attended, there should also be a “companion teacher” 13 hours per week - an extra resource that should be assigned to the school from the Government according to the group’s proposal. The companion teacher should have special teacher training and be responsible for the basic subjects – Swedish and mathematics – and teach braille at junior level. The companion teacher and the class teacher should participate in the further education course arranged by the Resource Centre on three occasions, each lasting one week. With this organisation the pupil integrated in the ordinary class would not hold any exceptional position but instead become a member of the group, according to the Tomteboda Group (ibid.). In order to create an even fairer relationship for the pupils with
visual impairments it was proposed that costs for staff assistance and technical devices should be provided by Government grants.

The adviser organisation

As a consequence of integration of disabled people in society in general, principles of proximity to, and availability of, competent support for the disabled person was discussed within the area of handicap politics in Sweden. Against this background and after proposals from the Study of Integration (SOU 1982:19), the central support with pre-school advisers and itinerant teachers built up at Tomteboda School was transferred to the Regional Schools Board in 1984. Co-operation between pre-school and school was maintained and further education for advisers and itinerant teachers should still be the responsibility of the Tomteboda School. In 1991, the Swedish National Board of Education was discontinued and two new government authorities were formed – the National Agency for Education and the National Agency for Special Needs Education (SIH). The organisation of advisers and itinerant teachers was then transferred to this new government authority SIH, which is the central administrative authority for the special schools in the country and TRC today. As a result, pre-school advisers and itinerant teachers were given a common name, i.e. adviser for children and adviser for pupils with visual impairments respectively.

The tasks and functions of the advisers for pupils with visual impairments have developed and changed in step with the changing view of society towards pupils with disabilities in compulsory education. The goal today is to transfer the efforts, which have been directed to the individual child/pupil, family and teachers to more general tasks. The aim of SIH is now to facilitate the attendance at school for pupils by giving advice and support to municipalities. According to a recent proposal, a co-ordinating special educator will be available in each municipality in order to offer pupils with disabilities an equivalent education (SOU 1998:66; Prop. 1998/99: 105). The Government authorities have changed SIH’s task from the proposals, which the Study of Integration once made, where itinerant teachers were expected to some extent teach the pupils.
Tomteboda School Resource Centre (TRC)

Many of the proposals made by the Tomteboda Group have been carried out. The Tomteboda School Resource Centre has today the task of providing special educational studies and training as well as information, training and further education for the child, the pupil, parents/caregivers, teachers and other staff. TRC now puts priority on work with pupils with profound visual impairments, as this was earlier the responsibility of the special school. During the pre-school years, it is more difficult to decide whether the child has additional impairments which is why some children in this group also get the support of TRC during their first six years.

There is no obligation to register children with visual impairment in Sweden. Thus the total number of children and young people in the age group 0-20 years can only be estimated. In the budget year of 1997 about 300 received support and training at TRC (TRC, 1997). Around 240 were children and young people with profound visual impairments, which is probably the total number in the country. In addition there is the equivalent work at Ekeskolan’s resource centre (ERC) for children/pupils with visual and additional impairments.

Current support to parents

Besides the support of advisers at SIH to the families with children and young people with visual impairments, courses are offered at TRC for parents, brothers and sisters, as well as other relatives, during the pre-school and school years.

Medical and educational investigations

The first eye specialist was already employed in 1906 by the Institute for the Blind. As a result of the improvement in medical eye care in the country during the first half of the 20th century, many of the children who started at the boarding school in the 1960s were well examined and medically treated according to the ophthalmologist at the school (Olson, 1964). The task as ophthalmologist at Tomteboda therefore changed to assess, in close cooperation with the educationalists, as early as possible whether the child
should be taught at Tomteboda, in a local low vision class or in an ordinary school (ibid.).

New knowledge about the possibility of using and developing residual vision (Barraga, 1964) was introduced by ophthalmologist Eva Lindstedt at the beginning of the 1970s when co-operation with the educationalists was intensifying (Lindstedt, 1979). A multi-disciplinary team of investigators emerged and a low vision clinic was established where the pupil’s vision could be assessed and trained. Knowledge of the importance of training of low vision also lay behind the rapid growth of low vision clinics in the county councils in the country (Bäckman & Inde, 1979). Between 1973 and 1986, 32 low vision clinics were established with at least one in each county council. In 1979, the Tomteboda Group had proposed that the medical/educational assessments, which had developed at Tomteboda should be extended and contain a complete analysis of the child’s psychological and medical condition. This was judged to be important for the continuing educational work. The new role of the local low vision clinics and the ophthalmologic assessments where the child lived in relation to the increased amount of investigative work at Tomteboda was still unclear. In course of time the co-ordination of these double resources has taken form. Now the adviser for children/pupils applies for examination of the child/pupil at TRC after discussions with parents and the local low vision clinic. These examinations function therefore as an extra central resource in those cases where capability and resources are not sufficient in the municipality where the child lives. During the budget year 1997, 111 examinations were carried out at TRC. The demand for examinations is large and there is a waiting list of 2-6 months. New medical findings within eye research has increased the demand for the special competence which can be found within the investigation team today (TRC, 1997).
Teacher training

Additional education for teachers

Until 1967 the Institute for the Blind /Tomteboda School had responsibility for a one-year further education course for teachers of pupils with visual impairments. The main emphasis in the course lay in aspects of teaching and practical applications at all levels and subjects in the special school. The course took on a more theoretical and academic direction when it was extended to a third term and transferred to the Stockholm Institute of Education in 1967. The practical applications remained, however, during certain weeks in classes in the special school. The training to become a special educationalist specialising in visual impairment is still located in the Stockholm Institute of Education and extends over three terms. The content of the education has, along the same lines as the changes within the area of disability politics concerning “a school for all”, moved during recent years towards a more general special educational competence. It means a supervisory and advisory function in combination with specific information about visual impairment and its consequences for the child’s/pupil’s cognitive and psycho-social development. After completing the special education training with specialisation in visual impairment, it is possible to work as an adviser at SIH, at resource centres, as a companion teacher in regular classes or as a special educationalist in comprehensive school.

The new findings concerning the significance of vision and reading training has brought about the creation of yet another professional category, i.e. low vision teacher. The training of low vision teachers has also been located to the Stockholm Institute of Education since 1976 (Myrberg & Bäckman, 1993). The demands for basic training as a teacher do not apply to this professional category. It is common that occupational therapists, physiotherapists, optical nurses and also child-care and teaching staff train as low vision teachers. Low vision teachers work, after completion of the training, in low vision clinics, at resource centres or within vocational rehabilitation training.
Further education for teachers

For teachers and other staff who work with children/pupils with visual impairments in the age group 0-20 years in the municipality, there are further education courses at TRC, which are initiated by SIH advisers. When it concerns school age pupils the courses are recruiting compulsory schoolteachers. The length of the courses vary but are never longer than a week depending on the pupil's degree of visual impairment, age and the type of education in which the child is participating. The regular class teacher of the pupil with profound or severe visual impairment, who will also learn braille, will attend three courses of one week each in a period of two years. Teachers of children/pupils with low vision do not attend the central TRC arranged courses to the same extent. Distance education and regionally arranged courses are therefore proposed for this group in the future (TRC, 1997). Regionally organised further education by SIH advisers also occurs in cooperation with TRC.

Number of children and young people with visual impairments

Medical registration 1994

In 1994 there were 2,373 children and young people in Sweden between the ages of 0 and 19 years with a visual acuity of <0.3 (6/18) registered at low vision clinics (Blohmé & Tornqvist, 1997a). This meant that there were approximately 10.9 children with visual impairments per 10,000 individuals in this age group (about 0.1%). There were 45 per cent with moderate low vision, 15 per cent with severe low vision and 26 per cent with profound low vision or blindness according to WHO's categories (Table 1). For 14 per cent the visual acuity was unknown. In 60 per cent of cases there was an additional impairment. Visually impaired with mental retardation exclusively (18.5%) but also combined with motor impairments (27.4%) represented the largest group.

Eighty-four per cent of the children had impairments due to either prenatal (before birth, 64%) or peri/neonatal factors (around birth or just after, 20%). Among those with prenatal causes half were caused by genetic factors.
The children born prematurely were in the majority among the peri/neonatal impairments (56%). It was also more common with additional impairments in this group (83%) (Blohmé & Tornqvist, 1997b). The two largest diagnostic groups were neuro-ophthalmological (49%) and retina diseases (14%). In the first group there were many children with additional impairments (88%) and also the largest group of children with cerebral visual impairment (CVI). Children with mental retardation often were diagnosed as having CVI (40%) (Blohmé & Tornqvist, 1997c). The statistics show the frequencies of additional impairments among children with visual impairment.

**Number of pupils in comprehensive school 1997/98**

According to educational support statistics (SIH) based on registered pupils in compulsory education (7-15 years) and who received support from an adviser for pupils with visual impairments, 970 pupils had a visual impairment in the year 1997/98 in Sweden. Of these 60 per cent had an additional impairment and 34 per cent were taught in a special group. Thirty-nine per cent of the pupils had a native language other than Swedish. Many of those had a profound or severe visual impairment (31 %). In the total group there were 712 with moderate low vision (73%), 136 with severe visual impairment (14%) and 122 pupils with profound low vision or blindness (13%).

**READING ACQUISITION**

*Individual incentives*

Reading is a wide and multi-dimensional concept. In order to be able to participate in a high technological society, reading ability is a necessary prerequisite. Contexts including reading activities are increasing daily in such a society (Skolverket, 1996). Also in personal everyday life, a well functioning reading ability is needed in order to experience integrity and independence. It is part of every person’s right to be able to read their personal post, private letters as well as more official written communications from authorities.
The ability to read, however, also contains other dimensions than the *functional*. Reading also has a *cognitive* side. The personal world of experience is expanded through reading fictional descriptions of foreign environments and other people’s way of thinking. New possibilities for reflection are created as well as the ability to reconsider our understanding of the world around us. When these new experiences can be transformed into the form of conversations about the reading experience with other persons who are important for us, reading takes on further *emotional and social* dimensions (Mead, 1934; Taube, 1988). Positive experience of reading thus satisfies many fundamental *needs* from the perspective of the individual and are, therefore, an important motive for learning to read. The personal motive for learning to read varies with necessity and is related to age, personal reading needs and the reading demands in the person’s environment.

**Social demands**

It is, however, not only own satisfaction and reading needs which control motivation of learning to read. Today’s society also places *demands* on reading skills. School and society impose reading tasks on us, a reading, which is relatively lacking in any compromises, as we often do not choose our reading tasks. In order to manage tasks at school and at work, reading ability of another nature is required than that required for reading for pleasure.

Everyday reading situations thus vary between individual needs and contextual demands in relation to ability. When reading ability corresponds to the individual’s own and everyday reading needs and demands, the concept *reading competence* has been used in this thesis. Reading competence is therefore, a relative concept based on the relation and interaction between the preconditions of the individual and his/her surroundings. A person with reading competence reads and understands, adapts reading strategy to the reading task, uses his/her reading ability in daily life and meets the reading demands which are expected from people in his/her surroundings. In order to express an opinion about someone’s reading competence, therefore, it is necessary to know the individual’s capability, reading task and reading demands.
Reading ability, on the other hand, is defined as the individual’s ability to decode text and understand its meaning, i.e. processes occurring during reading on sensory, perceptual, verbal and cognitive levels (Paper I). Different reading tasks make different demands even at these levels, which is why reading ability can vary for one and the same person depending on reading situation and surrounding circumstances in school and during leisure time.

Theoretical perspectives

How then does reading ability and reading competence develop? The standard used in this thesis for the development of the individual is that the child is a being, who actively searches for knowledge and in interaction with his/her surroundings, develops abilities and skills. The individual, as well as the surrounding environment, are active partners in this interaction. The individual influences and is influenced by the environment and vice versa. Kylén (1988) describes in a model the interaction between the potential of the individual and aspects in the environment. The individual is regarded, according to his theory, as a biological and psychological being where both aspects influence each other in a mutual and inseparable interaction. In the same way, the environment is regarded as physical and social. People, the social environment, populate the physical environment.

"To understand a human being, therefore, one needs in every situation to know the psychological and biological aspects of that human being and the social and physical aspects of his or her environment. Each of these four aspects has its own structure, dynamics and development."

(ibid., p. 9)

Kylén emphasises the dynamics in the interaction between the structures and those relations which are changed in pace with the individual’s psychological and biological development as well as changes in the social and physical environment. Kylén’s general model and view of the interaction has been one of the theoretical bases for the model of interaction for development of reading ability and reading competence for children/pupils with visual impairments in this thesis (Figure 1). The biological aspects, the nature and degree of the visual impairment, as well as any additional disabilities, must be regarded
together with the child's psychological resources and the conditions in the physical environment when making judgement of reading ability and reading competence. A teaching environment, where low vision or blindness does not become decisive for the child's further development is, with this approach, very important. This perspective agrees well with WHO's relative handicap concept where limitations due to functional impairment is decided in encounters with the surrounding environment. In an environment with good physical and social conditions, the visual impairment becomes accordingly less noticeable and the child is given opportunities to develop his/her potential ability. Vygotsky (1978) has also emphasised the importance of socio-cultural interaction in order for the child to be able to develop further from his actual development level. He talks about "the zone of proximal development" (ZPD) where the child has the opportunity of developing inherent resources during particular circumstances, e.g. in co-operation with or in interaction with more capable people. He defines the nearest development zone in this way:

"It is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." (ibid., p. 86)

With this perspective, the educational process becomes important for, and determines, the child's learning. Education must be based on those processes, which are under development in every child/pupil if it is to stimulate further development of higher cognitive processes. Reading is such a process. With this theoretical basis, the learning environment of pupils with visual impairments is very important in order to develop reading ability and reading competence. It presumes access to people who know about, and have experience of, the consequences of visual impairment for reading development in order to give the pupil possibilities for optimal development. It also presumes that tools exist in order to, e.g. develop written language which is most fundamental in order to become aware of language (Vygotsky, 1986).
A development theoretician who started from Vygotsky’s theories, but has further enhanced the significance of the environment for the development of children, is Bronfenbrenner (1979) who developed a theoretical system - ecological development model. The levels in this are described as hierarchical, composite structures, which stretch from the micro system, through the meso- and exo-systems to the macro-system. The basis is the child and the conditions in the environment for his/her development. The child influences and is influenced by the activities and roles he/she possesses in the immediate surroundings (micro-level) and the social relations which are developed in interaction with family, pre-school, school and friends (meso-level). The child can be inspired by others, obtain new role models and the desire to try new activities which lead to development. The surroundings can, in this interaction, strengthen or work against the child’s development in the current activity. The relations, which are developed between the child’s various immediate surroundings takes place at the meso-level. Positive relations in the immediate surroundings encourage the child’s development.

Bronfenbrenner also refers to other levels in society, which indirectly influence the child’s immediate surroundings. Various forms of community support in the child’s home environment belong to the exo-system, as does the parents working situation and different social networks. The interaction on the exo-level can be disturbed or stimulated both within the system and from adjoining systems, e.g. by political ideologies in the community as well as economic and political conditions in the macro-system.

Bronfenbrenner revised his theory at a later stage by highlighting the development of individuals and their potential over time (Bronfenbrenner, 1989). He developed then a bio-ecological model where he emphasised the importance of continuity and positive relations in the immediate environment (“settings”) in order to increase the effect of proximal processes for the individual’s development (Bronfenbrenner & Ceci, 1994). Fischbein (1986) also points out in her educational, interaction model how various structural factors at different levels affect the educational process in the classroom and shows
the significance of guidance and stimulation for individual development in general (Furu, Fischbein & Rosenqvist, 1994).

With the same theoretical perspective, Warren (1994) also raises new research questions about children who are visually impaired and their development when he writes:

"Children with visual impairment have certain abilities and characteristics, and they encounter a variety of environmental circumstances to which they must adapt. What is the nature of the reading adaptation, and how does that adaptation change with changes in the child's abilities and characteristics, on one hand, and with changes in the environmental circumstances on the other?" (p. 6)

Reading development is a life-long process (Rex et al., 1994). Reading ability is improved by being frequently used in meaningful contexts, which also give an increased variation and breadth of reading tasks. Using this ability also gives an increased frequency of reading which influences the development of reading ability positively (Stanovich, 1986). In pace with increasing demands on reading in different reading situations, opportunities for well-developed reading competence is also created, i.e. opportunities for reading various types of text in different contexts (Myrberg, 1997).

Questions about how children and young people with visual impairments acquire reading ability and reading competence in their natural reading environment has, on the basis of these interaction theories, been central to this thesis. Children/pupils have been studied in their immediate surroundings, above all in school. People who have been important for the child's reading development have also provided information about the child's reading activities and about the teaching situation in several studies (Papers II, III, IV and V). The outcome of reading competence has, however, only been possible to illuminate in the first study as the pupils in other studies have been at the beginning of their reading development and much too young in order to have managed to develop reading competence.
Figure 1. An interaction model of reading acquisition of children and young people with visual impairment based on Bronfenbrenner & Ceci (1994), Fischbein (1986) and Kylén (1988).
AIMS AND RESEARCH QUESTIONS

The overall aim in this thesis is

- to increase the knowledge and understanding of reading acquisition in pupils with visual impairments in mainstream education
- to find factors which influence reading acquisition of pupils with visual impairments from an individual as well as an environmental perspective.

Some important research questions which are focused on:

- What are the similarities and differences between sighted pupils and pupils with visual impairments of the same age with respect to reading performance of different types of texts, reading habits and interests? (Papers II and III)
- What is the variation in reading performance within the group of pupils with visual impairments in relation to visual conditions, reading medium and reading devices? (Papers I, II, V)
- Under which circumstances will the visual impairment cause reading problems? (Papers I, II, V)
- What factors can be identified in the learning environment, which promote the reading acquisition of pupils with visual impairments in an optimal way? (Papers I, III, IV and V)
THE VISUAL SYSTEM AND READING

The visual system

Vision is the collective result of the functions in the eye, the pathways of the brain and cortex. The anterior and posterior pathways lead the visual impulses on to the primary and associated areas of the cerebral cortex where the picture is processed and interpreted. In an individual with normal vision both input and processing of the visual information are well functioning. Normal vision provides a good basis for visual perception of letters and words.

Within medicine the focus is on visual functions and their measurable values while for educationalists functional vision (visual ability) in daily activities is central. These concepts are often mixed in the professional discussion, which sometimes could be confusing. The distinction between them is presented in the following to make it clearer.
**Visual functions**

The visual system comprises several different visual functions (Lindstedt, 1998; Rydberg, 1998):

- **Visual acuity**: a measure of the visual system’s resolution, i.e. the capacity to discriminate details.

- **Visual field**: that area/space which can be seen when the eyes are fixed on a certain point.

- **Contrast sensitivity**: detection of the differences between brightness (luminance) of two adjacent surfaces.

- **Colour vision**: perception and distinction between different shades of colour.

- **Visual adaptation**: functioning in different lighting conditions.

- **Ocular motor functions**: the capacity to fixate, to make saccadic and pursuit movements when reading words on a line.

- **Accommodation**: the adjustment of the lens for near vision to be able to project a focused picture on the retina.

- **Visual perceptual and cognitive functions**: the processing, organising and interpretation of visual input.

The various significance of each function for decoding letters and words must be known if we are to be able to assess the potential of these visual functions for the reading process. Each one of the visual functions can be measured using different methods or instruments. The measures of the visual functions only indicate the potential visual ability and not the functional visual ability in different daily activities. In earlier studies, for example, visual acuity has shown to be a poor predictor for reading ability in children with visual impairments compared to adults who acquire a visual impairment (Myrberg, Bäckman & Lennerstrand, 1996). One measure of a single function could be misleading. To start from only visual acuity when recommending reading medium and reading devices for individuals with visual impairments is not sufficient. The visual ability could then be overestimated and the recommendations incorrect. The question of the visual functions’ relation to
reading efficiency has shown itself to be more complex, above all in relation to reading acquisition in young people with visual impairments.

Visual perceptual and cognitive functions are not traditionally included within the measurements of the visual functions at eye clinics or low vision clinics. Ability to interpret visual input is, however, of the greatest importance when reading (Ek, Jacobson, Ygge & Fellenius, 1999). An assessment of all visual functions including visual perception is necessary to understand the practical functional vision.

The localisation in the visual system of the lesion, malformation or decease determines the pattern of the visual functions (L. Jacobson, 1998). If the cause of the visual impairment is located to the eye or the anterior pathways it is called ocular visual impairment (OVI). Visual impairment located to the posterior pathways or cortex is called cerebral visual impairment (CVI). Children with a visual impairment due to CVI have been more frequently seen in recent times at the eye clinics than earlier (Dutton et al., 1996).

Certain visual functions can, with the help of training, be improved in the case of children (Barraga & Morris, 1980; Chapman, Tobin, Tooze & Moss, 1989; Sonksen, Petrie & Drew, 1991). Other functions can be strengthened with optical devices or adapting the physical environment (Baker, Barrick & Wilson, 1995; Kapperman & Koenig, 1996; Lewis & Taylor, 1997). To compensate for and adapt a pedagogical programme in the case of dysfunctions in the visual perceptual and cognitive functional system is on the other hand more complicated. A thorough assessment of neuro-developmental and functional vision by a multidisciplinary team is then necessary.

**Functional vision (visual ability)**

The functional vision of an individual with a visual impairment i.e. the ability to use vision when carrying out different tasks, is not always equivalent with the results of the assessment of visual functions (Chapman & Stone, 1988; Corn & Koenig, 1996; Mason, 1997a). A survey of the functional vision of a child is therefore as important as the various visual functions when testing
and recommending reading devices and adaptations for coping with environmental demands (Lindstedt, in press).

Visual acuity

Low visual acuity and poor detailed vision in the reading situation can, for certain pupils be compensated for by magnifying devices. Another way of enlarging is to hold the text close to the eyes, a spontaneous behaviour in many children with low vision when the visual objects are too small. This can function as well or better than a magnifying device for a child with good accommodation ability (Faye, 1976; Good, 1993). In order to obtain a comfortable situation when reading, the text should be at least twice as large as the smallest symbol which is possible to see when visual acuity at close distance is tested (Hyvärinen & Lindstedt, 1981). Hyvärinen (1998) calls this functional visual ability “reading acuity”.

Visual field

The absence of a central visual field, which is used in reading, is more difficult to compensate for with reading devices. In that case the child/pupil has lost his/her detail vision in fovea and must choose another point on retina in order to fixate the letters (known as eccentric fixation). The visual acuity is decreasing in the peripheral part of the retina. The child/pupil will perhaps need reading devices if the chosen point of fixation is located far from fovea (Jose, 1985).

Contrast and light conditions

Correct illumination and high contrasts in reading and picture material can usually help reading problems caused by poor contrast sensitivity. Individual differences in the functional visual ability as well as different eye diagnoses and adaptation abilities determine the need and strength of extra illumination. The quality of the reading material is also important. Shiny material, together with inappropriate lighting which dazzles, can make reading impossible for a pupil who is sensitive to light but otherwise has relatively good visual acuity (Mason, 1997b; Zimmerman, 1996).
**Colour vision**

Reduced colour vision does not often create problems if the reading material has good contrast qualities. On the other hand, good colour vision can often be utilised in educational contexts when visual acuity and contrast sensitivity are reduced. By editing teaching material so that pictures are colourful and have good contrast instead of too many details, the pupil will be able to develop an awareness of shapes and an experience of pictures which will be possible to utilise for the future (Hyvärinen & Lindstedt, 1981).

**Visual perceptual and cognitive functions**

Edited material also helps pupils with disturbances in visual perception i.e. have problems with arranging and interpreting their visual inputs. For this group it is extremely important to reduce the amount of visual input and create a reading area which is as clear as possible. Letters which are close together can also make the text difficult to read for children who could read single symbols of a certain size but could not when they are in a line like in a text. Difficulties then arise when reading long words where the letters in the middle are the most difficult to distinguish, a phenomenon known as “crowding” in the literature (Atkinson, 1993; Jacobson, Ek, Fernell, Flodmark & Broberger, 1996; Jan & Groenveld, 1993; Pike et al., 1994). With computers as reading devices it is now possible to adapt both size of the letters, the distance between them and the amount of visual input based on each pupil’s needs.

**Ocular motor functions**

Children with visual impairments often have ocular motor problems, e.g. find it difficult to carry out saccadic movements when reading. In some cases the child compensates him/herself for these problems when reading, e.g. with the help of head movements (Ek et al., 1999). Another common ocular motor problem in children with visual impairments is eye tremor (nystagmus). The child then often adjusts the head posture in a way so that the eye tremor is least noticeable (Good, 1993; Jan, 1993). It has not yet been possible to demonstrate through research that disturbed eye movement causes reading problems but it is possible to state that poor readers often have irregular eye
movements (Ygge, Lennerstrand, Rydberg, Wijecoon & Petterson, 1993). Even good readers can show irregular eye movements depending on the difficulty of the text or when reading under stress (Morris & Reyner, 1991). Dysfunctions in the visuo-motorical perceptual system i.e. the ability of the brain to process rapid visual input and its effects on the perception of letters during reading are also a subject of discussion in research (Brannan & Williams, 1987, 1988; Lovegrove, Garzia & Nicholson, 1990).

THE READING PROCESS

Different perspectives

There are many theories about what happens when we read. Research on the reading process is extensive and opinions are, at times, divided depending from which scientific direction the question is approached. The various processes which operate during reading, i.e. de-coding of text and comprehension of what is being read can be described in simplified terms as the starting points for the discussion which is taking place on how these processes influence one another and in which order they occur during reading (Dalby, Elbro, Jansen, Krogh & Christensen, 1983).

It is possible to distinguish two main directions where psycholinguistic research and science of literature emphasise comprehension and pre-comprehension in the reading process. This perspective can also be found in the concept “top-down” and is characterised by starting from the whole text and going to details - a holistic theory of the reading process (Goodman, 1976a; Clay, 1991). With the help of clues in language (syntax and semantics) and the reader’s active search for the meaning in the text, reading has been described as a “guessing game” by the main advocate of this perspective (Goodman, 1976b). The reader need not notice all the details in the text but makes a series of qualified guesses during reading.

De-coding of the shapes of letters and whole words, that involves perception as well as memory, has engaged medical researchers and psychologists. Advocates of the significance of de-coding for the reading
process put emphasis on the ability to recognise and connect letters to sounds (phonological reading) in order to gradually understand the whole syllable and word pattern momentarily (orthographic reading) - a sequential theory of the reading process (Gough & Tunmer, 1986; Hoien & Lundberg, 1992; LaBerge & Samuels, 1974). Not before this ability is functioning well can an automatic reading ability be achieved according to this theory. With this perspective the reader begins with the details and goes to the whole, a "bottom-up" approach.

A third category of researchers emphasise the interaction between the cognitive, linguistic and perceptual component processes and claim that reading does not function without the co-operation of these processes (Adams, 1990; Rumelhart, 1977; Seidenberg & McClelland, 1989). Good reading implies a complex system of various abilities and information, which are dependent on one another. Adams (1990) has, by considering the reading process in this way, developed a model which shows inter alia how the de-coding and comprehension processes interact and support each other during reading. The visual de-coding of word patterns - the orthographic process - stands in direct connection with the phonological process - transforming the words' sound pattern. Both these processes stand in their turn in direct connection with the process of comprehension. Understanding the meaning of the word, which is being read, is the ultimate goal according to Adams. The more familiar the reader is with the word’s spelling patterning the quicker the meaning of the word will be interpreted. But the word is also interpreted based on the context. This occurs with the help of context processing. With the help of the orthographic and phonological processes, the reader can even decipher completely meaningless words, i.e. code letter for letter and put together a word using the component sounds. On the other hand the reader can also use meaning and context processing in order to interpret words or continuous text which is not clearly presented. In the end, it is, according to Adams, personal experience of a word pattern which is most important in the reading process and which decides the strength of the associations, which are aroused.
An interactive perspective on the reading process also characterises this thesis. When the reader has a visual impairment, the perceptual processes as well as the cognitive, linguistic functions and their interaction during reading, are important to specify in order to be able to adapt educational methods.

**The reading process and visual impairment**

The question about how and when an actual visual impairment causes reading problems is complex. There are children and young adults with pronounced low vision and limited visual functions but who have a surprisingly good reading ability in print. At the same time there are also children with less severe reduction in vision who have considerable reading problems. As there are many influential factors, it is often difficult to isolate the effects of the visual impairment when reading problems arise. These factors can be found in the various sub-functions in the reading process, in visual and linguistic decoding but also in the conception and pre-comprehension of the content. They can also be found in physical and psychosocial factors in the surroundings, which are significant for reading development. Access to readable text and adequate devices, as well as training to use them, are important preconditions for success in reading. Having an inclination for reading and inspiration, as well as encouragement from people who are important to the reader in various reading environments, is assumed to also influence success with reading for the visually impaired in the same way as it does for sighted readers. Research on the significance of the reading environment for pupils who are visually impaired is not as extensive as that which concerns the perceptual processes when the visually impaired are reading (Stratton, 1996).

**Acquisition of reading comprehension**

The linguistic and cognitive processes used when reading do not have to be different for readers who are visually impaired if they have access to text which can be understood visually or tactually, and the phonological and orthographic processes are functioning well (Millar, 1997; Rex et al., 1994). These processes build on the reader’s experience of the language’s syntax, semantics and comprehension of the content, an ability, which varies among
all readers. Children with profound or severe visual impairments can, however, have a more limited exposure to written language than fully sighted or partially sighted children as they are not exposed to written language in everyday situations and consequently do not become inspired to investigate by themselves (Craig, 1996; Stratton, 1996; Wormsley, 1997). Similarly, the conceptual and experiential world of the child who is born blind could be different from that of a sighted child thereby influencing comprehension of words. Research has however, not yet been able show any large differences in comparisons with sighted children in this respect (Warren, 1994; Millar, 1997). On the other hand researchers are of the opinion that there can be fundamental differences if one looks at “the inter-relationships among words and their underlying concepts: these may be less elaborated for children with visual impairments” (Warren, 1994, p. 146).

Perception and decoding in print reading

It is easier to envisage that the perceptual processes when decoding text differ between fully sighted, partially sighted and blind readers as different sensory channels are used which have different characteristics.

Efforts in order to make it easier to see the forms of letters more clearly are made for the reader with low vision. Optical devices, contrasts and/or adjusting the lighting, strengthen the quality of the picture on the retina. By using these measures, the reader with moderate low vision often has the same opportunities of achieving as good a reading ability as a sighted person if the other linguistic processes are functioning well (Faye, 1976). The reader with severe low vision needs, in general, more support and training to use technical devices and to develop reading strategies adapted to different reading tasks (Koenig, Layton & Ross, 1992).

Perception and decoding in braille reading

Braille letters build on different combinations of six dots aligned in two vertical columns with three dots in each, a braille cell (ii), named after its inventor Louis Braille (1809 – 1852). From these six dots it is possible to make 63 different combinations, i.e. many more than the alphabet demands. Even
though the combinations of six dots can be considered as many, the various
dot patterns are very similar. This means that a braille character lacks
distinctive features compared with print letters (Nolan & Kederis, 1969). The
same combination of dots can have different meanings depending in which
context they appear. The same braille pattern can also, in another position in
the cell, represent, for example, a punctuation mark or a mathematical sign.
Thus the reader must be aware of the context of the text in order to be able to
make the correct interpretation of the symbol. This places other demands, both
linguistic and cognitive, on the braille reader’s ability to interpret compared to
the print reader’s in the decoding phase (McCall, 1997; Millar, 1997).

What does it mean?

Figure 3. Sentence in braille

A braille character is just the right size in order to be apprehended in its
entirety under the pad of one finger. The finger must move over the character
in order for it to be understood tactually. It is also important that all the dots
comprising the character are equally clear for the character to be interpreted
correctly (Pring, 1984). If a person has good tactual acuity the finger can
distinguish two dots when they are between 2 and 3 millimetres apart (Millar,
1997). Researchers have claimed for a long time that the braille character is
apprehended as a shape and that the perceptual unit when reading is a single
character at a time (Nolan & Kederis, 1969). In order to read a word the reader
must therefore decode letter by letter, which would explain the slower reading
speed with braille in comparison with reading print (ibid.). More recent
research claims, however, that the reader apprehends braille characters as
texture and not as a global shape (Millar, 1985). It is the dot density of the
character, which gives the character its features, i.e. number of dots and the
distance between them (the dot gaps) and not their position in the cell
according to these findings (ibid.).
A good braille reader reads at about half the speed of a good print reader. This is partly because it takes a longer time to move the finger than the eye along a line and also the greater perceptual demands when interpreting the text (Hampshire, 1981; Mangold & Mangold, 1989; Nolan & Kederis, 1969). Braille is best read using both hands, which, completely or partly, follow each other along the line, but there are also readers who only use one hand. Fast braille readers have been shown to read using two hands during reading (Foulke, 1982; Kusajima, 1974). The tasks of each hand during reading have been the subject of discussion. Hypotheses about several fingers on the line increasing the “perceptual window” and making it possible to read larger units than a single character at a time has also been investigated (Grunewald, 1966). Other investigations show that hands have different and varying functions during reading depending on the character of the reading task. One hand reads during the time that the other one has a place-keeping function (Millar, 1988).

The reader is often aware of his best hand and best finger when decoding and several fingers are part of the hand movements, similarly. The choice of dominant reading finger/hand has not shown any connection with laterality of other motor activities (Ittyerah, 1993). Information about the different functions of the brain halves when processing shapes and language has also given rise to thoughts about which hand ought to be best for developing good reading ability and increased reading speed, but there is still a great deal of uncertainty about this point. “The evidence on hand use in braille can certainly not be interpreted in any simple one-to-one fashion” (Millar, 1997, p. 68).

The slow reading speed with braille as well as the bulk of the texts has given rise to contractions in the text, i.e. a symbol or a couple of symbols represent a whole word or part of a word. Contraction systems are used in many countries but no longer in Sweden in pupils’ textbooks. Contracted braille is, however, available in other contexts through the Swedish Library of Talking Books and Braille (TPB).
The significance of sub-processes other than decoding during braille reading, such as linguistic and cognitive ability, as well as different strategies depending on the nature of the reading task, are now focused on more and more in the literature. The educational consequences of a new way of looking at the reading process in braille reading are also included (Millar, 1997; Rex et al., 1994). The need of more research with this perspective is emphasised. Research in braille is lacking and is also sought after constantly in Sweden. At the beginning of the 1970s a research project was started at Uppsala University (Löthman, 1973) where, with the help of special equipment, they wanted to analyse the reading process in braille in as normal conditions as possible. An investigation was carried out but no written final report was produced.

**Reading problems in print**

If the reading process with regard to print does not become activated or does not function as well as expected despite technical devices and educational efforts for the pupil with low vision, more fundamental visual investigations are required. The importance of investigating the localisation of the visual impairment in these cases has begun to receive attention in ophthalmologic and educational investigations. Visual impairments actually localised in the eye or in the anterior visual pathways do not engage the brain’s cognitive functions and, therefore, do not necessarily influence the actual reading process. On the other hand, if the visual impairment is localised in the posterior visual pathways, the risk is greater that other functions in the brain are also influenced and that the normal process of reading will be disrupted. Many questions are, however, still unanswered concerning the effects of the diagnosis and its significance for reading acquisition (L. Jacobson, 1998).

**Reading problems in braille**

Children, who learn braille, differ exactly as sighted children in how easy they find learning letter shapes and associating them with the correct sound. Despite the fact that braille characters differ less from one another than print letters, it is common that children learn to recognise every letter characteristics during their first year at school. Some children, however, find it
very difficult to differentiate the characters. The question is whether this can be equated with dyslexia. According to Hoien and Lundberg (1992) dyslexia is a disturbance in certain linguistic functions which are significant for coding the language. The disturbance is caused by a defect in the phonological system and manifests itself in the form of difficulties in decoding words and in spelling according to Høien and Lundberg. This disturbance can, of course, also occur together with visual impairment. There is nothing, however, which speaks for a blind child, for example, having poorer phonological capabilities than sighted children. On the other hand, braille reading places greater demands on both cognitive and spatial abilities. How the reader uses his hands, known as scanning movements, and the reader's ability to make use of spatial frames of reference influence braille reading (Millar, 1987). The double tasks involved with reading braille, the verbal, during decoding and the haptic/spatial, during hand movements, seem to interfere with each other in reading acquisition by retarded children in braille (ibid.). Research on dyslexia and braille reading is currently taking place in England where good braille readers are compared from various aspects with those who have been shown to have specific difficulties. The results indicate so far that the very weak braille readers do not have any pronounced preference for either hand, and that two-handed reading might, therefore, disturb decoding in those cases (Arter, 1998).

Limitations for readers with visual impairments

There are some common circumstances for readers with visual impairments who read braille or use certain magnifying devices when reading print. Both ways of reading imply that the text is demarcated which makes it more difficult to quickly apprehend its structure and process the contents. In order to obtain an overview the reader must orientate himself in the text, either by touch or with the magnifying device. These circumstances are time consuming, influence the speed of reading and make heavy demands on the memory function. Some reading devices can also cause limitations, such as a computer or closed circuit TV, which are difficult to move around. This means that the reader must go to a particular place in order to be able to read. Lack of
correct lighting might disturb a reader with low vision. Text not available in braille is another obstacle. These circumstances naturally limit the opportunities of reading in everyday situations even for readers with good reading ability.

**Teaching reading**

How does a child learn to read? Are there special methods, which promote reading development? These questions are as relevant for reading researchers as for teachers engaged in teaching reading. The answer from the professionals is usually possible to deduce from the various scientific perspectives of the reading process. Sweden has been dominated for a long time by a psychological perspective based on the individual where educationalists and psychologists have studied the child’s reading behaviour, i.e. what the child does when reading and how they spell when writing. Reading is thus regarded as a perceptual, memory and cognitive process where the written characters are processed in the brain. Good reading ability implies that this processing occurs automatically and quickly. The reader recognises words automatically as he has seen them many times and they have established an orthographic identity in long-term memory. This orthographic reading strategy is also known as the direct way (Coltheart, Curtis, Atkins & Heller, 1993; Hoien & Lundberg, 1992). According to the same theory the phonological strategy - the indirect way - is used when reading meaningless words by re-coding letters or words to sounds which are merged together into a phonological whole. It is, with this perspective, important to train word recognition when learning to read in order to develop a good reading ability. Methods for learning to read which are based on this perspective put large emphasis on letter-to-sound stage and a letter-by-letter strategy, a synthetic method.

At the end of the 1960s, ideas about the child’s awareness of language, its content and form, for developing reading ability were introduced in Sweden (Liberg, 1990). Reading, with this perspective, was regarded as a communicative, linguistic activity. The child’s own language and dialogue between teacher and pupil becomes the starting point for learning to read. In
this perspective learning to read is meaning-based rather than code-based. Parts of words are analysed from its whole - an analytic method. During the 1970s, the method of reading known as LTG was introduced into Sweden (Leimar, 1974). The model for this method was the Language Experience Approach (LEA) from the USA. It is, however, more common nowadays that various reading methods are mixed together in Swedish schools rather than a single method being used in isolation (Liberg, 1990; Taube, 1998).

Teaching and learning braille

Braille is not read in the same way orthographically as print. The fingers do not have the possibility of apprehending long words instantaneously. Research has shown that the clue for word recognition in braille are the word’s first three letters, when reading is taking place automatically (Kusajima, 1974). For beginners, each letter’s particular characteristics are not completely obvious before the cell is understood as a unit and the dots within it can be related to each other. The space between the letters in a word must also be apprehended so that the dots from one cell will not cause confusion in the adjacent cell. In Sweden, methodology has therefore been based on analysing the cell and the position of the dots in order to be able to associate letters with sounds when learning braille (Fellenius & Lindbladh, 1988). This tradition also exists in Germanic countries where, as in Sweden, the spelling of many words is consistent with the way they are pronounced. The possibility of starting from the child’s own language, also for learning braille, instead of following traditional learning methods are now being discussed both among researchers and educationalists (Lamb, 1998). As yet there are no systematic studies designed out of this approach.

Incidental learning

Many sighted children learn to read long before they start school. Encountering written language gives rise to curiosity about how it functions at different times in the child’s life (Goodman, 1986; Söderbergh, 1986; Wells & Montgomery, 1981). The response from the child’s surroundings will be significant for the continuing desire to discover. The child also discovers by
himself the function of written language for the adult who unconsciously becomes the child’s model. This spontaneous learning with the help of the surrounding environment is mentioned in the literature as “emerging literacy” and is closely linked to the child’s ability to see, apprehend and to independently draw conclusions (Clay, 1991; Teale & Salzby, 1989).

The opportunities for the child with a visual impairment to discover written language by himself and “break” the reading code are limited, especially when the child is profoundly visually impaired. For the potential braille reader there are no letters and text available in their immediate surroundings to discover (Pring, 1994). The environment must be specially adapted and the people in the home and at pre-school who are close to the child must have knowledge about braille. It is difficult for adults to function as reading models when the child has other preconditions for reading.

For the child with severe low vision, text in the surroundings can be much too small and consequently not sufficiently interesting in order to awaken interest to investigate what it is by himself. It is also a requirement for this group that there is awareness among the people in the surroundings who can adapt and make things clear for the child. Research on how the differences between sighted and visually impaired children’s incidental learning reflect in the child’s future reading development is relatively new and very much sought after (Craig, 1996; Stratton, 1996; Stratton & Wright, 1991).

**DEGREE OF VISUAL IMPAIRMENT AND READING MEDIA**

*Blindness or profound low vision*

Pupils with profound low vision or blindness are offered braille as their main reading medium. Braille could be read on paper with embossed dots or on a braille display connected to a computer. Books recorded on tape or synthetic speech from a computer are used as supplementary media.

As auditory reading does not function like a written reading medium, this medium in Sweden is regarded as a supplement to braille or print. Braille fulfills many criteria for a well functioning reading medium for the profoundly
visually impaired. New technology has increased accessibility to text, which has been one of the disadvantages with this reading medium earlier. Accessibility to text in the form of information, facts and libraries via networks has, as a consequence of technology, also increased. The differences between the supply of text in braille and print has, as a consequence, been reduced which makes braille more interesting as a reading medium, even for groups which have not been in question earlier. The lack of an overview of the text can, to a large extent, be compensated for with the help of a computer, as it is possible to move around in the text quickly. Communication with non-braille readers no longer causes problems as before. One disadvantage, which remains with braille reading, however, is the slower reading speed compared to that of sighted readers.

**Severe low vision**

Pupils with severe low vision are often in a “border area” between the methodology used for profoundly visually impaired and those with moderate low vision. Print can be read in several different ways in this group. When visual acuity is very limited several different optical devices are sometimes required for different situations, e.g. strong lenses, magnifying glasses or closed circuit TV (CCTV) systems. The reader with severe low vision often reads very close up to the text, which affects a quick overview. Carrying out a reading task with strong lenses can, therefore, take a longer time. These pupils often use large print, recorded books or synthetic speech as supplements to print reading, although even braille is sometimes used as their main reading medium (Holbrook & Koenig, 1992). With a pair of strong glasses or a magnifying glass in his pocket, the reader is able to move around. For the reader who uses optical devices, the ergonomy of the reading situation is the critical aspect. A poor reading environment (wrong lighting or bad reading position, for example) tires out the reader with severe low vision. Reading close up to the text can also affect the reader’s concentration and perseverance (Lie, 1996). There is a risk that the pupil tries to avoid reading because of external circumstances. With the help of CCTV a pupil can use those teaching
materials which are used in the classroom. Pictures in textbooks become accessible, necessary details can be enlarged according to need.

![Figure 4. A closed circuit TV (CCTV) system](image)

Reading in a CCTV, however, places demands on the reader's ability to gain an overview and apprehend the structure of a page in a book in order to find a particular place in the text. This can take time. The way of working demands concentration and a systematic approach. Demands are also placed on having good eye-hand co-ordination, especially when writing. The device can be difficult to move and therefore limit its possibilities of use. Against this background, reading with a CCTV is regarded as a complement to another way of reading or reading medium (Lund & Watson, 1997). Factors which can be decisive for the development of reading ability for the reader with severe low vision can, consequently, be found on both the individual plane and in the reading environment (Koenig et al., 1992).

**Moderate low vision**

For pupils with moderate low vision, ordinary print is offered mostly as the main reading medium. Pupils with quite good visual acuity usually manage to read with or without reading glasses of varying strengths. As complementary reading media, this group is also offered books recorded on tape, synthetic speech from a computer or, in some situations, large print.
Selecting appropriate reading media and devices

The technical developments during the 1960s and 1970s have meant that new electronic devices for enlarging text for people with profound visual impairments are available. This increases opportunities for people, who have earlier been obliged to read braille or tapes, to use their residual vision and read print. The pendulum did not swing, however, to its extremity in Sweden as it did in the USA during the 1980s where braille reading “was generally considered to be the medium of ‘last resort’” (Koenig, 1996a, p. 57). The consequence was that many students in the USA, who should have had the satisfaction of learning to read braille were not offered that possibility but instead read large print or talking books. In turn, this development lead to organisations for the visually impaired in the USA taking the initiative to restore the reputation of braille and some States passed laws about the right to obtain education in braille (Wormsley & D’Andrea, 1997).

In Sweden we have endeavoured to provide the visually impaired with a main reading medium, either braille or normal sized print read with some form of optical device. The possibility of only reading in large print, with recorded tapes or CCTV systems is not adequate, except for children or young people who have additional disabilities. An investigation is carried out at low vision clinics or resource centres to evaluate each person’s capability and requirements for different reading media and ways of reading. The low vision therapist and the adviser for visually impaired are continually following up the outcomes in the reading environment of the child i.e. at home and at school. There are no standardised tests or routines for this investigation other than the experience of the professionals.

Mangold and Mangold (1989) have proposed the following criteria when selecting reading media and reading devices: the diagnosis, visual functions and functional vision, age of the pupil, cognitive ability and ability to handle devices. Instructions for observation of visual and tactile behaviour and recommendations for selecting literacy learning media before starting school have also been developed in the USA during the last decade (Caton, 1994; Koenig, 1996b; Koenig & Holbrook 1989). In many cases the pupil uses several
reading media and ways of reading depending on varying circumstances in the environment. Longitudinal research about reading acquisition and reading competence in these cases is not yet available.

Consequences of the choice of reading medium and devices

The choice of reading medium and reading device influences the whole study situation of the pupil. The pupil's own experience of the best way of reading perhaps does not always agree with that which seems to work best in the test situation. Often it is the measure of visual acuity, which decides the recommendation of reading medium. Reading in well-arranged surroundings at the low vision clinic, for example, is not the same as in a classroom. Many factors, both in the physical and mental environments, can in that situation change the otherwise apparently well-arranged reading situation. Very little is known about how the reading medium and the reading device affect the pupil's identity and self-image. Research on the development of reading ability and reading competence when a pupil uses both braille and print alternatively is also required. In several studies in this thesis it has been shown that the pupils do not use the devices they have been offered during reading tests in school but the question why has not been focused (Paper I, II and III).

ASSESSMENT OF READING ABILITY

There has never been a standardised reading test for pupils with visual impairments in Sweden. Experienced teachers assessed braille readers during the time when the special school existed. When braille readers are taught within the framework of the ordinary classroom by teachers without experience of braille reading, the question naturally arises about whether the pupil’s reading development is “normal”. Assessment of reading ability still takes place during the pupil’s visit to TRC based on the collected experience, which exists there. Advisers follow up the reading ability of the pupils with low vision in their local school and at low vision clinics. A survey of pupils’ reading ability, based on information from low vision clinics and advisers, showed that the knowledge about the pupils’ reading was very limited.
(Fellenius & Myrberg, 1993). Details about visual status and reading devices as well as assignment of resources in the school dominated the notes of the advisers. The low vision clinic’s conception of the pupils’ reading did not agree with the conception the advisers had from the classroom. The low vision clinic had a more positive conception of the pupil’s reading ability than the advisers, presumably because they meet the pupil in an environment which is optimally adapted for reading, during a short time at the low vision clinic.

In the USA there is a modified standardised test for measuring word-study skills, vocabulary and comprehension for braille readers and large print readers (Stanford Achievement Test, 1989) and also another for measuring word analysis, comprehension and oral and silent reading level, the Diagnostic Reading Scale (Duckworth & Caton, 1992). It is considered to be difficult to standardise tests for pupils with visual impairments, as the group is so heterogeneous. When using a standardised test for sighted readers which has been adapted to braille or large print, care should be taken when interpreting the results. Experience and knowledge about visual impairment and reading is required if the results are not to be misinterpreted. Such tests can be used as a diagnostic instrument in order to determine the pupil’s level when an individual reading program is to be prepared but are insufficient in assessment of reading ability when the pupil has a visual impairment (Layton, 1997; Rex et al., 1994).

In England special tests for braille reading have also been used (Tooze Braille Speed Test, 1962 and Lorimer Braille Recognition Test, 1962) but have been criticised as they only measure word recognition and not reading of continuous text. The Neale Analysis of Reading Ability is considered a better test which measures accuracy, speed and comprehension and which has been adapted to braille (Lorimer, 1977). This test shows clearly how large the difference is in time between pupils with and without visual impairments when they solve tasks, which can be a guide for teachers and administrators in the planning of teaching for pupils with visual impairments (Tobin, 1994, 1997). The possibility of taking in and processing information quickly is reduced when vision is impaired. Research has shown that the information
process involved in reading tactually in braille, for example numbers with several digits, takes three times as long as for sighted readers (Hull & Mason, 1993). Similarly, the speed of processing for the partially sighted is slower compared with the sighted (Mason & Tobin, 1986).

With new perspectives of the reading process, researchers and educationalists in the USA recommend that assessment of reading ability must be looked at from several perspectives. This results in different types of reading tests and evaluation where consideration is taken of observation of both product and process, as well as reading of standardised texts in national evaluations (decontextualised measures) and continual, informal follow up of reading (contextualised measures) (Rex et al., 1994). In a corresponding way, the reading of Swedish school pupils is evaluated at the present time in the classroom and in the National Tests (Garme, 1996). There are, however, no overarching data about pupils with visual impairments participating in the National Test or if the class teacher evaluates their reading ability in another way.

**METHODOLOGICAL AND ETHICAL CONSIDERATIONS**

Children and young people with visual impairments form a small heterogeneous group, which explains why research is difficult to carry out with the aim of achieving comparable results which, can be generalised (Unruh & Barraga, 1981). Earlier research on children with visual impairments and their development has, according to Warren (1989, 1994) as its basis, comparisons with the development of sighted children, a comparative approach between populations. Warren (1994) is of the opinion that such a comparison has both advantages and disadvantages. One advantage is that it is relatively easy to see differences between the groups using a developmental psychological approach. The variation within the group children with visual impairments is, however, very large which makes a comparative approach less interesting if the causes behind the child’s development are to be understood. It is, according to Warren, more interesting to find the causes for this variation with a differential approach and ask questions about what lies behind
exceptional development both in a positive and negative direction. With the knowledge thus generated we will have help to “intervene in the circumstances of children to optimise their development” (ibid., p. 4).

This thesis builds on empirical studies with different types of design in order to obtain a so comprehensive and complete picture as possible of how children and young people with visual impairments acquire reading ability and reading competence in mainstream education. It is of great importance to use different research designs in order to obtain as much knowledge as possible when the question is complex (Lipson & Wixson, 1986; Skidmore, 1996). Descriptive as well as explorative approaches have, therefore, been used in the five studies.

In order to obtain an overview of reading ability and reading environment for pupils with visual impairments, a total investigation was carried out on third year pupils, where data could be compared with a corresponding total investigation carried out in Stockholm on sighted pupils (Papers II and III) (Taube, 1995). This study generated a great deal of quantitative data. A deeper knowledge and understanding of the processes during reading acquisition when visually impaired were provided with help of descriptive, longitudinal case studies in the pupils normal reading environment at school, which generated a lot of qualitative data (Papers I, IV and V). Research in the field of special education lies very close to the medical, psychological and sociological scientific areas. It invites interdisciplinary approaches as in the final case study in this thesis. The methodological traditions of the various research paradigms can, however, be difficult to unify in one and the same study, but give several dimensions and increase knowledge within the problem area, which is being studied. Many new research questions are raised with an interdisciplinary approach.

The ethical aspects when selecting pupils for study in special educational research must be given special attention. The group of pupils with visual impairments is relatively small and many children/pupils are well known within support organisations such as SIH, TRC and low vision clinics. It can, therefore, be difficult to guarantee the children’s/pupils’ and families’
anonymity, above all in longitudinal studies with few pupils (Papers IV and V). Consideration must also be given to class teachers and school management which allow researchers to regularly participate in class teaching and document what happens with the help of video. This type of field study is dependent on a strong trust being established and maintained between home, school and researcher during the whole period of the study. By involving school staff in the background, purpose and questions of the project, they had a common basis for observations and written documentation, which they were requested to contribute. They became, in this way, participatory in the research process. During the project, parents and school staff were also provided with feedback on some occasions. When distributing the results from the longitudinal projects (IV and V) where illustrations from video recordings in the school were used, everyone involved has always been asked in advance and has given their consent. Permission has been obtained from the parents of all the pupils in the classes studied for video documentation in the last two case studies.

Another difficulty in special educational research is interpreting the significance of the missing rate in each study, as the group being studied is very heterogeneous and usually small. The rate of non-response from the studies in this thesis has not been judged to influence the general conclusions since in most cases, the reasons for them have been possible to explain.

**Sampling**

In Study I the pupils were chosen randomly. Studies II and III are investigations of the total population while the pupils in Studies IV and V are strategically chosen based on the purpose of the study. The distribution of the pupils in the various studies can be compared in Table 2 with the pupils registered at SIH and who attended compulsory school in school year 1997/98. Table 3 shows the pupils distribution with regard to sex and school level.
Table 2.
Overview of categories of visual impairment compared to statistics of SIH.

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Table 3.
Overview of total number at the end of the projects.

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* one pupil followed the curriculum for mentally retarded
METHODS FOR DATA-COLLECTION

In order to reach the breadth and depth of knowledge, which has been the aim of this thesis, multiple methods have been used for data collection in all of the studies (Patton, 1990; Cohen & Manion, 1989) (Table 4).

Individual prerequisites

Visual ability

Information about the pupils' diagnosis and visual status (visual acuity at long distance and at near, optical correction) reading distance, reading devices and environmental adaptations have been provided by low vision clinics (Paper I), advisers for pupils with visual impairments (Papers II, III and IV) and ophthalmologist (Paper V).

Verbal ability

A short-term memory test was carried out in study I based on a test from a study of aging, memory and dementia (Nilsson, 1992) and a vocabulary test taken from a Swedish study by Emanuelsson & Svensson (1986). In the studies reported in Papers II, III and IV data about memory functions and verbal ability are not available. Informal reports or comments from teachers, advisers for pupils with visual impairments and observations during visits to the schools are the basis for interpretation of the cognitive functions of the child in these studies. In case study V a psychologist assessed the four children with different standardised tests including memory functions (Alin-Åkerman & Norberg, 1980; Griffiths, 1990; WPPSI-R, 1991; WISC, 1980). Appropriate sub-tests from the neuropsychological battery NEPSY (Korkman, 1988) were also used including assessment of verbal ability.

Reading ability

Standardised and/or informal test methods have been used in order to measure the pupils' reading ability (reading technique, reading accuracy, reading speed and reading retention) depending on the respective studies' purpose and questions.
In study I both standardised and informal texts were used in the reading test, in study II only standardised texts, in studies IV and V only informal texts. In study I two reading tests were carried out, one at the low vision clinic carried out by a low vision teacher and one in the pupil’s school environment carried out by the author. The latter was recorded on video.

In study II the staff in the pupil’s school carried out the standardised reading test. The reading tests in the longitudinal projects (IV and V) have, in all cases, been carried out by the author and recorded on video for processing later.

Study II included a standardised word recognition test from the Stockholm investigation (Taube, 1995). In study V the pupils reading of words without any context (Björkquist & Järpsten, 1975) was compared with reading of running text in order to study reading strategies of long words in each context respectively. The child’s awareness of language was tested also with the help of a standardised test (Magnusson & Naucler, 1993). A revised word chain test (C. Jacobson, 1998) was also used in study V in order to see whether the pupils could orthographically distinguish whole words when they became able to read and in that way reduced the “crowding” effect.

Reading retention when reading texts was assessed by formal (study I and II) as well as informal questions (study I, IV and V).

Reading rate was measured as amount of words read per minute in text reading in four studies.

Reading habits and reading interests
Structured questions have been used in interviews with pupils in studies I and III. The interviews were carried out by the author in study I and by an adviser for pupils with visual impairments or school staff in study III. In Studies IV and V the pupils’ reading interests have been described in the documentation from the teachers. In association with the reading test during the visit to the school, informal interviews with the pupils have provided the author with certain information. In study V, a questionnaire with multiple choice answers about attitudes to reading was also used as interview material (The National Agency for Education, 1993).
Context and reading settings

In the structured interviews with the pupils in studies I and III there were questions about reading environment in school and at home. In study I there were also questions about the pupils' possibilities of coping with different kinds of reading tasks connected with everyday life in order to illuminate the concept of reading competence.

In study III the teachers provided information about goals and contents of teaching with the help of the questionnaire used in the Stockholm investigation (Taube, 1995) as well as additional information about resources with respect to pupils with visual impairments. In study IV the teachers filled in a structured questionnaire with the possibility of making comments concerning the relations in the school environment and the involvement of the home at the end of each school year. Their continual written documentation contained also qualitative descriptions of the reading environment. Informal interviews occurred during the project period and the visits to the schools, which provided information about the reading environment. In study V the teachers were interviewed with semi-structured questions during the school visit at the end of the project. Their written documentation also contained descriptions of reading environment.
Table 4.
Overview of measures of reading ability and reading environment in the five studies.

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*Measures of verbal skills*
- Short-term memory: x
- Vocabulary test: x
- Linguistic awareness: x
- Word chain test: x

*Measures of reading ability*
- Letters: x
- Words: x
- Text standardised: x
- Text informal: x
- Reading rate: x
- Reading retention standardised: x
- Reading retention informal: x
- Teacher's judgement: x
- Observations by video: x

*Context and reading settings*

**School**
- Teacher questionnaire: x
- Teacher interview: x
- Observations by video: x

**School and Home**
- Pupil interview:
  - Structured: x
  - Semi-structured: x
  - Informal: x

**SUMMARY OF THE STUDIES**

The first article in the thesis arose in connection with the research project report “Reading skills, reading training and technology for visually handicapped” at the Stockholm Institute of Education under the direction of Associate Professor Mats Myrberg during the years 1988 to 1992. As a result of this project the National Agency for Education gave its support to a total investigation of pupils with visual impairments in the country and their reading ability in grade 3. The results from this study are reported in article II and III. Article IV builds on the experience from a national project studying...
braille reading with the help of a computer carried out on the initiative of the National Agency for Special Needs Education (SIH). Tomteboda School Resource Centre (TRC) was the initiator of the pilot study reported in article V.

Article I: Reading Competence of Pupils with visual impairments in Sweden

A partial study was carried out in 1991 with 25 pupils with visual impairments within the framework of the project "Reading skills, reading training and technology for visually handicapped" in 1988 - 1992. The purpose of the study was to obtain a clearer picture of factors, which are significant for a pupil with a visual impairment for developing and maintain a functional reading ability. Another purpose was to describe the consequences of a visual impairment for the pupils’ reading in daily situations at home and in school, i.e. how these influenced their competence in reading.

The twenty-five pupils, 12 girls and 13 boys, were a random selection of 246 pupils from the earlier survey phase in 1988. The pupils attended different grades from intermediate level to upper secondary school. Details, from journals of 15 of the country’s 32 low vision clinics, concerning visual functions, reading media and way of reading as well as reading devices were followed up and compared between 1988 and 1991. The pupils were judged to represent the heterogeneous group of readers who were visually impaired. A low vision teacher at each pupil’s low vision clinic carried out a standardised reading test and a test of vocabulary and short-term memory. The result from this reading test was compared with the reading of the pupils in a textbook at school, which was video filmed and then analysed by the author. The pupils were also interviewed about their reading habits and reading interests at the school visit. In processing and analysis of the material an interactive perspective was used where reading ability at the low vision clinic and in school was related to the pupil’s reading interests and those reading demands which they considered existed in school and during leisure time.

Three equally large groups of readers with visual impairments were identified:
- competent readers who coped with reading in various situations both in school and during leisure time
- poor readers who found all reading situations difficult
- uncertain readers who coped with simple texts but not with those demands which school placed on them.

Neither visual acuity nor reading medium, reading device nor reading distance appeared to be decisive factors for developing good reading competence. High achievers showed a higher cognitive ability and greater reading interest than the other pupils. Low achievers with high cognitive ability appeared to have progressive visual impairment. Their difficulties with reading could be related to the visual impairment. Among the poor readers were also pupils who had additional disabilities. Special measures to increase the reading competence of the uncertain and low achievers by finding meaningful and functional reading situations in consultation with the pupil are discussed in the article. Programmes to stimulate reading must take place in co-operation with the home, school and advisers who have thorough knowledge about the consequences of visual impairment for reading.

**Article II: Swedish 9-Year-Old Readers with Visual Impairments: a Heterogeneous Group**

A cross-sectional study with the total number of pupils with visual impairments in grade 3 (n=88; 56 boys and 32 girls) was carried out in 1995 in order to increase general knowledge about reading ability of these pupils in relation to sighted peers of the same age. Another purpose was to obtain information about reading ability with different reading media and reading devices within the group of readers with visual impairments. The material from the Stockholm investigation for grade 3 (Taube, 1995) was used in its entirety for readers with low vision and, in a somewhat modified form, for braille readers. The reading material had its origin in the international IEA Reading Literacy Study (Elley, 1992) and consisted of a word recognition test, based on combining words and pictures, and six texts of different characters with following multiple choice questions for control of comprehension. A class teacher, or other resource staff at the comprehensive school, carried out the study. Details about the pupil's age and sex, their diagnosis and visual status, reading medium and reading devices were provided by the adviser at SIH
who also contacted the school and instructed the teachers. The teachers were instructed to follow the Stockholm investigation with its time limitations if they considered that their pupils with low vision could cope with this, or carry out the reading without time limitations and note the time the pupil needed for each reading task. It would then be possible to identify pupils who, despite visual impairment, coped with the same level as their sighted peers. Furthermore, important information would also be obtained about average and poor readers within the group with visual impairment.

Eighty-one (50 boys and 31 girls) of the 88 pupils took part in the reading test. Twenty-eight per cent of them had additional disabilities but attended comprehensive school. In the analysis the pupils were divided into four reading categories based on reading medium and way of reading reported by the advisers: pupils who read normal print (n=48), large print (n=10), in a closed circuit TV system (CCTV) (n=12) and braille (n=11).

Twenty-three pupils with low vision carried out the reading test in accordance with the instructions used in the Stockholm investigation and thirty-six used unlimited time. Nine of the eleven braille readers carried out the modified reading test in its entirety without time limitations. The material was coded and frequencies and correlation calculated by a computer program.

The analysis showed that pupils with low vision found it more difficult to manage the word recognition test than reading the texts, which was not the case for sighted pupils (n=6305). The time limitation was a decisive factor for the poorer results for pupils with visual impairments. Low reading rate, however, did not effect reading comprehension in this group.

Thirteen pupils (16%) did not complete the reading test as it was too advanced for them. Additional impairments, intellectual impairment (teachers’ judgements) and language problems were, in most cases, the reason for interrupting. Approximately 22 per cent (nearly one fourth) of the readers with low vision scored the median value of the sighted peers or above. Twelve per cent represented low achievers.

There were no differences in visual acuity or reading distance between good and poor readers. Thirty per cent of the readers with visual impairments
had difficulties with concentration, becoming tired quickly, rubbing their eyes or wanting to give up. Among the poor readers there were also pupils who, according to the teacher, showed evidence of ordinary reading and writing problems apart from their visual impairment (10%). Variation within the group of pupils with visual impairments appeared to be great which placed demands on the ability of those who supervise the teachers in school. The study showed that a thorough awareness of the consequences of visual impairment for reading is required in order to adapt the teaching program for the average and low achievers.

Article III: Reading Environment at Home and at School for Swedish 9-year-old Students with Visual impairments

In this article the pupils' answers to the questionnaires in the Stockholm investigation in grade 3 (Taube, 1995) about their reading habits and reading interests were analysed. These made up part of the reading test in grade 3 (Paper II) together with the corresponding questionnaire to the teachers, regarding the goals of teaching and methods for encouraging reading. The purpose of the study was to identify and describe how pupils with varying degrees of visual impairment experience their reading at home and in school and also to compare their answers to sighted peers. Research questions about whether or not similarities and differences could be explained on the basis of different reading media and devices were asked. The pupil's adviser presented the questions in the questionnaire to the pupils verbally, in most cases.

Eighty-two pupils (50 boys and 32 girls) of the total number of pupils with visual impairments (n=88) in grade 3 in 1995 participated in the interview. Of these, 26 per cent had an additional disability. In the analysis the pupils were divided into four reading categories based on reading medium and way of reading reported by the advisers: pupils who read normal print (n=45), large print (n=14), in a closed circuit TV system (CCTV) (n=12) and braille (n=11). Seventy-four of the 82 who answered the questionnaire verbally had tried to carry out the reading test (Paper II).
According to the advisers, 77 per cent of the pupils were equipped with some form of extra equipment (lighting or adapted reading desk) in the classroom. Fifty-seven percent used this always or some of the time. The pupils were also well equipped with low vision devices (reading glasses and CCTV). There were extra teaching resources or assistance available in 67 per cent of the classes. Seventy-five percent of the teachers thought that the resources were adequate.

The answers to the pupil and teacher questionnaires showed that there were no noticeable differences in the reading environment in school between visually impaired and sighted pupils, bearing in mind the supply of reading material. Differences existed, however, between the groups of pupils with respect to their use of reading material, e.g. textbooks and dictionaries. Pupils with visual impairments utilised this literature less frequently.

The teachers’ goal for teaching reading was also the same as in the Stockholm investigation.

The difference in the reading environment between pupils with visual impairments and sighted pupils was in the home. Interaction involving reading with members of the family was less, especially for readers who read braille or with a closed circuit TV system. There were also certain differences in familiarity with letters, words and sentences when starting school. Large print readers and CCTV readers had, in their own opinion, less experience of letters and words than other reader categories among the visually impaired. Many opportunities for unconscious reading training also differed from the sighted pupils, e.g. reading the sub-titles on the TV or reading cartoons. Pupils with visual impairments did not think that they had reading homework as often as their sighted peers did. In the article the difficulty is discussed, for a teacher without experience and knowledge of visual impairment, to balance demands and expectations of the pupil with a visual impairment.

Article IV: Evaluation of Computer-based Education for Young Braille readers in Mainstream Education

On the initiative of advisers from SIH, seventeen young braille readers (8 boys and 9 girls) in comprehensive school participated in a three-year longitudinal
project with computers. The age of the pupils varied from pre-school to grade 4 at the start of the project. The criterion for selection was that the pupils should be at the beginning of their reading development in braille. Advisers and educators at TRC chose the participating pupils and the schools for the project. The purpose of the project was to study the significance of computers for the development of reading and writing in beginners learning braille. Another purpose was to study how the pupils, with the help of computers, were able to participate in work in the classroom on more equal terms and whether communication increased with teachers and other pupils. The significance of the design of the specific technology for the young beginners was also studied.

Two different computer systems were used primarily, a portable with its own processor, and a keyboard adapted for braille connected to an ordinary PC system, in most cases stationary. The evaluation from 17 schools showed that teachers as well as advisers were agreed that the computer was necessary for the pupils' schoolwork irrespective of the pupil's age and intellectual level. It substituted the sighted pupils' paper, pen and eraser, i.e. was first and foremost a device for developing reading and writing skills for all pupils. It was used as frequently by weak pupils as by the able ones and most frequently in classes where the computer was used as a pedagogical tool for all pupils. The portable system was used most frequently. Pupils in grade 2 appeared to have a higher reading speed on average than previous pupils of the same age taught with traditional devices. Reading using a braille display did not affect reading technique in reading a braille book in a negative way.

The computer as a device in the social situation was not as clear-cut positive in this early school level. Both individual factors in the pupils with visual impairments, factors in the school environment and the teachers' way of working could influence this development. The only disadvantage with the computer work was, according to the teachers, insufficient time for preparatory work (which the computer gave rise to) and for their own further education. Two to three days' further training per term was needed in order to get to know the capabilities of the computer and to keep abreast of the pupils'
development. One person responsible for technical support attached to each school appeared to be very important, as the pupils became dependent on the computer as a reading and writing device. The teachers also needed continuous educational support in order to develop teaching methods with the computer. In many cases, advisers at SIH and educationalists specialised in computers provided important support. Thus the teachers considered that the advantages with the computer for the pupil overshadowed the obstacles due to technical problems.

Article V: Reading Strategies in Children with Cerebral Visual Impairment

The purpose of this study was to see how children with cerebral visual impairment (CVI), caused by periventricular leukomalacia (PVL), acquired reading ability. With this specific diagnosis visual disturbances in perception appear, which clinically manifest themselves by the child finding it easier to see single characters than to separate characters of the same size in a line ("crowding phenomenon"). This is assumed to have an affect on reading long words.

Four children, one boy and three girls, with visual dysfunction caused by PVL were selected for a longitudinal pilot study for two years. From many aspects than the diagnosis they were heterogeneous and chosen to reflect variety. One girl had a severe motor disability (caused by cerebral palsy) and moved around in a wheelchair. She could not co-ordinate her hands. Her right hand was the most functional. The criterion for selection was that they should take part in comprehensive school and were able to describe their experiences. They all demonstrated an uneven cognitive profile in the neuro-psychological test, where verbal ability was significantly higher than the visuo-spatial.

Three of the children began in grade 1 when the study was started in autumn 1996. Two of them recognised at that time all letters but could not read. The girl with cerebral palsy did not recognise any letter. The fourth child began in grade 3 and was able to read short words with the help of a closed circuit TV system (CCTV). Two beginners, the boy and one girl, with a higher visual acuity, were to follow the teaching in the class without any intervention from the project. The third beginner, who had cerebral palsy, as well as the
girl in grade 3 were recommended to read braille as an alternative reading medium as they had lower visual acuity and considerable problems with “crowding” when using vision.

An educator from TRC was seconded to each school and made visits regularly in order to follow the learning process closely. The planning of braille reading took place in co-operation with the TRC educator. The research questions focussed especially on what kind of strategies the child developed in reading long words (>5 letters), if braille could be an alternative as a sequential reading medium and if any special educational approach favoured these children in learning to read.

Documentation was made in the classes with the help of video during the whole project. The teachers also sent in, on a continual basis, logbooks and detailed notes of their observations. At the end of the project, the author interviewed the teachers, pupils and parents. A reading test was at the same time carried out with each child.

After two years, the girl in grade 3 read braille nearly as quickly as ordinary print in a CCTV system, but she preferred braille. The test with braille reading for the girl with cerebral palsy did not give the same positive result, but she succeeded after about one and a half years, with the help of the computer, to sound and write own messages in enlarged print. She had difficulties in re-reading what she had written unless the teacher pointed out the words letter for letter. She preferred to re-read on the screen of the computer with the help of synthetic speech.

The two beginners who read print had developed different strategies when reading long words. The boy pointed letter for letter i.e. used a phonological strategy while the girl guessed the endings of long words. With the boy’s strategy, there were fewer misreadings but time-consuming. The girl was judged by the class teacher, as being on completely the same level as the rest of the class after two years while the boy was placed among the poorest in his class because of the long time he needed. Two different teaching instructions had been used for these beginners. In the girl’s class they had worked meaning-based, in the boy’s code-based which can have been reflected
in their respective strategies. The time for the project was far too short to obtain an answer to the question about how their reading will be affected by “crowding” in the future. Evident for the three pupils, who were able to read after two years, was their dependence on context when reading long words both in print and braille.

The educational implications for facilitating reading for this group of pupils are discussed. Methods which build on the children’s strong phonological awareness, i.e. working with reading through writing, should further the children’s possibilities for building up orthographic word patterns which, in turn, should minimise the “crowding” effect. The computer is a natural device for such a method where different reading media and ways of reading can be adapted to the needs of each pupil. Prescriptions of computers as reading and writing devices ought therefore to be put into practise for the group of children with CVI irrespective of the degree of their visual acuity. Further research about these issues is proposed.
GENERAL FINDINGS

*Individual capabilities/opportunities for reading acquisition*

Readers with visual impairments are a heterogeneous group:

- Nearly 1/4 of readers with low vision in grade 3 achieved average reading results or above compared to sighted peers (Paper II)
- More than 1/4 were low achievers or were not able to perform the test for sighted in grade 3 (Paper II)
- There is a larger group of readers with visual impairments who need an adapted reading program in order to develop their inherent potential (Papers I and II)
- Thirty per cent had difficulties with concentration, became tired quickly, rubbed their eyes or wanted to give up the reading assessment in grade 3 (Paper II)
- Signs of ordinary reading and writing problems not due to the visual impairment were found among 10 per cent of pupils in grade 3 according to their teachers (Paper II)
- There were high achievers as well as low achievers among those with very low visual acuity (Papers I and II)
- Good readers used any kind of reading medium or device (Papers I, II and V)
- Reading comprehension was good even among very slow readers (Papers I, II and V)
- Good verbal ability in some cases compensated for a low visual ability in reading (Papers I and V)
- Short reading distance had no negative effect on reading performance (Papers I and II)
- Additional disabilities were more frequent among low achievers (Papers I, II, IV and V)
- There was an increased risk for poor reading among those with progressive eye diagnoses and cerebral visual impairment (Papers I and V)
• Children with severe visual impairments were less acquainted with letters and words at school start within the categories of readers with visual impairments (Paper III)
• There was a risk group found among uncertain readers who did not practice functional reading (Paper I).

Prerequisites in environmental settings for reading acquisition
• The pupils were well equipped with optical devices, lighting and special desks but seldom used the facilities in reading (Papers I and II)
• Tasks with time limitations were decisive for the reading results of many pupils irrespective of reading medium or reading device (Papers II and V)
• Reading narrative texts was much easier than documents and expository texts for pupils with low vision (Paper II)
• Pupils with visual impairments were not exposed, on a daily basis, to text at school and at home as often as sighted pupils (Papers I and III)
• Pupils with visual impairments did not experience having homework in reading very often (Papers I and III)
• The interaction with family members about reading issues were less for pupils with visual impairments than for sighted pupils (Paper III)
• The way of working in the classroom determined to a high degree the possibility for the pupil to take part (Papers IV and V)
• The computer was a necessary tool for developing reading and writing skills in braille as well as in print (Papers IV and V).
GENERAL DISCUSSION

The five studies on reading acquisition, which this thesis builds on, concern the child’s/pupil’s reading situation on several levels in the bio-ecological system (Bronfenbrenner & Ceci, 1994). Together they give a picture of the varying, individual pre-conditions which are represented in the group, the complexity, which is contained in the learning environment and the influence of the exo-system on this. The studies give a wide view over a subject area where research has been lacking for a long time in Sweden. Earlier international reading research on visual impaired people has, to a large extent, been based on the individual’s ability in relation to the nature and degree of the visual impairment, i.e. a psycho-medical perspective. In order to give a fair picture of reading acquisition when the child/pupil has a visual impairment, it is not sufficient to study only the child’s individual biological and psychological capabilities. Attempts should also be made to identify those factors in the child’s learning environment which might be significant for reading development (Hegarty, 1991; Lipson & Wixson, 1986). In this thesis, the ambition has also been to reflect the significance of the surroundings for success in reading in a socio-cultural perspective as reading development does not occur in a vacuum but, to a large extent, in communicative interplay (Vygotsky, 1978, 1986). With this interactive starting point, there is less risk of reducing the problems with success in reading to either individual or contextual explanations. The interaction between the child and the learning environment is instead placed in focus at the micro and meso levels but also forms of co-operation outside of the child’s immediate environment, important for the process in the classroom, such as society’s medical and educational activities (exo- and macro levels) for children with visual impairments and their families (Bronfenbrenner, 1989; Skidmore, 1996).

Three of the studies (I, II and III) have a quantitative approach while two of the studies (IV and V) are exploratory. Methodological difficulties always arise when tests for sighted pupils are used and results for the visually impaired are interpreted and compared against these (Paper II and III) (Tobin, 1997; Warren, 1994). The situation is not the same either when answers to
questionnaires are obtained verbally in an interview and interpreted against written answers. The quantitative, cross-sectional study clarified, however, important similarities and differences between sighted and visually impaired readers and also the heterogeneity within the group of readers who were visually impaired - information, which is useful in the planning of teaching in mainstream education. In the two longitudinal case studies (Paper IV and V) researchers, school staff and parents worked together continuously which made it impossible to assess what had influenced the pupils' reading development. The pupils' reading achievement could instead be observed and discussed in relation to the natural teaching situation, which gave a deeper insight. New questions were actualised and, in this way, increased knowledge about the specific situation of the pupils in the classroom.

With the knowledge gained through the various approaches, there are now possibilities, with both qualitative and quantitative studies, to proceed and consolidate the knowledge about the pupils' reading strategies and the learning situation in reading acquisition in mainstream education.

The heterogeneous pupil group

When a child is diagnosed as visually impaired at an eye clinic, he/she is registered in consultation with the parents to the county's medical and educational facilities, i.e. the low vision clinic and the adviser for children/pupils with visual impairments at SIH (National Agency for Special Needs Education). In a few county councils, the child is also registered to child habilitation services even if the child only has a visual impairment and no other obvious additional impairments. Nowadays many of the children/pupils with slight additional impairments are in ordinary schools (Papers I, II and III). Half of the group is taught there in special teaching groups according to information from SIH. Advisers have in this thesis, mainly supplied information about pupils with additional impairments. As all of the investigations have been carried out in ordinary compulsory schools, it is assumed that pupils with severe mental retardation are not included in the studies. In some cases, however, there were pupils who, according to reports, have been on the border between special school and ordinary school (Papers
II, III) or during the period of the studies have transferred to the curriculum for mentally retarded (Papers I, IV). The pupil group is, therefore, very heterogeneous both with regard to visual ability and cognitive ability. Only in study V has cognitive ability been thoroughly surveyed which is why uncertainty is large in the other studies concerning how the pupils' cognitive ability is related to reading results. This is, of course, a shortcoming as reading is a cognitive process. However, comments from the teachers have assisted with interpreting the reading results and shown the difficulties some pupils have with reading in ordinary teaching.

The studies have shown that there is a group of pupils in the third year (approx. 22 percent) who, despite their visual impairments, are able to read ordinary print in school as well as 50 percent of the most capable pupils in a normal class (Paper II). But there is also a larger group of pupils who have much greater difficulty in keeping abreast of the class and the amount of reading (approx. 28 percent). What then are the characteristics of the different groups of pupils? How great a role does visual ability play for the good and poor results respectively and how much can be attributed to other factors?

The majority of high achievers in study II turned out to have a visual acuity better than 0.2 (moderate low vision), they read normal sized print at a distance of 10 cm or more, seldom used any reading devices and coped with the tempo of the class. Their reading potential was therefore similar, to a large extent, to their sighted peers. But among the very good readers there were also a few exceptions, who broke the seemingly general picture of a relatively good visual ability being associated with good reading results. Two pupils with profound low vision, who also read close to the text were among the very good readers which indicates that visual acuity in these cases did not have a decisive significance for the reading result (Papers I and II). Cognitive factors might lie behind the good results and compensate for the bad vision.

Low achievers in study II also had relatively good visual acuity but, in this group, there were more pupils with additional impairments. Difficulties other than visual acuity were therefore apparent. It was also common for pupils with additional impairments in this group not to be able to carry out
the reading test at all. Visual potential varied greatly in this group. This actualises once again the question about the patterns of the visual functions and the significance of the diagnosis for reading development. The details about the pupils’ diagnoses in this thesis are based on secondary data (from advisers and low vision clinics) in four studies (I, II, III and IV). They are, therefore, judged to be much too uncertain to be used and related to the pupils’ reading results with the purpose of finding an answer about the significance of diagnosis and localisation of visual impairment for these. Damage localised only to the eye or the anterior visual pathways (ocular visual impairment, OVI) is presumed not to involve the brain’s cognitive functions and, therefore, not the cognitive processes, which are active during reading. There is, on the other hand, reason to think about the connection between reading development in children with cerebral visual impairment (CVI) who demonstrate a normal intellectual level (Paper V). This group of pupils, based on cognitive potential, is expected to become readers. It is difficult to find previous investigations concerning reading development for this group as it is small and has not been observed before (L. Jacobson, 1998). Through the fifth study in the thesis initiative has, however, been taken for further research and questions about the significance of biological factors for reading acquisition for children with CVI without mental retardation.

The “hidden” potential readers

Half of the group of pupils with visual impairments in year 3 belongs to the group of readers with varied reading results, neither extremely good nor poor. In this group we find the heterogeneous readers bearing in mind visual ability, reading medium and way of reading. The “uncertain” and the “uneven” readers are found here, i.e. pupils who can read and manage certain reading tasks relatively well but not all of the reading tasks which occur in school work. In this group there are pupils with very low reading speed but with good comprehension and who are first able to do themselves justice when they have the time they need in order to solve the task. We also find pupils in this group who do not read for their own needs but only when demands are put on them to read. We also find pupils here who have problems with coping
with several reading tasks in succession. Therefore, approximately fifty percent of readers with visual impairments, over and above those who are really poor achievers, need specific measures of different types. Among these pupils there is a development potential which is not utilised and which, with knowledge about reading and visual impairment, should be possible to take advantage of.

Consequences of different reading media for the reading process

There are many similarities between the reading of sighted and visually impaired people but also important differences for certain reading categories. When testing with different types of text (Paper II), the greatest difference for pupils with low vision appeared to be when reading documents of varying types as well as with the task of associating words with the correct picture within a time limit. The greatest similarity with sighted readers appeared to be when reading running prose, a type of text, which also functions well when reading braille.

The most obvious difference between readers with visual impairments and sighted readers is, naturally, the difference at the sensory level. The impressions obtained of letter symbols differ also between visual and tactile reading. But other important differences exist also at the perceptual and cognitive level. Compensatory techniques change the preconditions for reading. The "perceptual window" is limited at the word decoding level in braille and at the text level when the reader uses magnifying techniques such as CCTV or very strong magnifying glasses. These techniques also place a greater demand on memory functions, as an overview of the text is lost. In order to make the differences between sighted and visually impaired readers clearer, an interactive model of the reading process in the form of an hourglass, has been worked out within the project "Reading skills, reading training and technology for visually handicapped" in 1988 (Fellenius, 1996; Myrberg & Bäckman, 1993).
In this model the continuous interaction during reading between "bottom-up" and "top-down" processes is focused upon depending on how clearly the reader can read and interpret the letters and how well acquainted the reader is with the content, i.e. what can be expected to be in the text. If the reader does not have any problem with sensory impression or decoding, he can concentrate on interpreting the content (ibid.). When the reader does not understand what he is reading, he must make a number of strategic choices in order to get back "on track" again. He is, in this situation, in the middle of the hourglass, the "bottleneck", in the interplay between decoding and comprehension. He can then make use of different reading behaviours when he goes back in the text in order to re-read it.

The reader either checks, with the help of sensory impressions, if there is simply a printing error in the text or goes to the decoding level and checks if he has interpreted the letters, word order or syntax correctly. He transfers his mental energy to the lower part of the hourglass. Alternatively, he can choose the opposite strategy and go upwards in the hourglass and instead assess whether he has understood the important facts in the text, missed any essential information or misinterpreted the point of the author's text. The character of the reading task, the reading goal, the reader's experience and
expectation (schema) control the choice of strategy and, to some extent the reader's personal style. Certain people always read pedantically and put great emphasis on decoding. Others read with strong emphasis on their own pre-comprehension and expectation about what the text is about. The skilled reader varies his reading behaviour and uses that strategy which is most appropriate for the reading task (Rumelhart, 1977).

For the reader with a visual impairment it is important to have the text clearer by using optical devices or a distinct braille. Otherwise he/she has to put all his/her reading energy on the perceptual level at the bottom of the hourglass. There is also a risk that the beginner with a visual impairment gets stuck at the decoding level longer than the sighted beginner as the opportunities for building up word patterns through frequent exposure to words and text are fewer (Adams, 1990; Clay, 1991; Millar, 1997; Pring, 1994). In several studies (Paper I, II, V) it has been shown that pupils with visual impairments read less often than sighted pupils. Naturally, a consequence of this can be a less well developed sight or tactile vocabulary and, as a result, a difficulty in passing the hourglass' "bottleneck" to the comprehension level which is the goal of reading.

How does the reader with visual impairment pass the "bottleneck"?

The unconscious reading models which an experienced reader uses when reading different types of texts, such as bus timetables, newspapers, product labels, fiction, non-fiction, etc., build on experience of text structures and appropriate strategies in reading them. With severe low vision and braille reading the overview of the text is lost. The conditions for understanding the structure of the text are different. Reading strategies and reading schema other than those, which apply for sighted readers must, therefore, be developed. The reading strategies and schema, which the braille reader or the reader with profound low vision with strong magnifying devices make use of, are presumably completely different to the sighted reader's. The opportunities for pupils with severe or profound visual impairment to gain experience of different types of text as well as the best reading strategies for dealing with them, based on the conditions restricting their reading, are limited. They
cannot by themselves obtain experience by studying adult readers in the same
way as a sighted child. The braille reader and the CCTV reader are often the
only ones in their home and in their class who read in this way. There is still
insufficient known in this area in order to give the right kind of support. This
knowledge presumably exists in the very good readers with visual
impairments. The reading strategies and reading schema these readers have
developed should be of great help in teaching pupils with similar visual
abilities or who read braille. Further research is, therefore, required which
takes as its starting point the extremely good reader in order to, from an
"internal perspective", be able to utilise their experience and test these with
more readers with same reading conditions.

Current contributions to reading training for pupils at low vision clinics
are often aimed at, purely technically, handling reading devices and perhaps
not to the same extent finding out about reading schema and most efficient
strategies for different kinds of reading tasks. Training at low vision clinics
cannot either be transferred to the everyday situation in the classroom where
reading tasks and tempo are different and where psycho-social factors are also
involved (Paper I). Many pupils do not want to differ from their classmates.
Using a technical device is a confirmation of functional disturbance. The pupil
must obtain an insight into the advantages and limitations of reading media
and reading devices when reading different text structures. Only then he/she
can understand that any reading problems need not only be attributed to
his/her own inability and self-confidence can be maintained, an important
factor for reading development (Taube, 1988). The educational challenge lies,
therefore, in getting the pupil to discover the usefulness of a reading device
and reading training as part of a normal day in order to utilise his/her
inherent potential. Otherwise there is a risk that the pupil will avoid reading
situations or rely on help from those around him, especially at the
intermediate level when the differences in reading ability increase in
comparison with classmates (Paper I). Reading must, therefore, already be
stimulated at the primary level.
Many pupils who were equipped with magnifying devices (Papers I and II) avoided using them in the test situation, above all when it concerned solving tasks involving documents. This can be a signal that they have not developed reading strategies with their technical device but chose instead the way, which they considered as quickest in the test situation. The purpose with a reading device is to facilitate the reading situation and increase the reader’s perseverance. Nearly a third of the pupil group showed problems with concentration and perseverance, which must be interpreted as warning signs. Both the technical, psychological and educational prerequisites in the pupil’s reading situation must, in these cases, be investigated in order to find the causes behind these problems.

Means for reading acquisition

It is every individual’s right in a well-developed society to have the opportunity of developing reading and writing ability in order to be able to participate and function independently, i.e. achieve reading competence. The goal is the same for all citizens but pre-conditions and means can vary. In two studies in this thesis the focus has been on the processes in reading acquisition when visual impaired (Papers IV and V). In study IV the pupils had the same reading medium, braille, and, in this study, the computer was tested as a new reading and writing device for learning to read. It not only gave the pupils opportunities of working with text other than with the traditional tools but also new possibilities for participation in the joint work of the class.

The computer as a reading and writing device for reading development in braille appeared to have advantages. It provided completely new possibilities of working with written language and presenting words more often to the finger tips in a distinct form, a precondition for also developing lasting word patterns for a braille reader (Millar, 1997). It also increased the pupils’ motivation which, in its turn, influenced perseverance. There is nowadays a device which, from many aspects, compensates for the disadvantages which braille readers before have had to live with. Braille has become a realistic alternative as a communicable reading medium and should be utilised by other categories of readers with a visual impairment who have
problems with reading print. This assumption lay behind the proposal of introducing braille to the two pupils in study V. The computer was also used here as a reading and writing device. Good cognitive and linguistic capabilities, in combination with a systematically planned educational programme, seem to increase the chances of a success result if braille is to be tested as an alternative reading medium for pupils who have problems with visual perception.

Access to reading and writing devices is an important precondition which, to a large extent, also applies to pupils who are going to read print and require help with "getting round" the effect of "crowding". In this situation the computer is an indispensable tool with its ability to expand or delineate text in an appropriate amount based on each reader's abilities and needs. Pupils with perceptual disturbances do not only have difficulties in differentiating letters when the word becomes long but in many cases also visual-spatial problems which affect simultaneous sight (figure-background) and direction both when they read and write. With the help of a computer many of these difficulties can be surmounted. Consideration cannot be taken, with this problem, to the measures which are produced in assessment of visual acuity and which often decide the right to qualify for a technical device. This qualification must instead be governed by observations of the variables "reading acuity" and "functional vision reading", which in many cases differ from measurements of visual acuity.

New technical developments support pupils with visual impairments both with respect to the possibility of learning and being able to participate in the classroom. However, working methods and appropriate educational software are still lacking to a certain extent. Further knowledge and resources are needed in order to utilise all the advantages of computers for optimal learning for the reader with a visual impairment.

_A changed teaching and learning environment_

For children with profound and severe visual impairment, the teaching environment has undergone considerable change during the last two decades in Sweden. During that time the only special school for pupils with visual
impairments without additional impairments was closed down and ordinary schools in the child’s own local authority had to take over the Government’s responsibility. The new situation puts new questions at the forefront. The old answers about how pupils with severe visual impairments learn to read are only partly relevant as the conditions in the teaching environment have changed and also the recommendations about reading medium for different groups. For pupils who with profound and severe visual impairment, the ten-year special school has been changed to nine years with a timetable, which has fewer teaching hours per week. In a shorter time, therefore, the pupil has to cover the courses of compulsory school and, often, also obtain the individual compensatory training (orientation and mobility training for instance) included in the school day. In addition, all research shows that it takes a longer time for pupils with visual impairments to carry out schoolwork. This is an equation that does not agree. However, the solution does not lie in re-establishing special schools. To develop in a natural school and home environment is irreplaceable where skills such as reading ability can be connected to and used practically in everyday life. Not until then is learning experienced as meaningful, the incentive to achieve a reading competence which fulfils the individual’s needs and environmental demands. The focus must instead be on how pupils could get the opportunity to develop, at their own pace, from their own capabilities, in their natural environment, together with people who know about visual impairment and its consequences for learning.

Special education at ordinary schools has also undergone considerable change during recent decades. Concentration has shifted from “treating” the pupil’s shortcomings and difficulties in the 1960s to trying to find the reasons for the difficulties in the interplay in the pupil’s immediate surroundings and, in co-operation with the pupil, try to find the best kind of support. Nobody nowadays questions the school placement of braille readers as we have “a school for all”. This implies that “the school will arrange so that it is as well adapted for all pupils irrespective of their capabilities, qualifications and needs” (SOU 1998:66, p. 15, the author’s translation). This does not only put
large demands on the organisation at the administrative level but also on the
teacher in the classroom. Every teacher, in this educational/political intention,
ought to have good general knowledge about disability and the consequences
in the school situation (ibid.). What are the implications in the concept
"general knowledge" and are they sufficient in order to develop the potential
of the child/pupil with severe visual impairment, i.e. the zone for proximal
development, which Vygotskij (1978) describes:

“The zone of proximal development defines those functions that have
not yet matured but are in process of maturation, functions that will
mature tomorrow but are currently in an embrionic state.” (p. 86)

In teaching reading to pupils with visual impairments, knowledge is needed
about the similarities and differences in the reading process compared with
the sighted reader and also the consequences of a visual impairment when
carrying out different reading tasks. What demands can a teacher place on a
pupil’s performance? Where does the zone lie between too low expectations
and too high demands, the zone where the pupil’s development potential in
interaction with others exists? With this perspective, the knowledge and
actions of the school staff become decisive for the development of the pupil.

What kind of knowledge is offered to teachers over and above the
general, which he/she is expected to have and to what extent is it sufficient?
Further training is offered for a maximum period of three weeks to teachers of
braille readers and one week, at the most, for teachers of children with low
vision. Expectations and demands are great on the teacher without special
teacher training who has, for instance, a braille beginner using a computer
with braille display as a reading and writing tool and, at the same time, tries to
live up to the educational goal of inclusion (Paper IV). Specific knowledge is
required in this teaching situation and must exist constantly in the teacher,
who is close to the child, in order to be used at the right learning moment. This
specific knowledge cannot be replaced by a personal assistant to the pupil
without special educational training (Chapman & Stone, 1988; Tobin, 1993).

Where is this specific knowledge to be found then? Genuine knowledge
and experience of children/pupils with visual impairments exists in the
support organisation which has been established for the inclusive school system among advisers for children/pupils with visual impairments and resource centres at the exo- and macro-levels. However, the new tasks of the advisers are to work on a more overarching level by giving advice and support to staff in various management functions through further training and information. It is easy to imagine that the specific knowledge, which is needed so badly in the classroom, will be lost on the way with this organisation. Specific knowledge about visual impairment exists in a few schools in the classroom in the country, at the micro-level. It is found in schools where the local authorities have concentrated on trained special educationalists for children/pupils with visual impairments (Paper IV) and where it ought to be in order to making good use of the child’s “zone of proximal development”.

The home is another important teaching and learning environment for the child. The home environment gives rise to the foundation for reading and writing development of the child already before school starts. When school system changes the role of parents is also affected. Other insights and competence are demanded from the parents of children/pupils with visual impairments. Thus the studies have shown those difficulties which can arise when the child does not spontaneously take the initiative to “play read” or “play write” which is so natural for most sighted children. The initiative lies with the parents if the child is to come in contact with written language. In many cases the tools are not available in order to make the child curious about letters in a playful way, for example, when it concerns braille or enlarging text and pictures with CCTV. Another difficulty is judging when the child is receptive for play with reading and writing if the child does not take the initiative (Brodin, 1991, 1999). In study IV where pre-conditions and knowledge existed for play with words with the help of a computer, interest for written language was awakened later than expected in the children. It is, therefore, a sensitive task exposing the child at the right moment and on the child’s conditions so that the encounter with written language becomes positive and fun. In this process parents need support from people who know about this situation and also further training themselves about reading and
visual impairment. Later when the child is of school age and can read, it has been shown that many children experience that their reading is not talked about at home (Paper III). This applies above all to braille readers and CCTV readers, a result, which further emphasises the importance of increased awareness about the pupil’s reading situation in the home, increased support and further training for parents.

Concluding remarks

The studies in this thesis of pupils with visual impairments and their reading situation in mainstream education have revealed many factors, which lead to implications at school, home and for supporting activities. The basis for these implications is the relative concept of disability where the extent of the problem for a reader with a visual impairment is related to the person’s capabilities and the reading demands in his surroundings. A visual impairment is then defined as a reading handicap when a person, able to read, does not have access to text in the appropriate medium or appropriate format, when necessary reading and writing devices are not available or reading must take place in a badly adapted reading environment. Visual impairment can cause a reading handicap if the criteria for society’s order for technical devices and environmental adaptation is based on measured values of visual acuity, in the ordinary manner, instead of assessment of the child’s/pupil’s functional vision. A reading handicap caused by visual impairment could, therefore, be reduced with the help of more knowledge and taking sensible action. There are, however, vision related reading difficulties that have their basis in biological factors. With progressive diagnoses, where visual ability successively decreases, reading difficulties arise before the pupil has learnt to read using another modality, e.g. tactually (Papers I and II). For pupils with cerebral visual impairment (CVI) and additional impairments caused by neurological damage, reading ability can be difficult to achieve. The reason, in these cases, can probably be attributed to the biological damage (Paper V).

Irrespective of the cause of the visual impairment it is important when meeting the child/pupil to have a flexible approach and try all the means which are available to give the child/pupil a chance to acquire reading and
writing skills. Every child has his/her functional level from where optimal
development is possible with the appropriate measures. In order to arrive at
these appropriate measures an integrated medical, neuro-psychological and
educational expertise is needed in many cases. This assumes that the
educational programme is based on a thorough investigation by a
multidisciplinary team. It also assumes that the investigation is followed up
by people with specific competence within the official support facilities run by
the municipality, the county council and the State, in close co-operation where
roles and questions concerning responsibility are clearly defined. Pupil and
caregivers must participate in all decisions regarding recommendations for
technical devices and with planning educational programmes. These
programmes should always have the functional vision of the child/pupil as
their basis. Old criteria must be reassessed if new groups of children with
more complex malfunctions, who are currently attending ordinary schools, are
to have the opportunity of learning to read and write.

Children/pupils with visual impairments need to be exposed to text and
work with it more often than sighted children in order to improve their
possibilities of developing good reading ability. This already applies at pre-
school. An increased awareness about the significance and need for reading
training implies, at the same time, an increased awareness of the stress many
children/pupils with visual impairments are exposed to in the reading
situation, even in an environment which has been adapted for reading. In
addition there is the time which the pupil needs in order to carry out the
normal work in the class. For the reader with a visual impairment to find
enough time is a considerable worry. The situation has a tendency to be a
"Catch 22" where the conditions for achieving a good result are in conflict
with one another. Planning and interaction between the child/pupil and the
adults in such a situation is decisive for the child/pupil to manage a little extra
effort. It is a sensitive task to balance demands and expectations on the
child/pupil and the conditions, which exist for development, a work, which
requires competence. The competence is specific and cannot be a part of the
general competence, which a regular class teacher has, regarding disability.
Competence in the classroom must, therefore, be strengthened with special educationalists possessing specific knowledge of visual impairment. Only then pupils with visual impairments are offered the same opportunities for development as sighted pupils in mainstream education.
SVENSK SAMMANFATTNING


Det övergripande syftet med denna avhandling är att öka kunskapen om lässituationen i skola och hem för elever med olika grad av synskada och finna både individ- och miljörelaterade faktorer som påverkar en gynnsam utveckling.

Genomgående frågeställningar är:
- Vilka likheter och skillnader finns mellan seende elever och elever med synskada avseende läsning av olika texttyper, läsvanor och läsintresse? (Artikel II, III)
- Hur ser variationen i läsförmåga ut inom gruppen elever med synskada i relation till synförmåga, läsmedia och läshjälpmedel? (Artikel I, II, IV)
- Under vilka omständigheter orsakar synskadan ett läsproblem? (Artikel I, II, V)
- Vilka faktorer kan identifieras i lärandemiljön som gynnar barnets möjlighet till en optimal läs och skrivutveckling? (Artikel I, III, IV, V)

För att finna lämpliga rekommendationer på läsmedia och läsätt och därtill anpassade undervisningsmetoder behövs både medicinsk, neuropsykokologisk
och pedagogisk kunskap. Barnets förutsättningar måste också relateras till den lärande miljö som finns i skola och hem. Dessa är i sin tur beroende av samhällets människosyn och kunskapssyn. Sampelet mellan de individuella förutsättningarna och omgivningen är avgörande för att barnet med synskada ska ges möjlighet att nå läskompetens dvs en kompetens som motsvarar egna läsbehov och omgivningens läskrav.


utvecklingsprojekt initierat av SIH och TRC. Eleverna i projektet var
nybörjarläsare i punktskrift på olika nivåer och utrustades med datorer med
punktskriftsdisplay för att stimulera läs- och skrivutveckling, ett strategiskt
urval. Den femte artikeln är en fallstudie av fyra barns läsinlärning med olika
läsmedia under två år. Barnen valdes utifrån gemensam ögendiagnos
(hjärnsynskada, CVI, orsakad av periventrikulär leukomalasi, PVL) men var
för övrigt olika i många avseenden för att öka kunskapen om variationen inom
denna diagnosgrupp.

De fem studierna, med sina olika upplägg, ger både en överblicksbild av
elevernas läsförmåga och läsvanor och en närbild av utvecklingen av
läsförmåga under en längre tid i klassrummet. Data för att belysa de
övergripande frågeställningarna har samlats in med olika metoder:
- Läsobservationer med hjälp av videoinspelningar (artikel I, IV och V)
- Läresresultat vid textläsning från läsundersökning utförd tillsammans med
klasslärare (artikel II och III)
- Semistrukturerade lärarintervjuer (artikel IV och V)
- Lärarenkäter (artikel II, III och IV)
- Lärares dagboksanteckningar från undervisningen (artikel IV och V)
- Elevintervjuer (artikel III, IV och V)
- Föräldraintervjuer (artikel V)
- Enkätuppgifter från konsulenter vid SIH (artikel II, III och IV)

Resultat

Artikel I: Reading competence of visually impaired pupils in Sweden.
Tre grupper av läsare med synskada identifierades i denna studie:
- kompetenta läsare som klarade att läsa i olika situationer både i skola och
  under fritid
- svaga läsare som hade svårt i alla lässituationer
- osäkra läsare som klarade en enkel text men inte de läskrav skolan ställde.
Varken synskärpa eller läsmedium, läshjälpmedel eller läsavstånd visade sig
vara den avgörande faktorn för att utveckla god läskompetens. De goda
läsarna visade högre kognitiv förmåga och större läsintresse än övriga.
Särskilda insatser för att öka de osäkras läskompetens till de goda läsarnas nivå diskuteras.

Artikel II: Swedish 9-Year-Old Readers with Visual Impairments: a Heterogeneous Group

Vid en jämförelse vid läsning av olika texttyper mellan seende läsare i årskurs 3 och läsare med synskada visade det sig att ca 22 procent av de synsvaga läsarna klarade läsningen med vanlig skrift i skolan lika bra som de 50 procent bästa eleverna i en normalklass. Men det fanns också en större grupp elever som hade mycket stora svårigheter att orka med klassens tempo och läsmängd (ca 28 procent). Trettio procent av läsarna med synskada hade svårigheter med antingen koncentration, blev fort uttröttade, gnuggade ögonen eller ville ge upp. Bland de svaga läsarna fanns även elever som enligt lärarna visade prov på vanliga läs- och skrivproblem bortsett från synskadan (10%). Lästestet låg på en alldeles för hög nivå för 16 procent av eleverna som därför avbröt läsprövningen. Tilläggshandikapp, svag begåvning och språkproblem var i de flesta fallen orsaken till att de var tvungna att avbryta. Variationen inom gruppen elever med synskada visade sig stor vilket ställer höga krav på kunskap hos dem som ska handleda lärarna i skolan.

Artikel III: Reading Environment at Home and at School for Swedish 9-year-old Students with Visual Impairments

I denna artikel behandlas elevernas svar på de enkater om läsvanor och läsintresse som ingår tillsammans med läsprövningen i årskurs 3 i Stockholmsundersökningen samt motsvarande lärarenkät om undervisningsmål och metoder. Frågorna i elevenkäten ställdes som intervjufrågor till eleverna med synskada. Svaren från de båda grupperna jämfördes med seende elevers och deras lärares svar. Svaren visade att läsmiljön i skolan inte skiljde sig mellan elevgrupperna men däremot i hemmet. Den största skillnaden fanns i interaktionen med familjemedlemmarna, särskilt för läsare som läste punktskrift eller med förstorande TV-system. Uttalat synsvaga elever hade enligt egen utsago
mindre erfarenheter av bokstäver och text än andra läsarkategorier bland de synskadade vid skolstart och bör därför uppmärksammagas ytterligare.

Artikel IV: Evaluation of Computer-based Education for Young Braille readers in Mainstream Education


Artikel V: Reading Strategies in Children with Cerebral Visual Impairment

Fyra barns läsinlärning studerades under två år. Samtliga barn hade en normal eller god verbal förmåga men olika grad av visuo-spatiala problem. De visuellt perceptuella problemen tar sig uttryck i att barnen har lättare att se enstaka symboler än symboler av samma storlek på rad (crowding-fenomen).

Två barn med tillräckliga synrester för att läsa vanlig skrift följdes i vanlig nybörjarundervisning i sin hemskola. De utvecklade under projekttiden olika strategier för att läsa långa ord. Den ena eleven gissade slutet av ordet, den andra ljudade bokstäv för bokstäv. De utnyttjade emellertid båda contextuella ledtrådar vid läsning av löpande text. I de två klasserna förekom olika metoder vid läsinlärning vilket skulle kunna förklara elevernas olika strategier vid läsning av långa ord.
De andra två barnen rekommenderades att även läsa punktskrift för att hitta ett alternativt lässätt på grund av lägre synskärpa och svårare crowding-effekt. Ett av dessa barn hade redan gått två år i skolan och lärt sig läsa vanlig skrift med hjälp av CCTV och lyckades mycket bra att även lära punktskrift under de två projektåren. Även denna elev använde sig av contextuella ledtrådar vid läsning av långa ord i meningsfull text. Hon använde samma strategi både i punktskrift och vanlig skrift. Det andra barnet hade flera funktionshinder på grund av en CP-skada och var rullstolsburen. Försöket med punktskrift gav inget positivt utfall under den korta projekttniden. Läs- och skrivsätt med vanlig skrift med hjälp av dator och multimedia visade däremot en väg till framgång. Utgifallet beskrivs och diskuteras i artikelns både med avseende på barnens läsprestationer och lässtrategier efter två år samt undervisningsmiljö och metoder. Ytterligare forskning med inriktning på läsinlärning för barn med cerebral synskada och normal begåvningsnivå behövs för att klargöra både de biologiska faktorernas och undervisningsmiljöns betydelse för läsframgång i ett längre perspektiv.
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Kerstin Fellenius’ thesis Reading Acquisition in Pupils with Visual Impairments in Mainstream Education gives an overview as well as a close-up of the reading situation for pupils with visual impairment in the regular school system.

Children with blindness or profound visual impairment learn to read braille in the regular local school today, taught by the ordinary class teacher since the special school was discontinued in 1986. The larger group of pupils with low vision have always participated in the regular school system using ordinary textbooks together with more or less advanced optical devices. In five studies reading acquisition and reading ability of pupils with visual impairments of different degrees and reading media (braille and print) have been focused.

With regard to their reading performance, the readers with visual impairments have been divided into three groups. About one quarter of the population was average or high achievers, another quarter extremely low achievers, irrespective of visual acuity, reading media or reading devices. In most cases, additional impairments, intellectual impairment or language problems caused low achievement. The largest group, about half of the population, consisted of readers who were able to read but demonstrated difficulties in other ways. The author concludes that a large group of readers with visual impairments need an adapted reading program from the start in order to use their inherent potential ability. The competence in the classroom must be strengthened with special educationalists with specific knowledge about visual impairment. Only then the pupil with visual impairment is offered the same opportunity for development as sighted pupils in “a school for all”.

This thesis will be of interest to students, parents and school personnel and professionals in the field of habilitation of children and young people with visual impairments.