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# Learning Is Visual: Why Teachers Need to Know about Vision

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## Abstract

This chapter adopts an integrative literature review to describe and analyze theories and empirical research on visual development, impairment, screening, and intervention. The purpose is to inform teachers on how to influence students' education and social growth through understanding vision. Vision is especially essential for reading, accessing classroom materials, and learning. Yet, in many countries, vision problems in children are not assessed and thus not treated. The negative consequences for individuals and society are often significant. Though there is an abundance of eye health specialists in developed countries, not all visual problems that influence learning and reading are screened or treated effectively. This is worse in developing countries where eye health infrastructure often is lacking. Even screening and treatment given through the eye healthcare system is not always sustainable, since regular follow-up is lacking. The literature review shows that vision is a developing sense important for learning and that teachers can screen children's vision and support visual development. It can be concluded that every child in the twenty-first century school should have teachers with knowledge in vision. An example of a higher education initiative is presented to illustrate possible further education for teachers in the area of vision.

**Keywords:** visual development, stimulation, learning through vision, vision screening, teacher education

## 1. Introduction

The world is changing rapidly, and the necessity for good functional vision is greater than ever. Education is essential for the individuals' overall life quality and for personal, social, and occupational development. Societies depend on it for economic growth and democracy. Recent research revealed how important good vision is in all learning- and for all academic-related tasks. In classrooms around the world, visual inputs are involved up to 70% of the time [1], so even tiny disturbances can result in a lack of important information.

Unfortunately, not much has changed since Rogers, in 1924, claimed that the importance of vision in reading and writing is often overlooked [2, 3]. Even today few teachers have any special knowledge about the visual functions and vision disturbances [4] or how they affect learning, the development of motor skills and cognitive capacities. Reading is a particularly significant vision task depending on good visual acuity (VA) for detecting all the tiny details in a text. In addition, it

relies upon an intact functional visual attention span in the visual field (VF) for getting an overview of the next letters, the words to come, the end of line, and from where to continue reading the next text line. Vision is not a passive sensory system that is only receiving inputs; it is also an active and complex motor system that is continuously moving. The eyes must coordinate to fixate on the same spot, move around to different areas for searching, while the lenses adjust to the ever-changing locations. The goal is to give the brain clear inputs, no matter the distance. During reading, the gaze must jump precisely and should be coordinated from one fixation point to the next and adjust to the light level of the actual surrounding. This complexity indicates why vision must be considered in teaching [5–7]. There is no doubt that literacy is the foundation of almost all education and probably the most important skill to have in the twenty-first century, and this skill starts as a visual process. Thus, when children have problems with their vision, they may not be able to succeed in school [8].

Visual impairment is classified extensively by the International Classification of Diseases, ICD-11 [9]. Although the criteria are health classifications, many countries use them very strictly as eligibility criteria for educational services by the teacher for the visually impaired or blind. In most cases, only a significantly reduced VA and/or a VF loss after correction of refractive error will lead to services [10]. What is often not understood is that vision plays such an enormous role in learning, that even milder problems, which are frequent among children and youth must be considered in school. These problems will be the focus of this chapter. Several vision disturbances, not just decreased VA and VF, have a negative influence on the academic work, sports and leisure activities, and general learning. Such “milder” visual problems are often not addressed even in countries with a highly developed eye health-care system, although many children exhibit them [11]. If these problems are not identified, the children are left without treatment and sometimes even the wrong explanations are given for their learning problems. This may result in frustration, low school results, and a reduced self-esteem. Thus, regular vision screenings may be necessary in finding out whether children have the visual capacity to learn. Screenings are done by eye health professionals, but school-based vision screenings by trained teachers have shown to be effective [12–14].

In this chapter, we will describe and analyze the relationship between vision and learning, the implication of visual problems on reading, and how teachers can screen their students’ vision more comprehensively and make interventions as necessary. It begins with (1) an introduction and the description of the methodology we adopted. This is followed up with (2) our inquiry about the relationship between vision and learning, (3) the impact of visual disturbances on reading, and (4) screening and intervention of visual functions through teachers. The chapter concludes with the description of a Continuing Professional Development (CPD) course based on the theoretical framework and results of this literature review.

## **2. The integrative literature review methodology**

The theoretical framework of the literature review is based on teachers’ understanding, identification, and intervention of children’s vision and vision screening. Literature sources from various disciplines such as neuroophthalmology, ophthalmology, optometry, education, visual impairment, vision sciences, and vision rehabilitation were used. A thorough integrative literature review approach [15] was conducted to explore the relationship between vision and learning, the impact of

impaired visual functions on learning, and the reasoning for visual screening and interventions conducted by teachers. In general, a literature review is well suited to review the theories and evidence that exist in a very specific area, such as the role of vision in learning. In addition, a literature review is helpful to provide an overview of the topic. This also seems important since there appears to be a knowledge gap about the relevance of intact visual functions in learning. A literature basis can also be a foundation for the development of a model for new theories and practices. It will be investigated in this chapter whether a new model of teachers' screening and intervention can be derived from the literature review. However, in order to be more specific, it was necessary to narrow down the very broad method of a "literature review." An integrative literature is described as.

*Most integrative literature reviews are intended to address mature topics or new, emerging topics. In the case of mature topics, the purpose of using an integrative review method is to overview the knowledge base, to critically review and potentially re-conceptualize, and to expand on the theoretical foundation of the specific topic as it develops ([15], p. 336).*

The new emerging topic that we would like to address is the greater emphasis that schools and teachers may possibly have in the area of prevention, screening, and intervention of vision problems. We altogether viewed 65 sources, from the years 1901–2020 using various databases and search engines, using keywords such as vision, visual development, visual stimulation, vision screening, and vision screening in schools. The sources were analyzed by the themes established in the introduction, namely, the relationship between vision and learning, the impact of vision problems on learning, and screening and intervention.

### **3. Inquiry into the relationship between vision and learning**

Teachers and other caretakers of children may largely impact on the development and remediation of visual capacity. An analysis of the process of visual functioning, description on the relationship between visual development, and stimulation and how structured teaching improves some visual problems are of importance for conducting visual screening and for the possibilities of teachers to intervene when children do exhibit visual problems.

#### **3.1 Complexity of visual functioning**

Increased knowledge in neurology, anatomy, and psychology has provided new insight into the complexity of the visual sense (e.g., [16–21]). It is evident that visual functions such as a clear VA at near and far for seeing details and object together with the ability of noticing people, objects, and movements in the VF are essential for being able to function in our surroundings. A single image on different distances is reached with a functional vergence-convergence where the eyes stay parallel when looking at a point far away and turns more and more inward, converge, when fixating an object that comes closer. At the same time, the eye lenses must change their form, accommodate, for bending the light waves to fall on the central part of the retina. Only then the image is seen clearly respective to the distance. This accommodation function can be compared with a lens in a camera which also has to change its form due to the distance for the focused object. Convergence and accommodation are closely connected and must function coordinated and easily when the eyes are tracking and scanning on different items and objects of interest at far or near. These



functions are developing throughout childhood in response to stimulation and activation. This development is going on until children are in their teens [22].

Researchers have shown how cognition can influence vision by selectively directing the gaze to special elements of interest [23], but first of all, vision provides us with information about the world around us. Intact visual inputs are, among other things, a prerequisite for motor activities, higher level visual abilities, and the cognitive development. Clear visual inputs are necessary for fundamental visual perceptual skills, that is, identification of objects and people and for concepts of same—different, comparing, sorting, matching, catching, reading, and writing.

### **3.2 Visual development and stimulation**

In order to support the development of vision, children need an environment and activities which stimulate their senses, including their visual sense, from an early age on. Visual capacity is often taken for granted, although as we pointed out, it develops through childhood and also during the years in primary school. Children should be engaged in visual activities together with their caretakers and teachers from a very early age on. Words should accompany objects and pictures. When pointing to pictures shifting from close or far, the child is training accommodation and convergence, steady fixation, and saccades (the gaze jump from one position to the next) together with eye-hand coordination. This can be strengthened by entering a dialog of sounds and words, pointing to interesting features of pictures, comparing and naming objects of different sizes and perspectives, and imitating sounds of animals or cars. Making reading with children as part of a routine is a reciprocal and bonding experience between children and their caretakers [24]. Such activities can be the inspiration for children to draw or do other eye-hand activities.

Children should be encouraged to “look” at elements in their environment and become aware of their surroundings, of the natural and man-made environments, of differences between things they encounter such as flowers, plants, animals, colors, objects, shapes, etc. Teachers should have conversations with children about what they see and stimulate their visual perception, visual discrimination, and visual memory in different ways through games and structured exercises with a variety of age-appropriate materials. Especially, preschool teachers can include a number of activities that are stimulating and supportive of the visual system based on the abilities of the child. Puzzles, memory games, and building with blocks with and without models can give a good foundation for visual development. Children should do activities that stimulate their near and distance vision: They should be involved in coloring with crayons at near but should also play ball with friends from a distance. During the past years, more emphasis worldwide has been put on “digital learning” and the use of computers and tablets in preschools and schools. Although digital media can be used successfully in many different areas of life, there are reasons for caution of their increased use, particularly in preschools. Interestingly, many executives of technology development in Silicon Valley, one of the main centers of global digital development in the United States, seem to want to educate their children in a “device-free” school program, such as the Waldorf Schools [25]. As experts in technology development, they also seem to know the limits and even dangers of their products on child development. In addition, more and more children and students turn myopic because of all the near work done on screens [26].

Children need direct interaction with the material world to develop concepts. They need to touch, see, smell, grasp, and reach for real objects and have real experiences in the world surrounding them. Only then can they develop crucial vision, visual attention, and visual motor skills. If they have a firm grasp on

those more concrete experiences, they can move on to more abstract visual concepts such as letters and numbers.

### 3.3 Vision problems and teaching

Research that was originally conducted with visually impaired students and with people who suffered vision loss after brain injuries show that “vision” is a learned process thus can be improved through structured teaching. Such knowledge is valuable for all educators and should have consequences for our education systems.

*Natalie Barraga* [27] was the first vision teacher who carried out research in relation to structured visual education in order to teach children with a visual impairment to use their remaining vision better. She developed exercises focusing on visual discrimination and recognition using objects with different sensory qualities: size, figure, contrast, and color. In her lessons, she taught children to discriminate and reflect on forms and objects and connect the forms to their surrounding objects. Her findings revealed that structured vision education increased the childrens’ functional vision and resulted in more visual effectiveness.

Later research confirmed that visual qualities like VA, the attention in VF, and different ocular motor functions including accommodation and convergence can develop through structured learning [28]. *Gislén et al.* [29] were impressed of the VA capacity that the pearl divers showed under water, but afterward they trained some Swedish children who rather quickly reached the same underwater VA level. Behavioral optometrists have focused on children with eye motor disorders and have shown how better eye movements trough structured procedures also improve the VA at near and distance [6, 30–33].

*Walter Poppelreuter* [34], a psychologist and medical doctor, developed vision rehabilitation strategies for soldiers suffering from vision problems after gunshot wounds to their heads during World War I. Soldiers with reduced VF, the area of vision outside the fixation, learned eye movement techniques as compensation strategies [10]. These experiences laid the foundation for rehabilitation of vision problems following neurological disorders like stroke or traumatic brain injuries [7, 35, 36]. *Cyvin and Wilhelmssen* [37] demonstrated how a girl with brain damage got better balance and motor functions parallel to improved binocular vision.

All visual sensory and ocular motor functions are connected in a visual circle where the eye motor capacities influence sensory and perceptual functions and vice versa [38]. Tiny eye motor disturbances may affect concentration, attention, endurance, social communication, reading and writing, and motoric activities and have a negative influence on the ability to manage assigned tasks [33, 39]. Even communication with others is to a large degree visually mediated. Not only is the written communication visual, but we also use nonverbal communication when facial expressions and body language interpret the message we want to send. Therefore, increased vision will even positively influence social behavior and motor activities which rely on visual inputs [10, 37].

The conclusion that many visual functions such as VA, VF, accommodation, convergence, and ocular motor control are important for receiving clear visual inputs in learning and communication can be drawn from the discussion above. Thus, this importance for learning needs visual screenings to be comprehensive and inclusive of all visual functions involved in learning. In addition, vision is a developing sense; for it to thrive, it needs a stimulating environment provided by teachers and other caretakers. However, evidence from the literature show that visual function problems can be improved through intervention. Yet, most school vision programs however do not screen for all those visual functions mentioned, although their impact on academics, particularly reading, is significant [40].

#### **4. Impact of visual problems on the reading process**

When learning to read, the first important activity is to learn the sounds connected to the visual forms of each letter and how to combine sounds and form them into words. Visually, there is a need of being able to see the difference between a **t** and a **f** or depart an **o** from an **e**. This requires good VA for distance, so they can see the blackboard clearly and a good accommodation capacity and convergence for clear near inputs. For being able to read the letters in the correct order, the eyes need to focus together on the same spot. If not, it is difficult to decide if the word is **follow** or **flow**, **spot** or **ptos**. Letters will be turned around, or if the fixation is unsteady, they will even be seen jumping around. For children with ocular motor disturbances, the same word may appear differently during each time it is seen.

This phase is followed by a period where reading develops and turns into an automatic process where the child can read for learning [41] and understand the meaning of the texts. The child must develop a strategy where perceiving the text turns automatic, without great effort [42]. This level may be difficult to reach if vision is a challenge. Some can manage for a short time, but then the vision system is worn out and the text turns blurry or double.

Seeing the text clearly is of fundamental importance and requires a good VA. VA tests are presenting letters, numbers, or symbols with smaller and smaller sizes on each line down the chart. The most common tests are normally the distance VA tests carried out on 6 m or 20 ft, although some used for children are standardized for 3 m. If the line marked 6/6, 3/3 or 20/20 is seen from the actual test distance, the VA is normal. Full VA means that the symbols expected to be seen at 6 m, 3 m, or 20 ft are seen on this distance and noted as 6/6, 3/3 or 20/20 or as decimal number 1.0. If the 6/12 line is the last line seen, the vision is in decimals 0.5, which is the border line for the category of visual impairment in ICD-11 [9]. Then symbols that were expected and seen at 12 m (40 ft) are seen at 6 m (20 ft). For reading from the blackboard or seeing objects clearly from a longer distance, it is important to have good distance VA. Students with problems seeing objects far away are often near-sighted, having myopia [42].

It is important to remember that a normal distance VA is no guarantee for a clear VA at a reading distance. Therefore, it is also necessary to screen the near VA separately with a VA chart developed for 40 cm or 3 ft. It is a harder ocular motor activity to see clearly at near because the lenses need to adjust, or accommodate, and more and more the closer they must focus. Children with accommodation problems will perceive the text as foggy or blurry at near. Because the regulation of the lens is muscle work through the ciliary muscle in the eye, some children may lose the power to keep the accommodation over time. After some minutes, it will be demanding and tiring to continue reading [42]. A near VA test can show if the child has accommodation problems, a hypermetropia. The new ICD-11 [9] also categorizes a near VA as a visual impairment, if it is less than 0.5. This criterion is new compared to previous classifications. Together with testing the accommodation ability, the near VA test is an important predictor of visual discomfort for reading and other near activities [43].

The VA tests are done monocularly, with each eye alone, and binocularly, with both eyes together, to see if each eye has a good VA and if they function well together. When looking at something in the distance, the eyes normally stay in a parallel position and the eye lens has a relaxed shape. When looking at something closer, both eyes must not only accommodate, but also converge inward to fixate on the same spot. If the eyes are not fixated on the exact same spot during reading, double images will occur. Disturbed convergence is a binocular problem [6]. Students who struggle with double vision, will sometimes unconsciously suppress the visual inputs from one



eye and only depend on the information from the better eye. The suppressed eye will turn into a so-called “lazy eye,” with reduced VA [42].

The classic treatment of an amblyopic eye is to patch the good eye for hours each day, so the weak eye is used and stimulated [44]. The result may be two eyes with a good VA, but they will not always function well together—an ability that is essential for reading. Students may manage near-work in school if the letters are large and the reading time is limited. But they can have problems with reading, when the letters are smaller, the text gets longer, the line space is reduced, and the period of reading increases. The text may turn unclear and double and the eyes may even hurt. Some are then even rubbing their eyes or turning very sleepy.

The measured VA gives only information about the very central area of the vision where the gaze is fixated. The VF around the fixation point informs about the surroundings and what is happening there. This visual information tells the brain where to look next, what to be aware of through colors, forms, and movements. These signals are catching our interest and attention, and we move the gaze to new places for seeing the details clearly. Even in reading, VF is important. It contributes to the reading speed and reading flow. Only the awareness of the entire picture of the text can give information about what is coming and where the gaze must continue. With this information, the brain prepares where to place the next fixation. The gaze jump, or saccade, normally places the next fixation in the first part of the next word. Reading consists of continuous new saccades and fixations, and during this eye motor activity, the eyes must work well together to prevent double images [6, 42]. This shows how essential well-functioning binocular activities are for effective saccades and fixations during reading [45].

There are more accommodation challenges among school children than previously known [33]. In a group of nearly 400 schoolchildren, between 8 and 15 years, only 54% were found to have normal accommodation and convergence [46]. These are serious findings due to the connection between ocular motor disturbances and reading difficulties [41, 47]. Often, children with such problems receive refraction with plus lenses to relax the lens and to make text appear larger. However, this treatment may help children to overcome their accommodation problem but not necessarily their binocular disturbances [42]. So, prescribing glasses is not always enough or the best help for their visual reading challenges [48]. To train and strengthen the accommodation capacity on the other side has shown a good and long-lasting effect on reading [6, 10, 49]. Strengthening the ocular motor control and capacity will give better visual sensor qualities, especially the VA increases through better accommodation and steady fixation [10, 33].

The evidence theme that is emerging from this paragraph is that reading is a highly complex visual activity which relies upon intact visual functions. Some visual functions can be improved with eyeglasses, but not all. In terms of learning, it appears that many different visual functions have to be checked and also that there has to be some awareness of teachers that these functions are important. Otherwise, they may miss important signs of their students to indicate a visual problem. In addition, there is also the question what other types of intervention are identified by the literature if glasses are not the sole solution for visual problems that children may exhibit during learning [3, 22].

## **5. Screening and intervention of vision problems in school**

The functional consequences of a vision problem are often misunderstood and may be interpreted as signs of dyslexia or attentional disturbances [6, 22, 50]. Because vision inputs are so fundamental for the learning and reading process,



vision should be checked regularly. There is even an increase in vision disturbances through the years in school [51]. Children themselves are seldom aware of their vision problems, so several states in the United States have rules for checking childrens' vision during the years in school [52].

Teachers can learn to screen VA for near and far [4, 14] and other visual functions in their classrooms and identify visible eye health problems, for example, changes of the eye appearance, eye movement problems such as eyes moving in different directions and squinting. However, often the vision screening is incomplete, not addressing those latter problems [40]. Metsing et al. [13] also point out that in vision screening programs around the world, there often is a priority to identify problems related to distance vision to detect amblyopia and related problems, such as strabismus, in preschool children. Accommodation and convergence are often not screened for even though those functions are very important for reading and writing in older children. An issue, however, is also about training of the screeners. Screeners need to be educated well to be able to screen properly for many visual functions and avoid high false-positive or high false-negative identification [13].

Early on, Rogers [3] was convinced that teachers would identify many pupils with vision problems if they were better observers. Signs like making mistakes with letters and figures, holding the text abnormally close or leaning forward when reading something far away, and complaining about headache or blurry vision are still signs that a teacher has to take seriously. They can observe and notice light sensitivities in their students and become alarmed if a student is copying from their neighbors instead directly from the blackboard. When students are easily bored of doing near work or read slowly, teachers could become aware that the student may have vision disturbances. Equipped with knowledge and skills, teachers can communicate their findings to parents and the eye health system and ensure that there is follow-through with recommendations.

Students with accommodation and convergence problems may need structured vision training of the eyes in order to improve their reading skills. Even though there is still controversy about the main cause of reading problems, whether they are phonetic or visual in nature, there is evidence that visual training does improve reading outcomes, especially in poor readers and even children with dyslexia [53–55]. This training is usually done by experts in the field of behavioral optometry. However, there may also be a lack of optometrists, ophthalmologists, and eye health-care workers in many countries, particularly in developing countries [56, 57], so children may not have access to such training. There is also evidence that teachers can be educated to systematically stimulate childrens' visual capacities in a structured way [42].

From the literature, it appears that particularly eye movement disorders, accommodation, and convergence problems are often not screened for in vision screening programs. This is true for many countries around the world. These problems also cannot be changed through glasses alone but may need more structured vision training to improve.

## **6. Results and discussion of the literature review**

In the next paragraphs, results and discussion of the results are presented. Each major result of the literature review is discussed separately.

*Vision is a learnt and developing sense and can be stimulated by teachers and caregivers to improve best developmental outcome.*

Possibly all teachers should have knowledge about the role of vision in learning as part of their education. Such information can be delivered through teacher training and continuing education programs for teachers. Just even greater awareness of the importance of vision may be important to provide better learning environments. Teachers sometimes can prevent visual problems if they offer a visually stimulating environment and pedagogy particularly in preschools. They can educate students, parents, and caretakers about the importance of eye health and intact visual functions. Especially in developing countries, parents may not know about the signs and symptoms of visual problems or eye diseases, such as conjunctivitis [58]. Teachers can also provide an environment that is conducive to learning, with good lighting conditions, for example, and materials that have universally good visual features in form and contrast, such as clearly legible materials. Improved teacher training in the area of vision may be an important prerequisite to higher academic achievement in children. This however requires governments to invest in Continuing Professional Development (CPD) courses and in teacher training at the preservice level in the area of vision.

*Academic learning such as reading can be negatively impacted by visual problems. Intact visual functions such as visual acuity, visual field, ocular motor control, accommodation, and convergence are necessary for learning.*

Even though there is debate about the role of vision in areas such as reading difficulties and dyslexia, evidence was provided in how impaired visual functions can have an impact on reading. Reading difficulties cannot be attributed solely on visual problems, however, when children do exhibit reading problems, a thorough screening and assessment should take place [59]. This requires teachers being aware of the effect of visual problems on learning. It also needs a functioning networking system where teachers can refer children to for screening and intervention.

*Teachers can learn to screen for visual functions. School screenings need to encompass all visual functions involved in learning, not just visual acuity testing for distance vision.*

In different parts of the world, teachers have been trained in VA screenings [4, 14], but screening for many different visual functions, evaluating the results, making decisions for further steps, and ensuring follow-through does not fully occur [40]. However, for teachers to be able to do this and become successful screeners, it seems obvious that they have to be trained well [60]. There are several questions that must be answered regarding the training and who should be trained. In many countries, teachers of the visually impaired/blind (TVI) teach children with visual impairments, that means children who have a VA loss or a VF loss after correction of refractive error. These teachers have a foundation of knowledge in vision. They, however, would have to undergo a role change in that they would not only be responsible for children with significant visual impairment due to VA and VF loss, but they would also have to get involved with children that may have problems in learning due to eye movement problems, accommodation, or convergence problems. It would need to be researched further whether ordinary classroom teachers or specialist teachers, such as teachers of the visually impaired, should be educated further to conduct a comprehensive vision screening for all children. The exact manner through which school-based screenings are organized is also dependent on the specific context and country. Historically vision screening was primarily done by eye health professionals, which is the medical sector. The medical and

educational system in a specific country would have to begin to work together in a more coordinated way, also to ensure valid screening results and follow up in children. The issue of false-positive or false-negative identification of children through screening by teachers when compared with screening results conducted by ophthalmologists is a concern. However, it appears that with training this can improve, and the benefits outweigh the risks [61].

*Teachers can learn to intervene when visual problems occur. They can network and collaborate with eye health-care providers. A child may need more structured vision training/intervention to improve vision for learning.*

The issue of intervention can be even more challenging. Children with significant visual impairment or blindness classified by ICD-11 (after correction for refractive error) usually receive services by a TVI and often are taught compensatory skills and receive alternative materials to print reading. Children who need correction for refractive error only receive eyeglasses.

As we pointed out before, some problems that affect reading can be ameliorated with spectacles, but not all. Eyeglasses which are important in treating refractive errors such as myopia and hyperopia are necessary in many cases. The World Health Organization estimates that globally over 1 billion people have visual impairment due to uncorrected refractive error [62]. However, eyeglasses do not solve all visual problems that impact learning, such as accommodation and convergence problems. Teachers need to come to realize that even though a child is wearing eyeglasses and has seen an eye doctor, they may still struggle visually and need a different plan of intervention. Even children who have had their eyes checked but did not receive glasses may still have vision challenges. Eyeglasses may also not be sustainable for many children, particularly those from families that lack the financial resources to see an ophthalmologist or optician on a regular basis. For example, in some African countries peer pressure, costs, and availability of optical services were identified as the main barriers to spectacle wear in children [63].

There is also controversy with regard to vision training or “vision therapy” as it is also often called. Usually, this training is conducted not by medical eye doctors or teachers but by optometrists. There is a continuous debate about the benefits of vision training besides the controversy about who should actually do it [64]. There is however a consensus that vision therapy does work for visual disorders such as convergence insufficiencies. This leads to reading problems and reading aversions [65]. Much of this chapter is focused on precisely those types of problems, namely, of both eyes working together, which can have adverse effects on learning.

Eye health professionals may not always realize the impact of vision problems relevant to learning. For teachers to begin to address childrens’ vision problems in the school setting, this also would require a whole system wide approach and again collaboration between the medical and educational sectors.

Methodologically, this study was an integrated literature review. This also poses some limitations of the study, mainly the question whether all relevant information and studies on the topics were included. Further studies using different methodologies should continue to explore the relationship between vision and learning and particularly the relationship between the medical and educational systems when it comes to the area of vision screening and intervention. This study aimed at opening the discussion about a possible model of training teachers in the area of vision. Further studies and research must occur to identify benefits and problems/barriers of teachers conducting vision screenings and interventions in schools. However, the results of this review could help to inform the design of such a model of teachers’ training, while taking also into account the country and regional specifications.



## 7. Conclusion

*Experiment and test out new ideas. The basic mode of classroom pedagogy today in most schools has not changed much for decades. It may be worthwhile to consciously create a culture and room for 'disruptive' ideas and technologies and test whether innovations and different approaches work better than the status quo ([66], p. 63).*

Teachers may need to take on a more active role in the prevention, assessment, and intervention in visual problems in children due to the role of vision in all academic activities.

Just like Sumra et al. [66], quoted above, this may be a somewhat disruptive "idea" since the educational and eye health systems must converge to address the visual problems that occur in learning. The eye health sector and the education system have to become partners in working together continuously for the benefit of children with visual problems. Future studies need to explore the exact mechanisms of such collaboration and respective roles further. In any case, more thorough training and education in the area of vision, vision screening, and intervention is a prerequisite for teachers so that they become competent in those areas.

Professional development courses may be a good vehicle to increase knowledge in the area of vision and learning in addition to advanced degrees and more research into this area of education. Collaboration between the education and the eye health-care system is fundamental for education in the twenty-first century, with educators taking the lead for vision-related problems affecting learning in school.

Before concluding this chapter, an example of a Continuous Professional Development (CPD) course in the area of vision is presented. This CPD program was originally developed at the Western Norway University of Applied Sciences in Bergen for teachers in Norway. This program then was taught to the primary school teachers and faculty staff from Patandi Teachers College in Arusha, Tanzania. In the last paragraph, the elements of the course are highlighted.

### 7.1 The CPD course, *Vision for reading and learning*

The CPD course, *Vision for reading and learning*, has been taught at the Western Norway University of Applied Sciences, HVL, to teachers in Norway since 2010. In 2016, HVL, was awarded project funds for the project, *Securing education for children in Tanzania (2017–2021)*, from the Research Council of Norway, NRF, in cooperation with Innovation Norway and NORAD, the Norwegian Agency for Development Cooperation. Project partners were Patandi Teachers College for Special Needs Education, Tanzania, and University of Applied Sciences in Koblenz, Germany. The project team included teachers of the visually impaired, vision specialists, social scientists, and engineers. The project aimed to contribute to poverty reduction in Tanzania through improved teacher training in the area of vision through the CPD course. Thirty teachers were educated in the 30-credit post-BA blended learning course *Vision for reading and learning* took place over a period of 2 years (15 students completed the course each year). Instructors from Patandi Teachers College together with the teachers and headmasters from primary schools participated in the course. They all held at least a BA degree or a MA degree from an accredited institution in Tanzania. Most of the students had a teaching endorsement in a special education category, such as visual, intellectual, or hearing impairment. The theoretical foundations of the CPD course consist of elements that were described in this chapter: sensory, attentional, and motoric aspects of vision [38]; principles from rehabilitation programs for vision problems following brain injuries [36]; vision teacher methodology [7, 27, 37]; and behavioral



optometry [6, 33]. In addition, age-appropriate pedagogical principles [67] were considered since students completed their practical training with children in selected primary schools. The goal was that the participants of the course were able to assess a variety of visual functions and plan and administer visual stimulation and education programs and/or refer children to health care, eye clinics, or optometrists for further assessment or refraction when necessary.

The course lectures and classes took place at the college, combined with periods of self-study, and were taught by professors from HVL, Norway, and Koblenz University of Applied Sciences, Germany. Four colleagues from Patandi College, who had successfully completed the first year with *Vision for reading and learning*, assisted in the second round of the course with lectures and hands-on supervision in the following year. In addition, a close 1:1 supervision was provided by professors and other professionals who had completed the course in Norway previously. The course content consisted of a challenging theoretical basis but also practical component. Students had to learn hands-on how to do assessments and tests and critically evaluate the outcomes and design intervention programs. Examinations were rigorous and aligned with the expectations of HVL. All participants passed the course and used their new knowledge and skills in various positions throughout the school system of Tanzania. All participants grew professionally from the course as it gave them new perspectives on childrens' learning and the important role vision has for education. The new knowledge also influenced the curriculum at Patandi Teachers College of Special Needs for all disciplines including preservice teachers. Currently, a vision assessment center is being developed at Patandi Teachers College to assess children in collaboration with eye health-care providers. In addition, Patandi Teachers College is now planning to conduct CPD courses about vision for in-service teachers throughout Tanzania.

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