Class break exercises to reduce visual discomfort and musculoskeletal pain in primary school children

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Class break exercises to reduce visual discomfort and musculoskeletal pain in primary school children

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Summary

Visual complaints, like myopia and visual discomfort, and musculoskeletal symptoms are commonly reported problems among Chinese school children. To reduce the development of myopia and visual discomfort, traditional Chinese eye relaxation exercises are compulsory in primary and high schools in China twice daily. The exercises are based on traditional Chinese acupuncture methods; students have to massage specially selected acupressure points around the eyes and neck. These exercises are a daily routine in China, however, there is little scientific evidence that these exercises are effective. Members of the Philips project team ‘Enhance performance and healthy development in Chinese schools’ are currently developing a new concept to make the current eye exercises more effective. The idea of the proposed new exercises is based on laser projected content which: (1) can simulate and stimulate distant vision, (2) can guide eye and body exercises, (3) can be used in a well lit classroom and (4) should motivate students to correctly execute the exercises. The aim of the present study was to improve these newly proposed exercises by gathering input about visual comfort and musculoskeletal symptoms through qualitative (study 1) and quantitative (study 2) research methods. It was hypothesized that performing body exercises and increasing the light intensity in the classroom can increase visual comfort, can reduce posture pain symptoms and can increase positive emotional status. To test these experimental interventions a methodology was set up and two separate experiments were performed.

In study 1 a five minute set of body exercises was created in accordance with recommendations of the physiotherapists. They indicated that exercises should be performed using opposite movements of the positions of the joints which are fixed during sitting. The set of exercises consisted of dynamic and stretching exercises to stimulate blood flow, and to relieve the muscles used when seated, from the static load produced by sitting. Through focus group sessions with Chinese interns experiences, opinions and needs about the current and proposed new eye- and body exercises were explored. In general, the participants experienced the current Chinese exercises as relaxed, boring and difficult to correctly execute. With the proposed new exercises it is important to keep the relaxed feeling, but to improve the engagement and to guide the students through the exercises. Several different exercise schemes should be designed to overcome the problem of boredom. The basic movements could be similar, but included elements can be changed. Physiotherapists recommended combining the exercises with a dance or song. In addition group interaction can play an important role to motivate children and to activate them more. These elements can differ every day to keep students motivated to move. Laser-guided exercises can be a useful solution to overcome the problems of a lack of motivation and unclear instructions. By following a projected image, children would automatically make the correct movements. In addition, projected images can be easily combined with playful games, group interaction or music to motivate students. If all these aspects will be further explored in the design of the ‘exercise recipe’ we expect promising results to optimize the current Chinese eye exercises.
In study 2 a methodology was set up to test experimental interventions on visual comfort, musculoskeletal pain, emotional status and motivation. Two visual discomfort induction tasks, a neutral task and questionnaires were designed. These tasks and questionnaires were validated in a pilot study with two samples: adults (N = 14) and primary school children (age 11-12, N = 15). It was found that the visual discomfort induction task, based on stressful visual characteristics proposed by Wilkins (1995), reduced visual comfort in adults and children. In line with our expectations, visual comfort remained on the same level after a neutral task. In addition, the internal consistencies of the visual comfort, musculoskeletal symptoms, emotional status and motivation scales were reliable.

The validated tasks and questionnaire were used to test two experimental interventions: performing a set of body exercises and increasing the light intensity in the classroom. In an experiment with primary school children (age 9-12, N = 20) we found that performing a set of body exercises in the classroom increased visual comfort and led to a more positive emotional status. These effects were not found after performing a neutral task. This is in line with studies of Balci and Aghazadeh (2003) and Henning et al. (1997) who found similar results on visual comfort comparing exercise breaks with continuing to work in their study of VDT operators. In contrast with the findings of these two previous studies we did not find a positive effect on the reduction of posture related symptoms in the present study. However, the task which was used to induce symptoms had little effect on musculoskeletal pain, and therefore participants started the exercise condition without many complaints. It is expected that a reduction of musculoskeletal symptoms will occur when children perform these exercises twice daily for a longer period, because of a reduction of the duration of static sitting (Murphy & Buckle, 2004). To test this, further research in the long term is recommended with a larger sample of children who are suffering from musculoskeletal symptoms. Nevertheless, the present study provided valuable insights of the positive effects of performing body exercises on visual comfort and emotional status.

In the second experimental intervention with primary school children (age 9-12, N = 20) the light intensity was increased from approximately 300 lx to approximately 1000 lx in the classroom. Against our expectations we found no effect of any of the measured variables. This is not in line with a study of Aarås et al. (1998) who found that visual comfort increased in office workers when illuminance settings changed from below 300 lx to more than 600 lx. However, in the present study the light intensity highly varied during the entire experiment due to unexpected environmental factors which were outside of our control. The optimal light intensity to increase visual comfort in children should be further elaborated upon in future research.

To conclude, we found that taking a short exercise break after a visual stressful task can improve visual comfort and positive emotional status in primary school children. This is a promising result which might help many children to make the school day more effective and comfortable. It will be a challenge to fully integrate the new exercise in the Chinese daily school schedule. However this study showed that a simple five minute exercise can already make a big difference in increasing visual comfort. It seems as though it does not have to be that difficult.
Preface

My final thesis of my study career is lying in front of you. Time for a recap…

Eight years ago I started the adventure, which is called studying. From a very small town in the southwest of Brabant, I moved to the big city of The Hague to study Human Kinetic Technology. For four years I spent my time on walking in my underwear and palpating different bones, muscles and nerves in all parts of the body, on wearing coveralls and safety glasses to develop new ideas in the workplace and on wearing sports clothing and breathing masks to measure oxygen levels during sport physiology classes. And yes, of course, I also spent some time in my bikini on the beach in Scheveningen. Besides this I had the great opportunity to do two awesome internships for which I moved to Malawi (Africa) and Maastricht (almost abroad). After getting my Bachelor of Engineering degree on my 21st, my mind was still in learning mood and I wanted to expand my knowledge of technology and the human body with knowledge of technology and the human mind. I left the so-called “beautiful city behind the dunes” (Jekkers, 1982) for the city “where the light always shines” (Meeuwis, 2003), and started my ‘second’ student life studying Human Technology Interaction. Here I spent my time on studying technical and psychology related courses, on writing lots of essays, and on exhausting students with intensive tasks in experiments. Besides this I expanded my experiences abroad with organizing a study trip to Argentina and by studying a semester in Sweden. In addition, I developed several organizational skills by joining different committees, and I learned how to play squash and to drink beer.

Unfortunately my study career is almost over. So after these eight years of studying, what will I do now? Or what everybody always asks: “What do you want to become?” I always try to explain people what study programs I follow and what types of jobs I would like to do. In the beginning I gave a thorough explanation, but now I prefer the short version: something with technology, health and human behavior. When my grandfather asked me what I would be after finishing my master I told him: “I will become an engineer”. To which he replied: “You don’t look like one” (up until now, I still don’t know if that was a compliment). So this description might also not be the best one. But then, one of the children who participated in the experiment of the present study got me thinking by asking me: “Miss, are you an inventor?” First I started to laugh and I wanted to say that I wasn’t. But then, I thought about it, and responded: “Yes, maybe I am”. During the last eight years I learned how to design and develop solutions, and how to test these in lab- and field studies. In my opinion that sounds quite like the description of an inventor.

Many people helped me to become what I am now. First of all, I would like to thank my parents, who always supported me to follow my dreams and ambitions. Besides them, I would like to thank my brother, who was always willing to help me with difficult technology related courses. In addition, I would like to thank my boyfriend, who often made time for me to review my essays, and to give me many good advices to improve my work. These last two guys also knew nearly all sentences in this thesis, because they read
it several times to give me relevant feedback. Furthermore I really appreciate the support of my roommates, who made the most delicious meals after a long day of work and cheered me up when I needed it.

Besides my family and friends, I would like to thank my supervisors from the TU/e, Yvonne de Kort and Wijnand IJselsteijn, for their support and input. In addition, I would like to thank my supervisor from Philips Research, Eddine Sarroukh, for the interesting and sometimes intense discussions about the project, and my supervisor from Philips Design, Patray Lui, for her creative input during the first months of this project.

In addition, I would like to thank all the participants of this study. My friends who participated in the pilot study, and all the children who participated in the final experiments. I know that this was not the most fun experiment to participate in! A special thanks is for Harry Voss, the principal of primary school ‘De Opbouw’ who gave me the opportunity to perform the experiments in his school.

And now the answer on the previous question: what will I do after I’m graduated? The answer is quite easy: I will fly to a beautiful part of the world, and on the top of a mountain I will think about what my new invention will be.

Martine Huygens
Eindhoven, July 2013
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1. Introduction

Myopia, commonly known as nearsightedness, is a global public health problem. Population-based research on children has indicated that Asian populations, especially those of Chinese ethnicity, are most susceptible to myopia (Pan, Ramamurthy and Saw, 2012). The myopia rate in China varies from 41% for primary school students up to 79% for high school students (National Student Physical Fitness and Health Research, 2010). There has been a long standing debate about the primary causes of childhood myopia. A small proportion of myopia in childhood is clearly genetic; however, there is also strong evidence for environmental factors associated with increased education and urbanization (Morgan and Rose, 2005). In China a good education is seen as one of the most important factors to become successful in life. It gives access to a future of highly valued jobs and high social status (Lin & Qinghai, 1995). The daily school schedule of a Chinese student is intense, with very long school days. In addition, parents hold high expectations for their children and invest a lot of time and money to ensure that their children achieve academic success (Lin & Qinghai, 1995). There is an old Chinese saying, ‘Wishing for Dragon children’, which means that parents expect their children to learn as much as possible in order to succeed and stand out from their fellows in society. The one-child policy, introduced in 1979, has resulted in greater expectations and pressure focused on one child, which already starts for primary school children. It might be expected that one of the results of this sedentary lifestyle and intensive schooling is visual discomfort and myopia (Rosenfield & Gilmartin, 1998).

To reduce the development of myopia and visual discomfort, traditional Chinese eye relaxation exercises are compulsory in primary and high schools in China twice daily. In these exercises students massage specially selected acupressure points around the eyes and neck (see Figure 1). According to the theory of ‘Jing-Luo’ (Jing stands for channels, and Luo stands for collaterals, which connect the channels), it is believed that finger pressure and rubbing movements on these special points can improve the blood circulation, reduce visual discomfort, improve neural nutrition of the eye, and can prevent myopia (Ösberg, Horie & Feng, 1992). Although these exercises are a daily routine in China, there is little scientific evidence that these exercises are effective; they are more based on common beliefs. Another problem with these exercises is that an everyday repetition of the same exercises reduces the children’s motivation to correctly execute them.

Besides the above mentioned vision related problems, another side effect of the lifestyle of Chinese students are musculoskeletal symptoms in the anatomical areas of neck, shoulder and back (Cho, Hwang & Chen, 2003). Students are sitting most of the time during the day and lack the time to engage in sufficient physical activities. In addition, parents see sport as less important than studying.

Several members of the Philips project team ‘Enhance performance and healthy development in Chinese schools’ are currently developing a new concept to make the current eye exercises more effective. The first focus of this project is to reduce visual discomfort and visual fatigue and not myopia, because
reducing the development of myopia is a very complex problem and the exact causes of myopia are still unknown. There is some evidence that there is a relationship between accommodation insufficiency and subjective discomfort symptoms during near work (Sterner et al., 2006; Chase et al., 2009). However, the exact relationship between myopia and visual discomfort is not yet investigated. Through expert interviews and literature study the project team has explored that looking into the distance and a well lit classroom might reduce feelings of visual discomfort and visual fatigue. Whether these factors have some effect on myopia development in the long term should be further investigated. The second goal of the project is to prevent and reduce musculoskeletal symptoms. In combining eye exercises with body exercises this problem might be tackled. The third focus is to create exercises which engage students to correctly execute the exercises.

The aim of the present study was to investigate how class break exercises could be optimized to reduce visual discomfort and posture related symptoms and to set up a methodology to test the effects of visual comfort and musculoskeletal symptoms after interventions. A special focus was on two types of interventions: body exercises and light intensity in the classroom. First, qualitative methods were used to get more insights in: visual discomfort and myopia (guiding conversations with optometrist), musculoskeletal pain (expert interviews with physiotherapists) and experiences of Chinese students about current eye relaxation exercises and opinions about proposed new exercises (focus groups). Secondly, two quantitative experiments were performed to investigate if visual discomfort and musculoskeletal symptoms could be reduced by performing a set of body exercises or by increasing the light intensity. On the basis of these results recommendations were given to improve the current Chinese eye relaxation exercises.

Figure 1: Current Chinese eye relaxation exercises.
2. Theory

2.1. Introduction
Visual discomfort and musculoskeletal pain are common complaints among Chinese school children. This section describes the symptoms, causes, theories and intervention strategies of these two topics. At the end of this part the study aim of this project is discussed.

2.2. Visual discomfort
Prolonged close work activities such as reading can cause somatic and perceptual discomfort. Common ocular complaints include eye strain, text movement, blurred text, burning, irritation, pain, ache, sore eyes, and headache. The formal diagnostic term for these complaints is asthenopia (Sheedy, Hayes & Engle, 2003), however it is better known as visual fatigue or visual discomfort. These last two terms are synonymously used in previous literature. However, Lambooij and colleagues (2009) argue that these terms are related to different aspects of the ocular system. These researchers state that visual fatigue is related to physiological strain or stress resulting from excessive exertion of the human vision system, while visual discomfort is its subjective counterpart. In the current study we are predominantly focused on the subjective symptoms of asthenopia, and therefore the term visual discomfort is used.

The incidence of visual discomfort in university students is found to be quite high; varying from 17% (Borsting et al., 2007) up to 47% (Conlon et al., 1999). Visual discomfort symptoms are also common in primary school students. In a study by Sterner, Gellerstedt and Sjöström (2006) it was shown that one-third of the children with a mean age of eight years reported at least one subjective discomfort symptom (headache, asthenopia, floating text and/or facility problems) when doing near work. In a second examination almost two years later this number had increased up to approximately 40%. In studies by Wilkins et al. (1996), Jeanes et al. (1997) and Wilkins et al. (2001) prevalence numbers of 20-34% were found. The criteria and sample sizes differ between these studies, however it is generally concluded that visual discomfort is a common complaint among schoolchildren.

Visual discomfort can lead to a diverse and large number of symptoms. Meares (1980) and Irlen (1983) made a distinction between two categories of symptoms. The first category consisted of discomfort symptoms like sore and tired eyes, headache and photophobia (discomfort of the eyes due to light exposure) and the second category consisted of visual-perceptual distortions and illusions, like transient instability of focus, double vision and illusions of shape, motion and color. Sheedy, Hayes and Engle (2003) grouped visual discomfort symptoms in two factors on the basis of sensation type, sensation location, and inducing condition: external- and internal symptom factors. The external factors were related with symptoms in the front and bottom of the eye like burning, irritation, tearing and dryness. The internal factors were related with symptoms located behind the eyes like ache, strain, and headache.
Besides pain symptoms in and around the eyes, other studies related visual discomfort symptoms with pain in other parts of the body, like pain in the neck, back and shoulders (e.g. Stone, Clarke & Slater, 1980; Sheedy and Bergstrom, 2002). Previous studies showed that visual discomfort has different types of symptoms and suggest that these symptoms have different etiologies.

The most widely supported theory of visual discomfort is Wilkins’ theory of visual stress (1995). Wilkins argues that visual discomfort is caused by pattern glare due to a hypersensitivity to repetitive patterns. These patterns can evoke seizures in people who suffer from migraine or photosensitive epilepsy and can cause perceptual distortions in normal individuals due to a spread of excitation in areas of the visual system (neural overload). Pattern glare can be caused by geometric repetitive patterns. Especially bright patterns of high contrast stripes, with equal width and a spatial frequency of about three cycles per degree can cause both illusions and seizures (Wilkins, Huang & Cao, 2004). Successive lines of text can also be perceived as a pattern of stripes. Particularly when text is presented in small closely spaced lines and letters, and when it is set in a long paragraph. Simply observing a text with these characteristics can cause visual discomfort and headache (Wilkins & Nimmo-Smith, 1984). Knowing the fact that reading can induce visual discomfort because of the striped properties of the text, Wilkins and Nimmo-Smith (1987) suggest that a reduction in the number of stripes (only three lines of text) can lead to a reduction in visual complaints. He also argues that text in children’s reading material gets too small too quickly, resulting in visual discomfort (Wilkins, Huang & Cao, 2004). Potentially, any stimulus which evokes neural overload in the visual cortex can increase feelings of visual discomfort, for example high contrast and flickering illumination (Wilkins, 1995).

An alternative theory of visual discomfort is based on the magnocellular visual system. Two different cells can be found in the neural pathways between the retina and the visual cortex: magnocells and parvocells. Magnocells have a large receptive field and are sensitive to contrast and motion. Parvocells on the other hand, have a small receptive field and are sensitive to detail and color. These two systems work in parallel in a way that people can perceive clear scenes. The magnocellular system plays a major role in reading and deficits in this system are thought to be a cause of visual discomfort (Irlen, 1994; Livingstone et al., 1991; Lovegrove & Slaghuis 1986). Although there is some evidence for the magnocellular hypothesis, the exact mechanism behind it is still not elucidated.

Visual discomfort has a diverse number of symptoms and causes. Although the exact etiology of visual discomfort is still unknown, it is clear that it can lead to problems in learning; a reduction of reading speed (Wilkins & Nimmo-Smith, 1987), effective reading time (Conlon et al., 1999; Tyrell, 1995) and task efficiency (Conlon et al., 1998, Singleton and Henderson, 2007) are found to be problematic factors caused by visual discomfort. This can lead to a lack of practice in reading and difficulties in understanding large amounts of text (Reid, 2009). Myopia development and visual discomfort start to increase between the ages of 6-10 years (Lam et al., 1999; Wilkins, Huang & Cao, 2004). Therefore a treatment to reduce these visual complaints should be started in primary school.

2.2.1. Reducing visual discomfort

Much research has been performed on factors which can reduce visual discomfort. In the previous section particular textual characteristics are mentioned which should be minimized to reduce visual discomfort
(Wilkins & Nimmo-Smith, 1984; Wilkins 1995). However, besides textual conditions also exercise breaks and light conditions might play a role in the development of visual discomfort. These two factors will be discussed in the next two paragraphs.

**Exercise breaks**
The effect of breaks on visual discomfort is a well described topic in studies on visual display terminal (VDT) operators. Galinsky et al. (2000) studied the effect of a supplementary break schedule on feelings of visual discomfort, musculoskeletal discomfort and work performance. They found that four five minutes breaks in addition to the conventional break schedule (two fifteen minutes breaks + one thirty minutes break) reduced levels of eye soreness and visual blurring and reduced feelings of musculoskeletal discomfort, without reducing the work performance. Similar results were found in a study of Balci and Aghazadeh (2003), however in this study VDT users performed an easy set of stretching exercises during the breaks. In a follow-up study by Galinsky et al. (2007) the same conditions were tested, however in this study the effect of performing stretching exercises during breaks was investigated. Feelings of discomfort and eye strain significantly reduced and productivity increased in the supplementary breaks condition. No significant effect in discomfort was found between the group who performed the stretching exercises compared with the group who did not perform exercises. However a low compliance was found in performing stretching exercises (participants reported stretching in only 25% of conventional breaks and 39% of supplementary breaks). Henning et al. (1997) tested the effect of short rest breaks in two separate work sites for a nine week period. In one condition computer workers had to perform a simple set of stretching exercises during the break. At one work site they found no significant effects of either supplementary breaks or stretching exercises on discomfort, mood or productivity. At the other work site, however, computer workers reported a reduction of visual discomfort and musculoskeletal discomfort, and an increase in productivity when the short breaks included stretching exercises. This study proved that stretching exercises during a short break can have positive effects, however, there was no clear explanation for the different effects at the two work sites, and the sample size of this study was low. In conclusion, frequent short breaks can reduce visual discomfort in VDT workers. Performing exercises during the break might have a positive effect in the reduction of visual discomfort.

**Light**
Environmental factors can play a role in visual discomfort. Wilkins (1993) for example argues that a pattern of stripes can also be formed by certain luminaire baffles or by repetitive arrays of linear luminaires (Wilkins, 1993). Visual discomfort induced by light is better known as discomfort glare. Discomfort glare can be caused by exposure to pronounced luminance contrast or by large luminance area sources (Stone, 2009). Discomfort glare can be subjectively measured and does not necessarily reduce visual performance. Disability glare, on the other hand, refers to the experience of light scatter within the optical media of the eye resulting in interference in vision (Stone, 2009). It is well-known that excessive illuminance sources can induce discomfort glare resulting in feelings of visual discomfort (Sheedy, 1995). However, it is also found that low light conditions can increase discomfort and headache, because of the difficulty to discriminate contrast (Stone, 2009). In an intervention study of Aarås et al. (1998) it was found that by increasing the illuminance level from below 300 lx to more than 600 lx and reduce glare in an office environment can significantly reduce feelings of visual discomfort. The light intensity for classrooms is recommended to be within the range of 300 lx to maximal 500 lx (CIBSE, 2004). Increasing the light intensity in the classroom might be a factor to reduce feelings of visual discomfort.
2.3. Musculoskeletal disorders

Several studies have revealed the incidence of musculoskeletal symptoms in children and adolescents. Complaints in the anatomical areas of the neck, back and shoulder are commonly reported (e.g. Murphy, Buckle & Stubbs, 2007; Cho, Hwang & Chwen, 2003; Wedderkopp, 2001). Aspects in the school environment are frequently noticed as risk factors of musculoskeletal pain among children. Sitting is the most recognized factor associated with back pain (Balagué, Troussier & Salminen, 1999). The duration of static sitting posture in the classroom is found to be problematic (e.g. Murphy, Buckle & Stubbs, 2004; Geldhof et al., 2007; Grimes and Legg, 2004). Geldhof et al. (2007) examined classroom postures of eight to twelve-year old children in Flanders. They observed that children sat 85% of the time. 21% of the children experienced neck or back pain at a certain point within the previous week. The trunk of the children was flexed over 45° for 28% of the total time. Children who spent more time in a flexed position of the trunk reported more thoraco-lumbar pain. In a similar study into classroom posture and self-reported symptoms, Murphy and colleagues (2004) found that static sitting posture was related to upper back pain and neck pain in a sample of eleven to fourteen-year old schoolchildren in Surrey. In addition, they found that lessons longer than one hour were associated with self-reported low back pain. These researchers observed that children were sitting with a trunk bent over 20° to 45° for 25% of the time and with their neck in a flexed position of more than 20° for 34% of the time. In contrast to findings of Geldhof et al. (2007) trunk flexions of more than 45° were less commonly observed (only 3% of the observed time). In the study of Murphy et al., 26% of the children reported low back pain, 21% reported upper back pain and 24% reported neck pain at a certain point in the previous week. These numbers were respectively 44%, 35% and 52% for the previous month. Possible explanations for differences between studies in incidence numbers and posture patterns could be because of differences in educational organizations, time spent on reading and writing tasks, and age of the children (Geldhof et al., 2007).

Passive sitting postures can result in a reduction of activation in the stabilizing musculature of the pelvic (O’sullivan et al., 2002). This musculature is activated with erect postures during sitting and standing. A decrease in trunk muscle activity is related to increased pressure of the lumbar discs and ligaments (Goel et al., 1993). Wilke et al. (1999) and Harrison et al. (1999) have also found that sitting in a bended position can result in an increase in spinal load, and in an increase in disc pressure, resulting in decreased nutrition of the disc. This may lead to strain, instability or fatigue in the back region (Cholewicki & McGill, 1996).

Besides prolonged sitting also school furniture is frequently noted as a source for posture pain symptoms (e.g. Panagiotopoulou et al., 2004; Knight & Noyes, 1999). There is a mismatch between furniture dimensions and the anthropometry of children. The desk is too high or too low for most children, and chairs are too deep or too high. As a result children sit on the edge of their seats in a slumped position while reading and writing. Furthermore due to table height children are forced to lift their arms and shoulders while writing (Panagiotopoulou et al., 2004). This can result in neck and shoulder pain.

It can be concluded that prolonged sitting in the classroom can lead to musculoskeletal discomforts in primary school children. It is found that these disorders can lead to pain experience in adulthood (Brattberg, 2004). For these reasons it is important to focus on musculoskeletal discomfort prevention early in childhood.
2.3.1. Reducing musculoskeletal disorders

In paragraph 2.2.1 it was already mentioned that (exercise) breaks can reduce musculoskeletal disorders in VDT operators (Galinsky et al., 2000, 2007; Baci & Aghazadeh, 2003, Henning et al., 1997). The effect of exercise breaks on musculoskeletal discomfort has also been studied in the school context. Geldhof et al. (2006) investigated the effects of a two-year multifactorial back education program in 365 nine to eleven-year old children. This educational program consisted of back education lessons provided by physiotherapists and teachers, movement breaks in the class and supported tools to improve dynamic sitting (pezzi balls, dynair and a sitting wedge). The movement breaks were performed in the classroom twice a day. There was a different movement break for every day of the week, and a large picture was posted in the classroom which showed the correct movements. After two years it was found that the back education program resulted in a decreased duration of trunk flexion, neck flexion and neck torsion of children. As could be read in the previous section, a long duration of these movements could lead to self reported back pain (Murphy, Buckle & Stubbs, 2004; Geldhof et al., 2007). Reducing prolonged static sitting in a poor posture position was also the main goal of the ‘Moving school’ program (Cardon et al., 2004). This program encourages children to move in the classroom through work organization (like information stations), contextual influences (like stand-at places of work) and behavioral influences (like training on awareness and behavior needed for bodily health). Cardon and colleagues (2004) compared sitting habits in a ‘moving school’ and a traditional school in eight-year old children. They found that children in a traditional school spend on average 97% of the time in a static sitting position. In contrast, children of the ‘moving school’ were observed in dynamic sitting positions (53%), standing positions (31%) and were walking around (10%). Also trunk flexion over 45° and neck and trunk rotations were less observed. Based on the results they recommend teachers to allow children to interrupt sitting, to implement movement breaks and to interrupt frontal teaching. Encouraging children to move in the classroom can help in the prevention and reduction of musculoskeletal symptoms.

2.4. Study aim

The present study is part of a bigger project to enhance performance and healthy development in Chinese schools. This is a multi-stakeholder project (Philips Design, Philips Research and external stakeholders) with the main goal to support innovation and market growth in China. One part of this project is to design a new concept to reduce visual discomfort and musculoskeletal pain in Chinese children. The aim of this project is to develop an application and exercise recipe that can improve the current Chinese eye relaxation exercises. The idea of the proposed new exercises is based on laser projected content which: (1) can simulate and stimulate distant vision, (2) can guide eye and body exercises, (3) can be used in a well lit classroom and (4) should motivate students to correctly execute the exercises.

The initial goals of the present study were to gather input for the new eye- and body exercises, to set up a methodology to test the new application in a lab study and execute it. However, the application was not yet ready to be tested, so these tests could not be performed. Therefore it was decided to focus on two factors of the proposed new exercise recipe: performing body exercises and increasing the light intensity in the classroom.
The present study can be divided into two parts: gathering input to improve laser-guided exercises and investigating the effect of either performing body exercises or increasing the light intensity in the classroom.

**Study 1: Laser-guided exercises**
The aim of the first study was to gather input to improve the new proposed laser-guided exercises. Through expert interviews with physiotherapists I gathered relevant input to set up an effective set of body exercises, which could be combined with eye exercises in the newly proposed exercise recipe. Furthermore, during focus group sessions with Chinese interns experiences of eye relaxation exercises in Chinese schools were gathered, and opinions about newly proposed laser-guided exercises were explored.

**Study 2: Body exercises and light intensity**
Previous research has shown that exercise breaks can reduce musculoskeletal symptoms and can increase visual comfort in VDT operators (Balci & Aghazadeh, 2003; Henning et al., 1997). In this study we investigated if this is also the case in primary school children. Furthermore, in a study of Aarás et al. (1998) it was investigated that visual comfort increased in office workers when illuminance settings changed from below 300 lx to more than 600 lx. Because the light intensity for classrooms is recommended to be 300-500 lx (CIBSE, 2004), we expected that increasing the light intensity in the classroom could increase visual comfort in primary school children. Moreover, it was expected that there exists a relationship between posture pain symptoms and visual comfort. If one suffers from visual discomfort, he/she will lean forward to increase clear vision, which might result in posture pain symptoms (Grimes & Legg, 2004; Marumoto et al., 1999). In addition, these symptoms are commonly included in visual comfort questionnaires (Stone, Clarke & Slater, 1980; Sheedy and Bergstrom, 2002). Furthermore, it was expected that with a reduction of pain symptoms, positive emotional status will be increased.

Hence it was hypothesized that performing body exercises and increasing the light intensity in the classroom can increase visual comfort, can reduce posture pain symptoms and can increase positive emotional status. To test these hypotheses two separate experiments were performed.

The first step in this study was to set up and validate a methodology to measure visual comfort, musculoskeletal symptoms, emotional status and motivation in primary school children. The second step was to test the two experimental interventions in two separate experiments.
3. Study 1: Laser-guided exercises

3.1. Introduction
Members of the Philips project team ‘Enhance performance and healthy development in Chinese schools’ are currently developing a new concept to make the current Chinese eye relaxation exercises more effective. Through expert input, the goal of the class break exercise project is to develop an application that can:

1. Reduce visual discomfort,
2. Motivate Chinese children to perform the eye exercises through playful interaction and participation,

The project team performed expert interviews with optometrists, physiotherapists and Chinese doctors in the Netherlands and China to gather input and to understand the different principles of myopia, visual discomfort and musculoskeletal pain. Based on this expert input the project team created ‘exercise ingredients’ related to eye exercises, body exercises and motivation (see Table 1).

Table 1: Exercise ingredients for new proposed eye- and body exercises.

<table>
<thead>
<tr>
<th>Eye exercises:</th>
<th>Simulate an outdoor environment (lighting and distance of objects)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distant-focusing</td>
</tr>
<tr>
<td></td>
<td>Bright light and high contrast</td>
</tr>
<tr>
<td></td>
<td>Images in motion</td>
</tr>
<tr>
<td></td>
<td>Varying the location of images</td>
</tr>
<tr>
<td></td>
<td>Varying the size of images</td>
</tr>
<tr>
<td></td>
<td>Step-approach to the eye exercises</td>
</tr>
<tr>
<td>Body exercises:</td>
<td>Extend entire body to change the fixed position</td>
</tr>
<tr>
<td></td>
<td>Dynamic movements</td>
</tr>
<tr>
<td></td>
<td>Stretching</td>
</tr>
<tr>
<td></td>
<td>Breathing exercises</td>
</tr>
<tr>
<td>Motivation:</td>
<td>Exercise in pairs/groups</td>
</tr>
<tr>
<td></td>
<td>Co-creative</td>
</tr>
<tr>
<td></td>
<td>Educational</td>
</tr>
<tr>
<td></td>
<td>Playful</td>
</tr>
<tr>
<td></td>
<td>Variations or combinations of exercises</td>
</tr>
<tr>
<td></td>
<td>Rhythmic</td>
</tr>
</tbody>
</table>

In the design ideation phase projected graphics and a set of body exercises were designed to propose an ‘exercise recipe’ for the new class break exercises. The first concept was reviewed by Chinese experts (eye doctors, an acupuncture specialist and primary school teachers) using expert interviews in China.
Next a prototype was developed and the design of the graphics was further refined. The next steps will be to optimize the concept and prototype and to test the application in a lab study in China.

3.2. Description of the concept
In the proposed new class break exercises a laser projection is used to guide students to correctly execute the eye- and body exercises. The new concept is designed for nine to ten-year old students, because myopia development and visual discomfort starts to increase at that age (Lam et al., 1999; Wilkins, Huang & Cao, 2004). Students should follow animated graphics which will be projected 180 degrees surround in the horizontal plane and on the ceiling. The projected images change in focal depth and image size to simulate distant vision. In the first concept the animated graphic is a flying bird. A laser projector instead of a normal beamer is used, because laser light can be seen clearly in a well lit classroom. The total exercise takes five minutes of which three minutes eye exercises and two minutes body exercises. It is expected that simulated distant vision in a well lit environment can reduce visual discomfort. In addition it is expected that body exercises can prevent posture pain symptoms. The exercises and projected graphics will be combined with Chinese instrumental music to engage students more. With this ‘exercise recipe’ it is hypothesized that visual discomfort and posture related pain can be reduced and that students will be motivated to correctly execute these exercises every day. Examples of some of the ‘exercise ingredients’ can be found in Figure 2.

<table>
<thead>
<tr>
<th>Body exercises</th>
<th>Eye exercises</th>
<th>Laser projector</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Breathing exercises" /></td>
<td><img src="image2" alt="Eye rotation" /></td>
<td><img src="image3" alt="Laser projector" /></td>
</tr>
</tbody>
</table>

**Figure 2:** Several examples of the ‘exercise ingredients’.
3.3. Expert interviews physiotherapists

Three expert interviews with physiotherapists were performed to get better insights in the needs of and possibilities for the set of body exercises which can be included in the ‘exercise recipe’ of the laser-guided exercises. The goals of these interviews were:

1. To get more insight in posture related problems of primary school children,
2. To get more insight in exercises which can reduce posture related problems in primary school children,
3. To get more insight in the engagement of primary school children to perform the body exercises repeatedly.

3.3.1. Procedure

The following physiotherapists were interviewed:

A physiotherapist of ‘Fysio Company Care’, Eindhoven: ‘Fysio Company Care’ is a company which is specialized in health management, ergonomics and occupational health and safety. In the semi-structured interview with this physiotherapist the main goals and needs regarding posture related problems were discussed. Based on this interview ‘exercise ingredients’ were set up, which can be found in Figure 3. This interview was performed by a member of the Philips project team.

A physiotherapist of the study program ‘Human Kinetic Technology’ of the ‘The Hague University of Applied Sciences’: This study program is focused on applying (bio)medical and technical knowledge to solve movement issues. The guided conversation with this physiotherapist was performed to gather information about effective exercises based on the functionality of the joints. In addition the previously mentioned ‘exercise ingredient’ were tested. This interview was conducted by the author of this thesis.

A pediatric physiotherapist of ‘Kabelbont kinderpraktijk’, Bergen op Zoom: This physiotherapist is specialized in the treatment of children with developmental, neuromuscular and skeletal disorders/diseases. In the semi-structured interview with this physiotherapist effective and engaging exercises for children were discussed. In addition exercises were reviewed which were proposed by the previously mentioned physiotherapists. This interview was conducted by the author of this thesis.

Before each interview an introduction to the project was given using a PowerPoint presentation. Short movie clips of the current eye exercises as well as morning exercises (every day Chinese students can participate in morning exercises in the schoolyard) were shown. The ‘exercise ingredients’ were shown on cards in the last two interviews. A list of questions was set up based on the previously performed interviews. The interviews took approximately one hour and were recorded with a voice recorder. During the guided conversation notes were taken.

3.3.2. Data analysis

First, the recording of the expert interview which was already performed by a member of the project team was analyzed and the most important findings were noted. Then the guided conversation with a physiotherapist of the study program ‘Human Kinetic Technology’ was summarized. The expert interview with the pediatric physiotherapist was fully transcribed. The summaries and transcripts of the interviews can be found in appendix A. The most important findings were categorized. Finally quotations of all interviews were clustered in different categories to get an overview of all opinions.
3.3.3. Results

As previously mentioned, the last two interviews started with showing a movie of the current Chinese eye exercises. Interestingly after showing the movie clip to the pediatric physiotherapist, she mentioned that massaging points above the eyebrows (see Figure 1) are also used in the Netherlands. These are used to relax the muscles which are tightened during frowning and as a result can cause a headache. Also massaging muscles in the neck (see Figure 1) is used to reduce the muscle tension in the neck caused by an abduction position of the shoulders and an extended position of the neck. For these reasons she thinks that this massaging technique can be useful, however this technique is commonly used for adults. For children she thinks it can be effective to just include a break and to do something else than studying.

All physiotherapists mentioned that the main goal of the exercises should be to increase the blood flow. According to the pediatric physiotherapist it is important to improve the blood flow to reduce the development of connective tissue of muscles and ligaments and in this way to reduce the development of a movement restriction. The interview with the human kinetic physiotherapist added the insight that the most important cause of posture related problems is that the body is in the same position during the entire day. In the set of body exercises it is important to focus on exercises using opposite movements of these joints. The general physiotherapist mentioned that the set of body exercises should include exercises in which children should leave the flexed position of the back and extend the entire body. In addition she stated that it is important to perform dynamic exercises to release the static position of and static load on the muscles. According to all physiotherapists the most important areas to focus on are the hips, shoulders, back (spine) and neck.

“While sitting you have a bended lower back position, and a bended thoracal spine and lumbal spine. You need to compensate that with your neck, so you extend your neck. Especially when doing computer work or writing. So what you want is to do exercises which stimulates the muscles to allow the spine to straight out again.” (General physiotherapist)

“When your body is in the same position the entire day, you should do exercises using opposite movements of the joints.” (Human kinetic physiotherapist, translated from Dutch)
The human kinetic physiotherapist mentioned that the hips are in a flexed position while sitting; therefore it is important to compensate for this flexed position during the exercises. Children should stand up and rotate their torso. If one foot is moved before the other one (step position) this will be more effective. The pediatric physiotherapist however, mentioned another exercise, which is according to her, more useful. In this exercise children should swing the legs forwards and backwards while standing. If the leg is also moved to the side, the oblique abdominal muscles will be stretched. When swinging the leg backwards the buttock muscles (m. gluteus) will be activated. The pelvic floor muscles and oblique abdominal muscles are needed to keep the stability in this position, so the stability is simultaneously trained. Another exercise can be to write the name with the foot in the air. In this exercise the same muscles are trained, but it will be more fun to perform.

While sitting, the back is in a flexed position (bended thoracal and lumbal spine) so it is important to extend the back (stretch the m. erector spinea) in the set of body exercises. The pediatric physiotherapist mentioned that if the hips are stretched simultaneously (i.e. stand up) it will be more effective. The human kinetic physiotherapist as well as the general physiotherapist mentioned that because of a flexed position of the spine, it is difficult to exhale. While sitting the thoracic spine is in a curved position and as a result, the thorax is in an inspiration position (Figure 4b). In contrast while extending the body the thoracic spine is in a straight position and the thorax is in an expiration position (Figure 4b). So while sitting it is easy to breathe in, but difficult to breathe out. An effective breathing exercise could be to stand up, extend the entire body and to stretch the arms to the ceiling.

According to the human kinetic physiotherapist, another problem related to posture is the position of the shoulders. During writing, reading or using a computer the shoulders are in abduction and exorotation position (see Figure 5). Therefore exercises should be performed which stimulate adduction and endorotation movements. An example of an exercise which stimulates this is to put the hands on the back (to create endorotation) and to move the shoulders up and down as far as possible (create adduction).
Figure 5: Abduction and exorotation movements during writing, reading or using a computer.

The pediatric physiotherapist mentioned the importance of doing neck exercises, because ligaments in the cervical vertebrae are fixed during sitting. She stated that it should be taken into account that it can be painful to just turn the neck. It is more effective to make movements in the physiological direction of the neck joints (processes transverse); these neck joints move like a winding staircase toward each other. An effective exercise can be to move the neck from the armpit to a position as when looking over the opposite shoulder in a slightly upwards direction. By only turning the head sideways the blood vessels in the neck will be pinched off.

“I would immediately disapprove this neck exercise [turn the neck] from a physiotherapeutic perspective.” (Pediatric physiotherapist, translate from Dutch)

While questioning which exercises could be dangerous for children they all mentioned that it is important to look to the range of motion of each child. Every child is different and has different movement amplitudes. The pediatric physiotherapist mentioned that special attention should be given to the neck area, because the neck joints can easily be affected. The human kinetic physiotherapist noticed that it is important to take care that it will not be a competition. Students should not compete against each other to test who can reach the furthest.

“It is important to know what the quality, range of motion, of the joint is, and to adjust the exercises with what people can handle.” (General physiotherapist)

“It is important to respect everyone’s movement capabilities. Everybody is different and has different movement amplitudes.” (Human kinetic physiotherapist, translated from Dutch)

The general physiotherapist mentioned that good instructions are important to be sure that exercises will be correctly performed. The pediatric physiotherapist stated that it is important not to give instructions about their own body. Children need instructions which are more externally focused, which can be achieved by instructing them with regard to objects/properties in their environment. For example when children should extend their body and arms in an exercise you can instruct them by saying that they should try to touch the ceiling. The general physiotherapist indicated that instructions can be given by showing a movie on the digital school board. The pediatric physiotherapist however, said that it is better
to give feedback directly, especially if it concerns instructions about motor skills to young children (up until the age of nine).

Talking about the motivational part of the exercises the pediatric physiotherapist responded that it is important to do different exercises to keep students motivated, instead of everyday a repetition of the same exercises. Children can be more motivated when something unexpected is proposed. Exercising in combination with a dance or song can be effective. As example she mentioned the ‘write dance’, a Swedish teaching method to practice the fine and gross motor skills with the aid of imaginative drawings, music, rhymes and games. By using melody and rhythm the quality of movements can be improved as well as the interaction of a group. The general physiotherapist mentioned that it is also important to change the atmosphere in the classroom from a learning setting to a more dynamic movement setting to activate children, which can also be achieved by the use of music. Both physiotherapists said that it can be fun to do exercises in couples. This can increase the group interaction, which can also be an important factor to increase the level of alertness. Another idea which is proposed by the general physiotherapist is to make use of a toolkit with materials like balls and sticks.

“Just make sure that it is fun to move around. To make it fun to interchange the static load with something else, I think that is the main target for younger children.” (General physiotherapist)

Another interesting fact which is mentioned by the pediatric physiotherapist was about stimulating the senses. So called ‘units of activation’ can be triggered, for instance by experiencing pressure, by moving or by yawning and can this can activate the cortex. She proposed to start the set of exercises with dynamic exercises, like jumping, to feel the pressure on the feet, and as a result to activate the entire body. She believes that the influence of light can also stimulate these ‘units of activation’. The general physiotherapist on the other hand, does not know if light can have an influence on the improvement of the exercises.

3.3.4. Final set of body exercises

A five-minute set of body exercises was created in accordance to the expert interviews with the physiotherapists and the literature reviews. The set of exercises consist of both dynamic- and stretching exercises to stimulate blood flow and to relieve the static load of the muscles in the neck, back, hip and shoulder area. Considering the different exercises which were proposed by the physiotherapists the focus was on the exercises which were most effective, easy and fun to perform.

The set of body exercises consist of:

1. Dynamic movements to stimulate blood flow and to relieve the static load of the muscles: the children should stand up from their chair to compensate for their flexed positions and jump several times.

2. Pelvic/buttock exercise: children should move their legs backwards and forwards. Subsequently they should write their name with their foot in the air. Left and right legs were alternated (Figure 6a).

3. Breathing exercises: children should extend their back to relieve the flexed position of the spine. They should stretch their arms to the ceiling and as a consequence extend their spine and open their chest, and breathe in and out (Figure 6b).
4. Shoulder exercise: during writing/reading/using a computer the shoulders are forced in an abduction and exorotation position. The opposite movement should be performed in the set of body exercises. Children should put their hands behind the back and move their shoulders up and down as far as they can go (Figure 6c).

5. Neck exercises: the neck should be stretched in the physiological position of the neck joints to increase blood flow. Children should turn the neck to the side and look to the ceiling and turn the neck to the other side and look to the armpit (left and right side alternative) (Figure 6d).

3.3.5. Discussion
The three main purposes of these expert interviews were to get better insights in: posture related problems in primary school children, exercises to reduce these problems and engagement to perform them. It is found that the main posture related problems occur in the anatomical areas of the neck, back, shoulders
and hips. A change in sitting posture is the most important aspect to focus on. Exercises should be performed using the opposite movements of the positions in which the joints are fixed during sitting. The main goal of the exercises should be to increase the blood flow and as a result to increase the level of alertness and to reduce the development of movement restrictions. It is important to combine exercises with music, dance or group interaction to motivate the children.

It might be better if all expert interviews were conducted by the same person with the knowledge of anatomy and physiology. The first interview was conducted by someone who had no background in this field. This could have had an influence on the way of responding of the interviewee. In addition, in this interview only general issues were discussed, while in the two other interviews more in depth issues were reviewed using anatomical terminology. Besides this, the first interview is the only conversation which was performed in English, while the interviewee was a Dutch native speaker. Sometimes the physiotherapist was struggling to find the right words. This could have had an influence on the way she explained some aspects.

Due to the different backgrounds of the physiotherapists, different approached were used. The human kinetic physiotherapist was more focused on the functionality and biomechanics of the joints, while the other physiotherapists were focused on the general functionality of the body. In addition the pediatric physiotherapist answered the questions with a child’s perspective in mind. Combining these different approaches was useful to set up the final set of body exercises for this project.

3.4. Focus group
A focus group is a qualitative research method consisting of structured group interviews to reveal a target audience’s desires, experiences, and priorities (Kuniavsky, 2003). The main goal of these exploratory focus group sessions was to get a better insight in Chinese students’ experiences with, opinions about and needs for the current and proposed new eye- and body exercises. The objects were:
1. To explore the experiences, beliefs and motivation of the current Chinese eye exercises.
2. To explore the thoughts and opinions of the proposed new class break exercises.
3. To explore how Chinese students can be engaged in order to correctly execute the exercises repeatedly.

Chinese interns were invited to the focus group sessions for two reasons. First because they have experiences with the current Chinese eye exercises, and secondly the Chinese children may need another approach for motivation compared to our Western culture. By inviting these Chinese interns both issues could be tackled.

3.4.1. Procedure
Two focus group sessions were performed: one session (N = 4) with Chinese Philips interns (two males, one female), a Singaporean Philips intern (male) and a Chinese assistant moderator, and one session (N = 3) with two Chinese Philips graduation interns (males) and one Chinese Philips employee (female). The first part of the focus group session consisted of an introduction to the project. In the second part the current eye relaxation exercises were discussed. In the third part the new proposed ideas were introduced and it was discussed how the exercises could be made more engaging for Chinese primary school
students. The focus group schedule can be found in appendix B. Some visual tools were used to guide the focus group sessions. A PowerPoint presentation was used to explain and support the ideas of the project. In addition, short movie clips of the current and proposed new eye- and body exercises were shown to start the discussion and brainstorm about the two topics. Different mood boards of the target group (9 year old students), with respectively movies/cartoons, games, sports, education and new ideas were shown to support the brainstorm. The focus group sessions took approximately two hours and were recorded with a voice recorder.

Figure 7: One of the focus group sessions.

3.4.2. Data analysis
Voice recordings were analyzed and fully transcribed (see appendix B). After that, the transcripts were reviewed and the ideas, opinions and thoughts categorized. Then, the transcripts were analyzed again and the most important quotations were listed in the different subcategories.

3.4.3. Results
The first goal of the focus group sessions was to investigate the experiences, beliefs and motivation of the current Chinese eye exercises. Almost all participants mentioned three important factors: they experienced the current eye exercises as relaxed, boring and difficult to do correctly. They mentioned that it was nice to have a break in between the lessons and that the exercises leaded to relaxed feelings. At this point most of them believe that the exercises could have some positive effects for the eyes. However, when they were young, they did not understand the benefits of the exercises, they just performed the exercises because they were compulsory. In addition, the participants were not motivated to do the exercises every day, because they were not fun or interesting. They also did not know how to do the exercises correctly, how to position their hands on the right acupuncture points. Massaging the acupuncture points accurately is important to achieve the benefits of these exercises. In both groups the participants mentioned that even the teachers did not know exactly how to perform the exercises correctly.

“I know now that it is quite effective and that it is good for your eyes, for your health. But when I was in primary school I was too young, I couldn’t understand why I had to do it.” (Focus group 2, p1, female)

“Personally I think it is kind of relaxing just as a break between lectures. But to be honest, it is not fun.
We have to repeat for times and times.” (Focus group 1, p3, male)
“It is not fun; it is not an interesting exercise. I think a lot of students just sit there and pretend to do the exercise.” (Focus group 2, p2, male)
“They never told us how to do it right. I mean: you have to find the right acupuncture points, but nobody told me where they are.” (Focus group 2, p1, female)

Interestingly, although the participants experienced the current eye exercises as boring and difficult, not all participants believe that it is needed to replace the current eye exercises with a new set of exercises. However, if there is scientific evidence that another set of exercises has more benefits than the current exercises, they think it is good to replace the current. Some of them mentioned that the focus should lie on playing outdoors instead of doing exercises indoor. In addition, they learned at school that it is good to look outside in the distance. Light condition was also mentioned as a factor which could reduce myopia development.

“If Chinese medicine suggests that there is a better exercise, I think it is good to learn new things. But the old one is still okay for me. I think the problem for me is the passion to do it every day. It should be more fun, more interesting.” (Focus group 2, p1, female)
“I think we should focus on the outdoor environment. For me another reason to mention is the light. The light in my primary school, middle school and high school was very bad. It was hard to see and my eyesight became worse.” (Focus group 2, p3, male)

After watching a short movie clip of the proposed new exercises the participants were asked to write down their opinion and thoughts about the new ‘exercise recipe’. In general, the participants responded positive, especially about the engaging part of the exercises. However, they wonder if students will still like them when they perform the same exercises every day.

“I think your experiment has many advantages. The first is that these graphics will keep the students motivated. I guess that they like it.” (Focus group 1, p2, male)
“I think these exercises will be more interesting, especially the first time, because then it is exciting what comes next and next and you try to focus.” (Focus group 2, p1, female)
“I’m also wondering if it is not too predictable, if every day will be the same.” (Focus group 1, p1, male)

Most of them suggest that it is important that something can change over time. Ideas for changing elements mentioned by participants were: different graphics/characters, different colors and a change in music. In general, they liked the projection of the bird. However, they suggest that it can be improved with more color, a more complex graphic, or a popular cartoon figure. When asking if it has some benefits to include body exercises with eye exercises the opinions were contradictory. Some said it was good to also include body exercises, to keep the body full of energy during the day and to keep students motivated. However others said that the movements were quite similar with the morning exercises, and that it is therefore not needed to also include them in the class break exercises. Both groups mentioned the limitation of space in the classroom. They were wondering if students would not interfere with each other while performing the exercises because of the large number of students per classroom (up to 80 or 90 students per classroom were mentioned), and the limited amount of space per person.
At the end of the focus group session a brainstorm was held about how nine to ten-year old students could be stimulated to execute the class break exercises every day. Involvement of elements of surprise, making the exercises more playful and combining them with a game were commonly mentioned ideas. The theme ‘nature’ was mentioned several times. Forest, underwater world, animal protection and grassland were mentioned as attractive topics. When asking if it would be a good idea to combine an educational aspect with the exercises, conflicting opinions were given. Some said that it is better to create a relaxed atmosphere and let people feel relaxed, while others said it would be good to do something with education because in this way students will keep their attention.

“I think the idea to let people feel relaxed is good. Now they do so much stuff at school. If you combine it with education, people have to think. I think it is better to just do the exercises.” (Focus group 2, p2, male)

“We are so academic, if there is no grade, than I don’t want to do it. So if it is related to the course it will be better, if not, students will not participate I think.” (Focus group 1, p1, male)

In the Chinese school system, competition and rewards are very important (Lin & Qinghai, 1995). While discussing to include a competition or reward system in the exercises, opinions were again contradictory. Some mentioned that it was common to get a small bonus when they do something good, so it would be more motivating for students to also include it in the exercises. Others said that a competition is not important per se, but rather the involvement of all students in the class.

“You feel proud about the flower [reward] you got. But it is not really a competition. You do not compete against other students. Everyone just wants to do something good, so they just reward you with a small flower.” (Focus group 2, p1, female)

“To me it is not important to have a competition, but just to let everyone be involved in this kind of activity.” (Focus group 1, p3, female)

After discussing the ideas of the participants about the engagement part of the exercises, the ideas of the project team were shown on mood boards. The idea was to combine the bird projection with a story. One example is that the bird is flying to Beijing and that information about the city is given by teachers. Most of the participants thought that this could be an interesting idea, but it was difficult for them to come up with new ideas for other stories. In both groups participants mentioned that it could be interesting to tell something about Europe, however one of the reasons for this could be their own new experiences in Europe.

**3.4.4. Discussion**

These focus group sessions were performed to get better insight in the target group experiences with, opinions about and beliefs toward current and proposed new eye exercises. In general, the participants experienced the current Chinese exercises as relaxed, boring and difficult to correctly execute. With the proposed new exercises it is important to keep the relaxed feeling, but to improve the engagement and to guide the students through the exercises. The general opinions about the proposed new exercises were positive. However, although the new exercises were seen as more engaging for students, it was recommended to optimize this further to keep students motivated over time.
Another part that should be investigated is the addition of body exercises to the class break exercises. Both groups mentioned the limited space in the classroom and were wondering if the exercises could be executed correctly, without hindering other students. In addition, some participants doubted the advantage of these exercises, because body exercises are also included in the morning exercises.

Only seven participants in two focus group sessions were interviewed. This is a low number, however, the responses were useful and quite similar across the two focus group sessions. In future studies it might be useful to also perform focus group sessions with Chinese primary school children. These should be performed in China, because Chinese children in the Netherlands are biased and more used to the European culture.

In summary, the new ideas were reviewed as interesting and fun. However, the ‘exercise recipe’ should be further elaborated upon. The final concept should be tested in a quantitative study to prove that the new exercises have more benefits for the eyes. As mentioned before, the concept of the laser-guided exercises is based on four principles to reduce visual discomfort and posture pain related symptoms: (1) distant vision, (2) guided body and eye exercises, (3) a well lit environment and (4) increase motivation. Although it is expected that these four principles have a positive effect on visual comfort, it should be separately tested if this is also the case in primary school students. In the next study the concepts of body exercises and light intensity will be further investigated.
4. Study 2 – Light intensity and body exercises

4.1. Introduction
In this quantitative study two ways to increase visual comfort were investigated by either carrying out a set of body exercises (Experiment 1) or by increasing the light intensity (Experiment 2) in the classroom. The experiments were performed with fourth and fifth grade primary school students (age nine to ten). This group was chosen because at this age myopia development and visual discomfort start to increase (Lam et al., 1999; Wilkins, Huang & Cao, 2004). First a methodology had to be set up and validated. A visual discomfort induction task was created to ensure that children felt visual discomfort symptoms before the experimental interventions. In addition, a neutral reading task was designed to compare the effects of the experimental interventions with a neutral school task. Furthermore a questionnaire was designed to test feelings of visual comfort, emotional status and motivation. To validate the tasks and questionnaires a pilot study with adults and sixth grade primary school students (age eleven to twelve) was performed.

4.2. Pilot study
In this pilot study two hypotheses were tested. First we expected that visual comfort can be reduced through a visual discomfort induction task. Secondly we expected that visual comfort would not be influenced by a neutral reading task.

In this pilot study two samples were tested: adults (N = 14) and primary school children (age eleven to twelve, N = 15). First the pilot with adults was performed to test if the visual discomfort induction task was not too intensive. The pilot study consisted of a within-subject design in which feelings of visual comfort were measured before and after a visual discomfort induction task and before and after a neutral reading task. Because visual discomfort was induced twice in the final experiment (before experimental- and neutral condition), this was also done in this pilot. Therefore we also tested whether there was a difference in feelings of visual comfort after the first and second induction task. Besides this, the reliabilities of the visual comfort, emotional status and motivation scales were analyzed.

The study with adults was carried out in the third week of January 2013 and the study with children in the first week of February 2013.
4.2.1. Method

4.2.1.1. Participants

Adult sample
Participants were recruited in the Eindhoven University of Technology and in the Philips Design building in Eindhoven, the Netherlands. Only Dutch-speaking people could participate, since the tasks and questionnaires were in Dutch. In total, 14 adults took part in this pilot study, of which 11 (78.6%) were male. The mean age was 24.7 (SD: 2.70, range: 19-29) and 8 of them wore glasses or lenses (57.43%).

Primary school sample
Participants were children of the sixth grade (Dutch: groep acht) of Primary school ‘De Opbouw’ in Eindhoven, the Netherlands. Before the start of the experiments, all parents were informed through a consent form. In total 15 children out of a class of 28 children took part in this pilot study, 13 parents did not sign the informed consent. The reason for this was unknown. The mean age was 11.47 (SD: 0.52, range: 11-12) and 9 of them (60%) were boys. In total 5 children wore glasses (33.3%).

4.2.1.2. Setting
The pilot tests with adults took place in quiet office rooms in the Philips design building and in the IPO building at the campus of Eindhoven University of Technology. Participants were tested individually or in groups of two or three. The pilot test with children took place in the coffee room of primary school ‘De Opbouw’. All children were tested simultaneously. The tests were performed during office/school hours.

4.2.1.3. Tasks

Visual discomfort induction tasks
In chapter 2.2 it can be read that different textual characteristics or repetitive patterns can induce visual discomfort. Several tasks with these aspects were considered for the visual discomfort induction task in the present study. A primary consideration was that the task could induce feelings of visual discomfort for a minimum of five minutes (during the entire experimental intervention) and that it resembled a regular school task. In addition the task could not be too difficult and not too boring to ensure that children would stay focused on the task during ten minutes. To make the task not too boring it was decided to choose two different tasks, each of five minutes. It was expected that an exciting children’s story presented in visually stressful conditions (Wilkins, 1995) and a word-search task set on a black and white pattern (Singleton and Henderson, 2007) could meet these demands. Both tasks have been used in studies with primary school children.

The reading task, a story of a children’s book (Dutch reading level: avi 8), was presented in 9-point ‘Times New Roman’ bold font, set ‘single spaced’ with a 4-point horizontal spacing between words. The text was set in different paragraphs of 74 mm wide (two columns on one page), with an interline space of 3.15 mm (see Figure 9). The task consisted of 1.5 pages.

In the visually stressful word-search task a participant had to locate a three-letter word in a matrix of distracting other three-letter words. In the study of Singleton and Henderson (2007) this task was presented on a computer screen, in the current study the task was presented on paper to simulate a regular
school task. In the matrix 18 x 15 letters were presented in 10 point ‘Arial’ bold font. The matrix was set on an alternating black and white horizontally striped background, which filled the entire A4 paper (see Figure 9). The word to be found was printed above the matrix. When the particular word was found participants had to turn the page and search for the next word in another matrix. In total 26 matrixes were given. Both tasks were designed in Microsoft Word 2007.

Neutral task
To test if feelings of visual comfort remain on the same level after a neutral task of five minutes another reading task was created. Funny interesting stories for children were found on the ‘Zo Zit Dat’ website, a website of a Dutch informative children’s magazine. Short stories were presented in a neutral format: 12-point ‘Arial’, aligned to both left and right margins. Colored pictures related to the stories were placed beside the stories (Figure 8). The entire task consisted of six pages.

<table>
<thead>
<tr>
<th>Neutral reading task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dolfijnen sporen bommen op</strong></td>
</tr>
</tbody>
</table>

Source: www.zozitdat.nl/category/weetjes/

Figure 8: Example of the neutral reading task.

Source: Van Mol and Van Gerven (2005)

Figure 9: Visual discomfort induction task: visually stressful reading task and visually stressful word-search task (next page).
win
4.2.1.4. Measures

A questionnaire was specially designed to measure feelings of visual comfort, emotional status and motivation in children. Visual comfort questionnaires of previous studies (e.g. Conlon et al., 1999; Sheedy et al., 2003; Stone, Clarke & Slater, 1980) were examined. Most of these questionnaires included the items: tired eyes, ache, strain, and irritation in or around the eyes, blurred vision, dry eyes and blinking eyes. In some questionnaires also items about musculoskeletal symptoms like neck, back and shoulder pain were included (e.g. Stone, Clarke & Slater, 1980; Tyrell & Leibowitz, 1990; Sheedy & Bergstrom, 2002). Most questionnaires were designed to measure long term effects (trait measures), however in the present study we were interested in short term effects (state measures) of visual comfort. The symptom questionnaire of Stone et al. (1980) was related to short term effects of a particular task. Besides the previous mentioned items also questions about the difficulty and attractiveness of the task were added.

In the present study the same questionnaire was used before and after the visual discomfort induction task and the neutral reading task and therefore the previously mentioned questionnaires needed to be adapted to this study. In the visual comfort scale questions about tiredness, painfulness, blurriness and blinking eyes were asked (for example ‘do your eyes feel tired or rested?’), as well as questions about headache and working posture fatiguing (‘do you suffer from neck, back or shoulder pain?’). The questions about working posture fatiguing can be both related to visual comfort as to musculoskeletal symptoms. The entire scale consisted of ten items. To measure emotional status questions about attention, nervousness and happiness were asked. For each mood state two items were formulated (For example happiness: ‘How angry/cheerful do you feel at this moment?’ and ‘How sad/happy do you feel at this moment?’). The total emotional status scale consisted of six items. Finally, three questions to test motivation were asked (For example: ‘I liked/ did not like the task’). The list of (translated) items can be found in Figure 11.

Although symptom questionnaires are frequently assessed in studies with children, it is argued that questioning children about subjective feelings can give unreliable results due to a lack of understanding of the questions (Northway, 2003). Furthermore, Balague, Dudler and Nordin (2003) state that children are still in the learning process of expressing feelings of pain in an adequate and acceptable manner. When using a questionnaire in children studies a special focus should be on the design of the items and scales. Markopoulos et al. (2008) proposed a list of guidelines for a children’s survey design. Pilot the language, limit writing, use appropriate tools to reduce suggestibility, keep it short and make it fun are some examples of these guidelines which should be taken into account when designing a questionnaire for children. In the present study special attention was given to the language and all questions were discussed with a primary school teacher. In addition, a special scaling method for children was used: the Smileyometer (Read, MacFarlane & Casey, 2002). The Smileyometer is based on a five point Likert scale and designed with the help of children. This scaling method was originally designed to ask children what they think of a product. Underneath the smiley’s textual information was given and children had to make a checkmark on one smiley to indicate their opinion. This is thought to be a very easy tool for children (Markopoulos, Read, MacFarlane & Hoysniemi, 2008). In the present study children were asked to make a checkmark on one smiley to indicate how they felt at a particular moment. The option ‘I cannot answer this question’ was added to check if some questions were too difficult to answer.
All questions were asked in Dutch. Above the different parts of the questionnaire was written: ‘Please indicate how you feel at this particular moment’. Examples of the different questions with the smileyometer can be found in Figure 10, the list of (translated) items in Figure 11. The entire questionnaire can be found in the appendix C.

<table>
<thead>
<tr>
<th>Voelen je ogen moe of uitgerust aan?</th>
</tr>
</thead>
<tbody>
<tr>
<td>super moe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hoe vrolijk/boos voel je op dit moment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>super boos</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ik vond de taak/oefening:</th>
</tr>
</thead>
<tbody>
<tr>
<td>helemaal niet leuk</td>
</tr>
</tbody>
</table>

Figure 10: Examples of some questions of the visual comfort scale (top), emotional status scale (middle) and motivation scale (bottom).
### Visual comfort scale:

1. **Voelen je ogen moe of uitgerust aan?**  
   **Do your eyes feel tired or rested?**
2. **Doen je ogen pijn?**  
   **Do your eyes hurt?**
3. **Zie je scherp (helder) of onscherp (wazig, alsof je water in je ogen hebt)?**  
   **Do you have bright or blurred vision?**
4. **Moet je op dit moment veel knipperen met je ogen (meer dan normaal)?**  
   **Do you have to blink your eyes many times (more than usual)?**
5. **Zou je je ogen nu graag dicht willen doen?**  
   **Would you like to close your eyes?**
6. **Heb je hoofdpijn?**  
   **Do you have a headache?**
7. **Als je de kans zou krijgen om nu een pauze te nemen, zou je dat dan doen?**  
   **Would you like to take a break?**
8. **Heb je last van je nek?**  
   **Do you suffer from neck pain?**
9. **Heb je last van je schouders?**  
   **Do you suffer from shoulder pain?**
10. **Heb je last van je rug?**  
    **Do you suffer from back pain?**

*Items eight, nine and ten were analyzed in a separate sub-scale for posture pain symptoms in the final experiment (see paragraph 4.2.2.1.)*

### Emotional status scale:

1. **Hoe uitgerust/slaperig voel je je op dit moment?**  
   **How rested/tired do you feel right now?**
2. **Hoe onrustig/rustig voel je je op dit moment?**  
   **How restless/calm do you feel right now?**
3. **Hoe vrolijk/boos voel je je op dit moment?**  
   **How cheerful/angry do you feel right now?**
4. **Hoe zenuwachtig/ontspannen voel je je op dit moment?**  
   **How nervous/relax do you feel right now?**
5. **Vind je het moeilijk om je aandacht bij deze vragenlijst te houden?**  
   **Do you think it is difficult to keep your attention to this task?**
6. **Hoe verdrietig/blij voel je je op dit moment?**  
   **How sad/happy do you feel right now?**

### Motivation scale:

1. **Ik vond de taak leuk/niet leuk**  
   **I liked/did not like the task.**
2. **Ik vond de taak/oefening: moeilijk/niet moeilijk.**  
   **The task was /was not difficult.**
3. **Ik zou de taak/oefening tijdens de schoolles: vaak/ niet vaak willen doen.**  
   **I would/ would not like to do the task more often during the school day.**

---

**4.2.1.5. Procedure**

At the beginning of each test, the experiment leader shortly briefed participants, and participants in the adult sample were asked if they suffered from migraine or photosensitive epilepsy, because the visual discomfort induction tasks could provoke an attack (Wilkins, 1995). After the short introduction, an informed consent form was signed. Two weeks before the pilot study with primary school children information letters and informed consent forms were handed out in class. In case the parents gave permission to let their child participate in the study, the forms were signed and returned. Parents were informed that children who suffered from migraine or photosensitive epilepsy were excluded from the study. This was also checked by teachers.
First, participants filled out their personal data: age, gender and whether they wore a vision correcting aid. In addition the participant had to fill out the visual comfort and emotional status scales. Before every questionnaire it was mentioned that the participants had to answer the questions regarding to how they felt at that particular moment. Next the visual discomfort induction task was introduced. Participants silently performed a visually stressful word-search task for five minutes and subsequently a visually stressful reading task for another five minutes. Before the reading task it was mentioned that the participants had to read the text carefully and that they could expect some questions about the content of the text at the end of the experiment. This was done to ensure that participants read the text carefully. When the time of a reading task was over participants highlighted the last sentence they had read.

After the visually stressful tasks, visual comfort and emotional status were measured using the previous mentioned scales. In addition, questions about motivation were given in the children sample. Next, the participant read a neutral reading task for five minutes and the questionnaire was administered again. Then the entire experiment was repeated: visual discomfort induction tasks (10 minutes), questionnaire, neutral task (5 minutes) and questionnaire were handed. One entire session took approximately 50 minutes. The experiment design can be seen in Figure 12.

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 Visual discomfort induction 10 min.</td>
<td>Q2 Neutral task 5 min.</td>
</tr>
<tr>
<td>Q3 Visual discomfort induction 10 min.</td>
<td>Q4 Neutral task 5 min.</td>
</tr>
<tr>
<td>Q5</td>
<td></td>
</tr>
</tbody>
</table>

Figure 12: Design of the pilot study. Q stands for questionnaire.

### 4.2.1.6. Data analysis

A reliability analysis was applied to determine the internal consistency of the visual comfort, emotional status and motivation scales. Cronbach’s alphas were calculated for the different scales given at five different times (see Figure 12). High alpha values imply that the scales are measuring the same construct. If the Cronbach’s alpha was around .6 and no items had a negative item total correlation, the internal consistency was considered as acceptable. Items that reduced the internal consistency were excluded in further analysis.

Next a paired samples t-test was conducted to investigate the differences between feelings of visual comfort before and after the different tasks. The statistical analyses were performed using SPSS 19.0 for Windows.

### 4.2.2. Results

#### 4.2.2.1. Reliability analysis of questionnaires

**Adult sample**

First an outlier analysis was performed. No values were found which exceeded mean visual comfort scores and mean emotional status scores of +/- 2 standard deviations away from the mean. Then a reliability analysis was applied to determine the internal consistency of the visual comfort and emotional...
status scales given at five different times (before and after the visual discomfort induction tasks and neutral tasks).

Cronbach's alphas were calculated for each of the five times participants filled out the visual comfort scales (10 items): .267, .521, .462, .672 and .735 respectively. Negative item total correlations were found in item 3 (‘Do you have bright or blurred vision?’), item 5 (‘Would you like to close your eyes?’) item 7 (‘Would you like to take a break?’) and item 9 (‘Do you suffer from back pain?’). When excluding item 7 Cronbach’s alphas in all five questionnaires became higher. In addition, when excluding item 9, total item correlations of item 8 and 10 became very low. Besides this, item 8, 9 and 10 (‘Do you suffer from neck, back and shoulder pain?’), had relatively high inter-item correlations. For this reason these three items were further analyzed in a separate subscale for posture pain symptoms.

After excluding items 7 till 10, the internal consistency of the visual comfort scale was considered as acceptable (Cronbach’s Alphas: .702, .592, .593, .697 and .721 respectively). In addition, all total item correlations were positive, except for item 3 in questionnaire one. However, this item describes one of the most important symptoms of visual comfort (bright or blurred vision), and for that reason it was still included.

Cronbach’s alphas of the items 8, 9 and 10 (new subscale for posture pain symptoms) were high (.828, .867, .917, .821 and .907 respectively). Cronbach’s alphas of the emotional status scales highly varied (.697, .353, .176, .000 and .629). Item 1 and 5 (both about attention) had a negative item-total correlation in questionnaires two, three and four. When excluding these items Cronbach’s alphas became higher (.766, .649, .537, .435 and .621) and no negatively correlated items occurred. However, it was interesting to know how tired participants were after performing the different tasks. In the pilot test with children the same items were utilized. After the analysis of this pilot study we considered which items to include in the final experiment. An overview of the reliability analysis can be found in appendix D.

**Children sample**

Again an outlier analysis was performed for the mean visual comfort and emotional status scores. One subject was left out of analysis because of mean scores below 2 standard deviations from the overall mean.

The internal consistency of the five visual comfort scales (all ten items) was high with Cronbach’s Alphas of .386, .865, .935, .891 and .792 respectively. Conform the results of the pilot study with adults, negative or low item-total correlations occurred in items 8, 9 and 10. When excluding these items Cronbach’s Alphas became even higher: .462, .917, .924, .939 and .863 respectively and no negative item-total correlations occurred. Contrary to the results of the pilot test with adults, excluding item 7 reduced Cronbach Alpha’s in all questionnaires. Therefore this item was still included in further analysis and hence the first seven items were utilized in the final experiment to subjectively test feelings of visual comfort.
Cronbach’s Alpha’s for the items 8, 9 and 10 (posture pain symptoms), were high (.340, .718, .970, .902 and .845) consistent with the pilot study with adults, and therefore these items were analyzed in a separate subscale for posture pain symptoms in the final experiment.

The internal consistency of the emotional status scale (all six items) was acceptable, with Cronbach’s Alphas of .663, .614, .854, .831 and .824 with no negative item-total correlations. Therefore all six items were included in the emotional status scale in the final experiment.

Finally, items about motivation (three items) were given in questionnaire two (after the first visual discomfort induction task) and three (after the first neutral task). The internal consistency of these items was acceptable (Cronbach’s alpha’s of .585 and .793) and therefore included in the final experiment. An overview of the reliability analysis can be found in appendix D.

In the final experiment the following items were used for the different subscales:

- Visual comfort: items 1 till 7
- Posture pain: items 8 till 10 (originally from the visual comfort scale)
- Emotional status: items 1 till 6
- Motivation: items 1 till 3

The list of items can be found in Figure 11.

### 4.2.2.2. Comparing mean scores of visual comfort

**Adult sample**

A paired samples t-test was applied to test if feelings of visual comfort decreased after the visual discomfort induction task and if it remained on the same level after a neutral reading task. Items 7 till 10 were excluded in this analysis. The results can be found in Figure 13.

On average participants in the adult sample experienced significantly lower feelings of visual comfort after the visual discomfort induction task (M2 = 3.61, SE = 0.10), than before (M1 = 3.94, SE = 0.11), \( t(13) = 3.27, p < .01 \). As expected no significant difference (\( p = .828 \)) of visual comfort level was found after the neutral reading task (M3 = 3.62, SE = 0.10), compared with the visual comfort score before this task. Therefore it can be concluded that feelings of visual comfort remained on the same level after the neutral task. The same effects were found in the second part of the pilot study: visual comfort level reduced after the second visual discomfort induction task (M4 = 3.49, SE = 0.12), \( t(13) = 2.35, p = .035 \) and no significant difference (\( p = .389 \)) was found after the neutral reading task (M5 = 3.43, SE = 0.13).

Comparing the effects of the two visual discomfort induction tasks, lower scores on visual comfort level were found after the second visual discomfort induction task (M4 = 3.49, SE = 0.12) compared with the first visual discomfort induction task (M2 = 3.61, SE = 0.10), however this difference was not significant (\( p = .075 \)).

An overview of the results can be found in Figure 13 and Figure 14.
A paired samples t-test was also conducted to test the differences of feelings of visual comfort after the different tasks in the pilot study with children. Items eight till ten were excluded in this analysis. The results can be found in Figure 15 and Figure 16. Results were comparable with the pilot test with adults. Mean scores on visual comfort reduced after the visual discomfort induction task (M2 = 3.44, SE = .23) compared with feelings of visual comfort before the task (M1 = 3.87, SE = .13), and as expected, this effect was significant (t(13) = 1.77, p = .016). No significant difference (p = .344) was found after performing a neutral task (M3 = 3.57, SE = .20) compared with mean scores before this task. In the
second part of the experiment feelings of visual comfort reduced after the second induction task ($M_4 = 3.33, SE = .23$) and this effect was again significant ($t(13) = 2.70, p = .018$). After the second neutral task visual comfort remained on the same level ($p = .566$).

Like in the pilot test with adults lower scores on visual comfort level were found after the second discomfort induction task compared with the first, however this effect was again not significant ($t(13) = 1.03, p = .323$).

An overview of the results can be found in Figure 15 and Figure 16.

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q1</strong></td>
<td>Mean: 3.87</td>
</tr>
<tr>
<td>SE: .13</td>
<td>SE: .17</td>
</tr>
<tr>
<td><strong>Q2</strong></td>
<td>Mean: 3.44</td>
</tr>
<tr>
<td>SE: .23</td>
<td>SE: .23</td>
</tr>
<tr>
<td><strong>Q3</strong></td>
<td>Mean: 3.57</td>
</tr>
<tr>
<td>SE: .20</td>
<td>SE: .23</td>
</tr>
<tr>
<td><strong>Q4</strong></td>
<td>Mean: 3.33</td>
</tr>
<tr>
<td>SE: .23</td>
<td>SE: .17</td>
</tr>
</tbody>
</table>

- $t(13) = 2.77$  
  $p = .016$  
  $r = .61$

- $t(13) = -0.98$  
  $p = .344$  
  $r = .26$

- $t(13) = 2.70$  
  $p = .018$  
  $r = .60$

- $t(13) = 0.59$  
  $p = .566$  
  $r = .16$

- $t(13) = 1.02$  
  $p = .323$  
  $r = .274$

Figure 15: Results of the paired t-test for subjective feelings of visual comfort in the children sample. I stands for visual discomfort induction task, N stands for neutral task. Note: significant differences are indicated in bold.
4.2.3. Discussion

The goal of this study was to set up and pilot a methodology to test experimental interventions on visual comfort, musculoskeletal symptoms, emotional status and motivation. Two visual discomfort induction tasks, a neutral task and a questionnaire were designed. We hypothesized that visual comfort can be reduced through a visual discomfort induction task and that visual comfort remained on the same level after a neutral reading task.

In line with our hypotheses visual comfort reduced after performing the visual discomfort induction task and remained on the same level after the neutral task. This was found in both the adult as the children sample. Because visual discomfort will be induced twice in the final experiment it was tested whether there was a difference between feelings of visual comfort after the first and the second induction task. Lower levels of visual comfort were found after the second induction task in both samples. These differences were not significant, however it would be better to include a break in between the two sessions, so participants can restore from the induced effects of the performed tasks of the first session. Another benefit of the break is that children can also relax and talk a little bit. During the pilot test it was observed that some children had difficulties staying concentrated until the end of the test. Also teachers mentioned that it is difficult for young children to stay focused and calm during fifty minutes. Therefore a short break should be included in the experiment where children can play a nice game.

The number of questionnaires should also be taken into consideration for the experiment, because children indicated that it was quite boring to fill out the same questionnaires for five times. In this pilot study it is proved that visual comfort reduced after the visually stressful tasks. Therefore measures before the visual discomfort induction task are not necessary. It will be interesting to measure the level of visual comfort, posture pain symptoms and emotional status at the start of the experiment and after the break.

Figure 16: Visual comfort scores in the adult sample. I stands for visual discomfort induction task, N stands for neutral task.
However, increasing the number of questionnaires can result in unreliable measurements due to a lack of motivation to fill out the questionnaires.

The internal consistencies of the visual comfort, emotional status and motivation scales were found to be reliable. From previous research it was expected that pain in the back, neck and shoulders are symptoms of visual discomfort (Stone, Clarke & Slater, 1980; Sheedy and Bergstrom, 2002). In the present study we found that the three items about back, neck and shoulder pain reduced the internal consistency of the visual comfort scale. Therefore we expect that posture related symptoms are more indirect symptoms that could accompany visual discomfort. When small letters are read children lean forwards to improve their visual comfort (Grimes & Legg, 2004) which might result in posture pain symptoms. However, it need not be a direct effect of visual comfort due to different locations of symptoms. Because we were still interested in musculoskeletal pain in children we decided to make a separate subscale for the three items about posture pain symptoms.

In the experiment the validated tasks and questionnaire were applied to investigate the effects of two different experimental interventions: performing a set of body exercises or increasing the light intensity.

4.3. Experimental interventions

In this field-study it was investigated whether performing a set of body exercises (Experiment 1) or increasing the light intensity (Experiment 2) has an effect on visual comfort, emotional status and musculoskeletal pain. We hypothesized that these experimental interventions can lead to increased feelings of visual comfort, can lead to a reduction of musculoskeletal pain in the areas neck, back and shoulder and can increase positive emotional status.

The visual discomfort induction tasks, neutral task and questionnaires, which were validated in the pilot study were utilized in this experiment. Like the pilot study these experiments consisted of a within-subject design in which feelings of visual comfort, emotional status and musculoskeletal pain were tested before and after the experimental interventions (body exercises or light intensity) and the neutral task. The design was counterbalanced to test for order differences. Two separate studies were performed for the two experimental interventions. Participants were randomly assigned to one of four groups:

- Group 1a – Experiment 1: Neutral task – Body exercises
- Group 1b – Experiment 1: Body exercises – Neutral task
- Group 2a – Experiment 2: Neutral task – Light condition
- Group 2b – Experiment 2: Light condition – Neutral task

This study was performed in four classrooms of primary school ‘De Opbouw’ in Eindhoven and was carried out in the second week of April 2013 on Friday afternoon. All groups were tested simultaneously.
4.3.1. Method

4.3.1.1. Participants
Participants were children of the fourth and fifth grade (Dutch: groep 6/7) of Primary school ‘De Opbouw’ in Eindhoven, the Netherlands. In total 40 out of 58 children participated in this study. 13 parents did not sign the informed consent, 4 parents did not respond at all and 1 child was ill on the day of the experiment. In addition, 1 child was excluded from the study, because he/she suffered from epilepsy. The reasons why the other parents did not sign the consents were unknown. The mean age was 10 years and 10 months (SD: 0.775, range: 9 years and 5 months – 12 years and 5 months). 18 of them were boys (45%). Participants were randomly assigned (gender, age, disabilities) to one of the four groups. An overview of the number of children per group can be found in Table 2.

<table>
<thead>
<tr>
<th>Group</th>
<th>Male</th>
<th>Female</th>
<th>Mean age</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a: Neutral task – body exercises</td>
<td>4</td>
<td>4</td>
<td>10 years + 7 months</td>
<td>0.778</td>
</tr>
<tr>
<td>1b: Body exercises – Neutral task</td>
<td>6</td>
<td>6</td>
<td>11 years</td>
<td>0.889</td>
</tr>
<tr>
<td>2a: Neutral task – light condition</td>
<td>4</td>
<td>6</td>
<td>10 years + 9 months</td>
<td>0.717</td>
</tr>
<tr>
<td>2b: Light condition – neutral task</td>
<td>4</td>
<td>6</td>
<td>11 years</td>
<td>0.713</td>
</tr>
</tbody>
</table>

4.3.1.2. Light setting
The experiments were carried out in four classrooms of primary school ‘De opbouw’ in Eindhoven. The same lighting system was implemented in all classrooms. With this lighting system four different light settings could be chosen. In the body exercise experiment a light setting of approximately 300 lx and 4000 K was used. During the five minutes experimental treatment in the light experiment the light was set on approximately 1000 lx and 6500 K (high intensity setting). During the remaining part the light was set on 300 lx and 4000 K (normal setting).

The weather during the experiment day continuously changed. It varied between dark clouds with rain and a blue sky with sun. All classroom windows had sunblinds which were automatically controlled, dependent on the day light level. These could not be manually controlled. Because of the weather condition the blinds went up and down several times and therefore the light condition highly varied. Daylight sensors in the lighting system could anticipate on natural daylight, however this was not enough to compensate for light intensity differences. In the classrooms where the light experiments were performed the light setting was measured during the experiment. The normal setting varied from 360 lx, 4900 K to 1830 lx, 5850 K and the high intensity setting varied from 630 lx, 2540 K to 1360 lx, 5030 K. The two classrooms for the light experiment were positioned next to each other, so the influence of daylight could be considered as equal.
4.3.1.3. Tasks

Visual discomfort induction task
The same visual discomfort induction tasks were utilized as previously used in the pilot study (see paragraph 4.2.1.3.). First the visually stressful reading task had to be executed for five minutes and then children had to locate words in the visually stressful word-search task for another five minutes.

Neutral task
The same neutral task was used as during the pilot study (see paragraph 4.2.1.3.). The task consisted of seven pages of short interesting stories of a Dutch informative children’s magazine.

Experiment 1 – Body exercises
A five-minute set of body exercises was created in accordance to expert interviews with (pediatric) physiotherapists (see chapter 3.3.4 and Figure 6). The exercises consisted of both dynamic exercises and stretching exercises to stimulate blood flow and to relieve the muscles used when seated, from the static load produced by sitting. The following exercises were used: dynamic jumping exercises, pelvic/buttock exercises, breathing exercises, shoulder exercises and neck exercises. A five-minute movie clip was shown on the interactive digital school board, so children could imitate the movements. A voice instruction was added to the movie clip to be sure that children knew exactly which exercises to perform.

Experiment 2 – Light
As mentioned before, during the five minutes experimental intervention the light was set from ‘normal’ (approximately 300 lx, 4000 K) to ‘high intensity’ (approximately 1000 lx, 6500 K) (Note: these numbers should be considered with caution because of the influence of varying natural day light, see paragraph 4.3.1.2.) During these five minutes children read a neutral reading task (see paragraph 4.2.1.3.). This task consisted of seven pages of short interesting stories of a Dutch informative children’s magazine.

4.3.1.4. Measures
The questionnaire, which was validated in the pilot study, was utilized in this experiment. The visual comfort scale consisted of seven items (pre-questionnaire Cronbach’s $\alpha = .851$, post-questionnaire Cronbach’s $\alpha = .888$), the posture pain symptoms scale consisted of three items (pre-questionnaire Cronbach’s $\alpha = .804$, post-questionnaire Cronbach’s $\alpha = .860$), the emotional status scale of six items (pre-questionnaire Cronbach’s $\alpha = .796$, post-questionnaire Cronbach’s $\alpha = .858$), and finally the motivation scale of three items (post-questionnaire Cronbach’s $\alpha = .684$). All items of the questionnaire can be found in Figure 11.

4.3.1.5. Procedures
First the participants were told to which of the four groups they were assigned and were sent to the right classrooms. Three teachers and the experiment leader simultaneously conducted an experiment with one group each. To be sure that all groups were identically instructed a protocol was set up and discussed with the teachers.

The experiment consisted of two sessions. In each session participants started to perform the visual discomfort induction task (ten minutes). After this task they filled out their personal data (age in years plus months, gender and if they wore glasses) and the questionnaire to test visual comfort, posture pain...
symptoms and emotional status. Then either a neutral task or experimental task (body exercises/light intervention) was performed for five minutes. Next they had to fill out the same questionnaire, as well as a scale to test motivation. Between the two sessions a break of five minutes was included where children played the game hangman. This was done to neutralize the effects of the tasks of session one. The entire experiment took approximately 45 minutes. The experimental design for the four groups can be found in Figure 17. Before every questionnaire it was mentioned that the participants had to answer the questions regarding to how they felt at that particular moment. Before the reading tasks it was mentioned that the participants had to read the text carefully and that they could expect some questions about the content of the text at the end of the experiment. When a reading task was finished participants highlighted the last sentence they had read.

Light settings (intensity and color temperature) were measured before the start of the experiment in all four classrooms. In the two classrooms of the light experiment, light settings were measured during the experiment.

<table>
<thead>
<tr>
<th></th>
<th>Session 1</th>
<th>Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Visual discomfort induction</td>
<td>Visual discomfort induction</td>
</tr>
<tr>
<td></td>
<td>Pre Q.</td>
<td>Neutral task</td>
</tr>
<tr>
<td>Group 2</td>
<td>Visual discomfort induction</td>
<td>Pre Q.</td>
</tr>
<tr>
<td>Time:</td>
<td>10 min.</td>
<td>5 min.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Session 1</th>
<th>Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Visual discomfort induction</td>
<td>Visual discomfort induction</td>
</tr>
<tr>
<td></td>
<td>Pre Q.</td>
<td>Neutral task</td>
</tr>
<tr>
<td>Group 2</td>
<td>Visual discomfort induction</td>
<td>Pre Q.</td>
</tr>
<tr>
<td>Time:</td>
<td>10 min.</td>
<td>5 min.</td>
</tr>
</tbody>
</table>

Figure 17: Within- and cross design experimental 1: performing body exercises (up) and experiment 2: Increasing the light intensity. Q stands for questionnaire.

4.3.1.6. Data analysis
Linear Mixed Model (LMM) analyses were performed to investigate the effect of either performing body exercises or increasing the light intensity on subjective measures of visual comfort, posture pain symptoms and emotional status (post-questionnaires). These results were compared with performing a neutral task. A LMM analysis was chosen because the cases of data were dependent (the same
participants were measured in the experimental as well as in the neutral condition in two groups). In addition LMM analysis can deal with missing values.

Separate LMM analyses were applied for each dependent variable. In these analyses, participant was added as random variable to group the data per participant and to indicate that each participant was measured twice (two sessions). Pre-questionnaire measures were added as covariate and session, condition (neutral and body exercises/light condition) and the interaction between these two variables were added as predictors for the dependent variable. Post-hoc tests were performed to test the differences between post-measures in the different groups.

Besides the LMM analyses t-tests were performed to test whether the differences between pre- and post measures were significant in the two subgroups within one experiment. The statistical analyses were performed using SPSS 19.0 for Windows.

4.3.2. Results

4.3.2.1. Experimental 1 – Performing body exercises
First we investigated if order, starting with either a neutral task or body exercises, had an effect on pre-measures of visual comfort, emotional status and posture pain symptoms. The variables session (first or second), condition (neutral or body exercises) and the interaction between these two variables were added as fixed factors. The factor session has a significant effect on pre-measures of visual comfort (p = .005), emotional status (p = .003) and posture pain symptoms (p = .001). Especially pre-measures before the body exercises in the second session showed more symptoms (see Table 3). Therefore in the next analysis pre-measures were added as covariates to control for these measures.

Next separate LMM analyses were applied for each dependent variable, with session, condition and the interaction effect between session and condition as fixed factors and pre-measures of the dependent variable as covariate.

Table 3: Results of Linear mixed model analysis for effects of session on pre-measures.

<table>
<thead>
<tr>
<th></th>
<th>Session 1</th>
<th></th>
<th>Session 2</th>
<th></th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutral task</td>
<td>Body exercises</td>
<td>Neutral task</td>
<td>Body exercises</td>
<td>F   df    p</td>
</tr>
<tr>
<td>Visual comfort</td>
<td>EMM      SE</td>
<td>EMM      SE</td>
<td>EMM      SE</td>
<td>EMM      SE</td>
<td>F   df    p</td>
</tr>
<tr>
<td></td>
<td>3.407  .178</td>
<td>3.321  .145</td>
<td>3.490  .151</td>
<td>2.429  .178</td>
<td>10.03 (1,20) .005</td>
</tr>
<tr>
<td>Emotional status</td>
<td>3.563  .173</td>
<td>3.361  .141</td>
<td>3.498  .144</td>
<td>2.917  .173</td>
<td>11.75 (1,19) .003</td>
</tr>
<tr>
<td>Posture pain symptoms</td>
<td>1.958  .250</td>
<td>1.972  .204</td>
<td>1.966  .211</td>
<td>3.292  .250</td>
<td>15.60 (1,16) .001</td>
</tr>
</tbody>
</table>

Note: EMM stands for estimated marginal means.
**Visual comfort**

LMM analysis on post-measures of visual comfort showed that there was no significant main effect of the body exercise condition \( F(1,28) = 2.38, p = .134 \). However, there was a significant interaction effect between condition and session \( F(1,22) = 6.038, p = .022 \). The covariate (pre-measures visual comfort) was significant \( F(1,33) = 10.20, p = .003 \).

Post-hoc tests with Bonferroni correction showed that there was a significant difference \( p = .002 \) between post-measures of the neutral task (EMM = 2.823, SE = .172) and the body exercises (EMM = 3.557, SE = .139) in session one. This effect did not occur in the second session \( p = .592 \). In Figure 18 and in Table 5 it can be seen that participants of group 1a started the body exercise condition in session two with a lower level of visual comfort (M = 2.306) compared with the children of group 1b who performed a neutral task in the last session (M = 3.480). This means that the children of group 1a were probably not fully restored after the break, from the visual discomfort induction task which they had performed in the first session.

Looking to the directions of the effects it can be seen that these were in the expected directions in both sessions: feelings of visual comfort increased after the body exercise condition and decreased/remained the same after the neutral condition. To figure out if the differences between pre- and post measures were significant a t-test was performed for the two different sub-groups in the two sessions. These results can be found in Table 5. The mean scores can be seen graphically in Figure 18. It can be seen that there was a significant difference between measures before the body exercises condition (M = 3.321, SE = .129) and after this condition (M = 3.619, SE = 1.31) with \( t(11) = -2.233, p = .047 \) in the first session. This effect was not significant in the second session \( p = .242 \). However it should be mentioned that only seven children \( (df = 6) \) filled out the post-questionnaire (the total group consisted of eight children and one child went to the bathroom during the last session). The differences between the pre- and post measures in the neutral condition were, as expected, not significant (session one: \( p = .121 \), session two: \( p = .714 \)).
Figure 18: Graphical view of means (M) (dark colors) for pre- and post measures, and estimated marginal means (EMM) (light triangles) for post-measures of the neutral (green) and body exercise (red) condition. P-values are given for EMM differences between post-measures within one session, and for M differences between pre- and post measures.

Table 4: Results of the Linear mixed model analysis on post measures of visual comfort (VC).

<table>
<thead>
<tr>
<th>VC post-measures</th>
<th>EMM</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral session 1</td>
<td>2.823</td>
<td>.172</td>
</tr>
<tr>
<td>Body session 1</td>
<td>3.557</td>
<td>.139</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>3.311</td>
<td>.151</td>
</tr>
<tr>
<td>Body session 2</td>
<td>3.151</td>
<td>.229</td>
</tr>
</tbody>
</table>

Table 5: Results of the t-test for pre- and post measures of visual comfort (VC).

<table>
<thead>
<tr>
<th>VC pre-measure</th>
<th>VC post-measures</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Neutral session 1</td>
<td>3.407</td>
<td>.10</td>
</tr>
<tr>
<td>Body session 1</td>
<td><strong>3.321</strong></td>
<td><strong>.129</strong></td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>3.480</td>
<td>.095</td>
</tr>
<tr>
<td>Body session 2</td>
<td>2.306</td>
<td>.356</td>
</tr>
</tbody>
</table>

Note: Significant differences are indicated in bold.

**Emotional status**

LMM analysis on post-measures of emotional status showed that there was a significant main effect of the body exercise condition (F(1,25) = 10.76, p = .003). Besides this a significant interaction effect of
condition and session was found (F(1,20) = 16.96, \( p = .001 \)). The covariate (pre-measures emotional status) was significant (F(1,28) = 107.01, \( p = .000 \)).

Post-hoc tests with Bonferroni correction showed that there was a significant difference (\( p < .001 \)) between post-measures of the neutral task (EMM = 2.974, SE = .106) and the body exercises (EMM = 3.730, SE = .085) in session one, however this effect did not occur in the second session (\( p = .489 \)). In Figure 19 and Table 7 it can be seen that in the second session pre-measures of emotional status were lower for participants of group 1a who performed the body exercises (M = 3.024) compared with participants of group 1b who performed the neutral task (M = 3.500). As explained in the previous paragraph this can be due to the fact that the children of group 1a were not fully restored after the break, from the visual discomfort induction task which they had performed in the first session.

Similar to the previous mentioned analysis for visual comfort, t-tests were performed to investigate the differences between pre- and post measures for the two different sub-groups in the two sessions. These results can be found in Table 7 and Figure 19. It can be seen that there was a significant difference between pre-measures (M = 3.361, SE = .102) and post-measures (M = 3.708, SE = .182) in the body exercise condition in the first session (\( p = .006 \)). In contrast, this effect was not significant in the second session (\( p = .457 \)). Similar to the visual comfort scale this scale was only filled out by seven participants (\( df = 6 \)). Unexpectedly the differences between pre- and post measures for the neutral task were significant in the first session (\( p = .010 \)): significantly lower scores of emotional status were found after the neutral task. In the second session scores of emotional status remained the same (\( p = .574 \)).

![Figure 19](image.png)

Figure 19: Graphical view of means (M) (dark colors) for pre- and post measures, and estimated marginal means (EMM) (light triangles) for post-measures of the neutral (green) and body exercise (red) condition. \( p \)-values are given for EMM differences between post-measures within one session, and for M differences between pre- and post measures.
Table 6: Results of the Linear mixed model analysis on post measures of emotional status (ES).

<table>
<thead>
<tr>
<th></th>
<th>EMM</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral session 1</td>
<td>2.974</td>
<td>.106</td>
</tr>
<tr>
<td>Body session 1</td>
<td>3.730</td>
<td>.085</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>3.420</td>
<td>.090</td>
</tr>
<tr>
<td>Body session 2</td>
<td>3.314</td>
<td>.118</td>
</tr>
</tbody>
</table>

Table 7: Results of the t-test for pre- and post measures of emotional status (ES).

<table>
<thead>
<tr>
<th></th>
<th>ES pre-measure</th>
<th>ES post-measures</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Neutral session 1</td>
<td>3.563</td>
<td>.191</td>
<td>3.1667</td>
</tr>
<tr>
<td>Body session 1</td>
<td>3.361</td>
<td>.102</td>
<td>3.708</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>3.500</td>
<td>.137</td>
<td>3.556</td>
</tr>
<tr>
<td>Body session 2</td>
<td>3.024</td>
<td>.283</td>
<td>2.929</td>
</tr>
</tbody>
</table>

Note: Significant differences are indicated in bold.

Posture pain symptoms
Due to too many missing values a LMM analysis for posture pain symptoms could not be performed. Only five children of group 1a filled out the scale after the body exercise condition in the second session. One child went to the bathroom and two children forgot to fill in the page with the posture pain symptom scale. Therefore only a t-test was performed. The results of this analysis for posture pain symptoms can be found in Table 8. It can be seen that pre-measures (except for body exercise condition in session two) were low, which means that the visual discomfort induction task had little effect on posture pain symptoms. Contrary to the expectations significantly more posture pain symptoms were indicated after the neutral task as well as the body exercise condition in session one ($p = .029$ and $p = .014$ respectively). In the second session, more posture pain symptoms were found after the neutral condition and fewer symptoms were indicated after the body exercise condition in the last session. However, these effects were not significant ($p = .251$ and $p = .195$ respectively).

Table 8: Results of the t-test for posture pain symptoms (PPS).

<table>
<thead>
<tr>
<th></th>
<th>PPS pre-measure</th>
<th>PPS post-measures</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Neutral session 1</td>
<td>1.958</td>
<td>.206</td>
<td>2.708</td>
</tr>
<tr>
<td>Body session 1</td>
<td>1.972</td>
<td>.223</td>
<td>2.399</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>1.879</td>
<td>.157</td>
<td>2.152</td>
</tr>
<tr>
<td>Body session 2</td>
<td>3.800</td>
<td>.343</td>
<td>3.200</td>
</tr>
</tbody>
</table>
Figure 20: Graphical view of the results of the t-test on posture pain symptoms for the neutral condition (green) and body exercise condition (red). P-values are given for differences between pre- and post measures.

Motivation
Due to too many missing values (only five children filled out the scale after the body exercise condition in the second session) a LMM analysis for motivation could not be performed. Results of a t-test analysis of motivation can be found in Table 9. Note that questionnaires were only given after the neutral and body exercise tasks. Mean values were almost equal, except for the body exercise condition in session two. However, the difference between both tasks was not significant.

Table 9: Results of the t-test for motivation.

<table>
<thead>
<tr>
<th></th>
<th>Motivation session 1</th>
<th>Motivation session 2</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
</tr>
<tr>
<td>Neutral task session 1 &amp;</td>
<td>3.133</td>
<td>.327</td>
<td>2.333</td>
</tr>
<tr>
<td>body ex. session 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body ex. session 1 &amp;</td>
<td>3.222</td>
<td>.118</td>
<td>3.25</td>
</tr>
<tr>
<td>Neutral task session 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: t-test analyses were performed for both groups: group 1a (neutral task session 1 & body exercises session 2) and group 1b (body exercises session 1 and neutral task session 2).
4.3.3. Discussion

The goal of this study was to investigate if performing a set of body exercises could increase visual comfort and emotional status, and could reduce musculoskeletal symptoms. To test this intervention, participants first performed a visual discomfort induction task and subsequently a set of body exercises or a neutral task. The results showed that performing a set of body exercises in the classroom can increase visual comfort and can lead to more positive feelings in primary school children. These effects did not occur after performing a neutral task.

In contrast with our expectations a significant increase in posture pain symptoms was found after both the body exercise condition as well as the neutral condition in session one. In session two a reduction of reported symptoms was found after the body exercise condition, but this effect was not significant and the sample size of this group was low (n = 5). In Table 3 it can be seen that the reported symptoms after the visual discomfort induction task (pre-measures) were low (except for group 1a in session two) which means that this induction task had little effect on posture pain symptoms. The task was mainly designed to induce visual discomfort. However, we expected that visual constraints can have an indirect effect on posture pain. When small letters are read children lean forwards to improve their visual comfort (Grimes & Legg, 2004) which might result in posture pain symptoms. This effect is only found in the second session for children who performed a neutral task in the first session, and body exercises in session two (group 1a). These children experienced low feelings of visual comfort and high feelings of posture pain symptoms after the second visual discomfort induction task. After performing body exercises feelings of posture pain symptoms reduced, however, this effect was not significant. An explanation for these results can be that exercises only have an influence on musculoskeletal symptoms in the long term.

A reason for low pre-measures of the body exercise condition in the second session (group 1a) can be that children were not totally restored from the visual discomfort induction task they performed in session one (group 1a). To neutralize the effects of the first session a break was included in between the two sessions. However, this break was probably too short (five minutes) to reach this goal. In contrast, children of group 1b scored equal pre-measures in the two sessions. This group preformed body exercises in session one, which improved visual comfort. Participants of group 1b performed a neutral task in session one, which did not improve visual comfort.

Moreover, children of group 1a were less motivated to perform the body exercises (session two) than to perform the neutral task (session one). Although the difference between reported motivation of the neutral task and the body exercise task was not significant (p = .170), it was observed that children had some difficulties staying concentrated until the end of the test. In the last session they complained that the experiment took too long, which probably reduced their motivation. This might also be related to the fact that three children did not fill out the last two scales of the questionnaire. Hence, results of the last session for children of group 1a should be considered with caution. Fewer complaints were observed in children of group 1b and motivation scores for both sessions were equal (p = .894). This might be due to the presence of a teacher, who conducted the experiment in this group. In the other group this was done by the experiment leader. The teacher has more experience how to approach and motivate children to finish their tasks.
Only twenty children participated in this experiment, however, similar results were found for both groups. We have found useful insights of the effect of performing a set of body exercises on visual comfort and emotional status in children.

**4.3.3.1. Experimental 2 – Increasing the light intensity**

The same analyses were performed for the light intervention. Again we first investigated if order had an effect on pre-measures of visual comfort, emotional status and posture pain symptoms. The variable session, condition (neutral or light) and the interaction effect between these two variables were added as fixed factors. Results can be found in Table 10. The factor session has a significant effect on pre-measures of visual comfort ($p < .001$), emotional status ($p = .044$) and posture pain symptoms ($p = .005$). Therefore pre-measures were added as covariates to control for these variables in the next analyses.

| Table 10: Results of Linear mixed model analysis for effects of session on pre-measures. |
|----------------------------------------|----------------------------------------|-------------------|
|                                      | Session 1                                | Session 2                                | Statistics          |
|                                      | Neutral task Light condition              | Neutral task Light condition              |                      |
|                                      | EMM  SE                                 | EMM  SE                                 | F                 |
| Visual comfort                       | 3.129 .248                              | 3.100 .248                              | 23.54 (1,20) <.001 |
| Emotional status                     | 3.400 .234                              | 3.483 .234                              | 4.620 (1,20) .044  |
| Posture pain symptoms                | 2.233 .319                              | 1.733 .319                              | 10.15 (1,20) .005  |
|                                      | 1.900 .319                              | 2.833 .319                              |                    |

Next separate LMM analyses were applied for each dependent variable, with session, condition and the interaction effect between session and condition as fixed factors and pre-measures of the dependent variable as covariate. However when doing these analyses the variance of the random intercept (participant) showed to be zero which means that there were no correlations within participants which differed between participants. In other words, the random intercept did not vary between participants. For this reason the random intercept ‘participants’ is removed in further analyses.

**Visual comfort**

LMM analysis on post-measures of visual comfort showed that there was no significant main effect of the light condition ($F(1,40) = 0.182, p = 672$). Besides this no significant interaction effect between session and condition was found ($F(1,40) = 0.176, p = .677$). The covariate (pre-measures visual comfort) was significant ($F(1,40) = 162.83, p < .001$). Post-hoc tests with Bonferroni correction showed that the estimated marginal means of post-measures of the neutral task (EMM = 2.853, SE = .121) and the light condition (EMM = 2.852, SE = .120) in session one were equal ($p = .996$). Similar results were found in session two ($p = .553$). The results of the LMM analysis can be seen in Table 11 and Figure 21.
Table 11: Results of Linear mixed model analysis on post measures of visual comfort (VC).

<table>
<thead>
<tr>
<th></th>
<th>VC post-measures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EMM</td>
<td>SE</td>
</tr>
<tr>
<td>Neutral session 1</td>
<td>2.853</td>
<td>.121</td>
</tr>
<tr>
<td>Light session 1</td>
<td>2.852</td>
<td>.120</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>2.841</td>
<td>.120</td>
</tr>
<tr>
<td>Light session 2</td>
<td>2.740</td>
<td>.121</td>
</tr>
</tbody>
</table>

Figure 21: Graphical view of estimated marginal means (EMM) for pre- and post measures of the neutral condition (green) and light condition (orange) for visual comfort.

**Emotional status**

LMM analysis on post-measures of emotional status showed that there was no significant main effect of condition (F(1,40) = 0.551, p = .479). Besides this no significant interaction effect was found between condition and session (F(1,40) = 1.360, p = .250). The covariate (pre-measures emotional status) was significant (F(1,40) = 209.82, p < .001). Post-hoc tests with Bonferroni correction showed no significant differences between post-measures of both conditions in the first session (p = .752) and in the second session (p = .191). Table 12 and Figure 22 show the estimated marginal means.

Table 12: Results of Linear mixed model analysis of post measures on emotional status (ES).

<table>
<thead>
<tr>
<th></th>
<th>ES post-measures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EMM</td>
<td>SE</td>
</tr>
<tr>
<td>Neutral session 1</td>
<td>3.301</td>
<td>.092</td>
</tr>
<tr>
<td>Light session 1</td>
<td>3.325</td>
<td>.092</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>3.498</td>
<td>.093</td>
</tr>
<tr>
<td>Light session 2</td>
<td>3.325</td>
<td>.092</td>
</tr>
</tbody>
</table>
Posture pain symptoms
Two subjects were left out of analysis because they reported maximal scores of posture pain symptoms for almost all items in both conditions compared to relatively low scores which were reported by other participants. LMM analysis on post-measures of musculoskeletal symptoms showed that there was no significant main effect of condition (F(1,36) = .236, p = .630). Besides this no significant interaction effect was found between condition and session (F(1,36) = 1.778, p = .191). The covariate (pre-measures posture pain symptoms) was significant (F(1,36) = 78.369, p = < .001). Post-hoc tests with Bonferroni correction showed no significant differences in post-measures between both conditions in the first session (p = .202) and in the second session (p = .551).

Table 13: Results of Linear mixed model analysis of post measures on posture pain symptoms (PPS).

<table>
<thead>
<tr>
<th>PPS post-measures</th>
<th>EMM</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral session 1</td>
<td>2.447</td>
<td>.208</td>
</tr>
<tr>
<td>Light session 1</td>
<td>2.084</td>
<td>.187</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>2.179</td>
<td>.186</td>
</tr>
<tr>
<td>Light session 2</td>
<td>2.350</td>
<td>.213</td>
</tr>
</tbody>
</table>

Figure 22: Graphical view of estimated marginal means (EMM) for post measures of the neutral condition (green) and light condition (orange) for emotional status.
Figure 23: Graphical view of estimated marginal means (EMM) for post measures of the neutral condition (green) and light condition (orange) for posture pain symptoms.

Motivation
LMM analysis on post-measures of motivation showed that there was no significant main effect of condition ($F(1,40) = 0.126$, $p = .724$). Besides this no significant interaction effect was found between condition and session ($F(1,40) = 1.004$, $p = .322$). Post-hoc tests with Bonferonni correction showed no significant differences between both conditions in the first session ($p = .650$) and in the second session ($p = .343$).

Table 14: Results of the mixed model analysis of post measures on motivation.

<table>
<thead>
<tr>
<th></th>
<th>PPS post-measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EMM</td>
</tr>
<tr>
<td>Neutral session 1</td>
<td>3.300</td>
</tr>
<tr>
<td>Light session 1</td>
<td>3.467</td>
</tr>
<tr>
<td>Neutral session 2</td>
<td>3.383</td>
</tr>
<tr>
<td>Light session 2</td>
<td>3.033</td>
</tr>
</tbody>
</table>

4.3.4. Discussion
The goal of this study was to investigate if increasing the light intensity in the classroom could increase visual comfort and emotional status, and could reduce musculoskeletal symptoms. To test this intervention participants first performed a visual discomfort induction task and subsequently the light intensity was increased from 300 lx up to 1000 lx and children had to perform a neutral task, or the light intensity remained on 300 lx while children had to perform a neutral task. In contrast to our expectations
we found no significant effects on any of the measured variables. This is probably because the results were influenced by unexpected environmental factors which were outside of our control.

The initial light intensity was planned to be 1000 lx for the experimental intervention and 300 lx for the remaining part of the experiment. However, the light settings varied from approximately 600 lx to more than 1300 lx in the experimental intervention and varied from below 400 lx up to more than 1800 lx in the normal condition. This was due to continuously changing weather conditions and sunblinds which were automatically controlled, dependent on the daylight level. Moreover, high intensity of daylight was shining in the classroom several times during the experiment, and may have caused discomfort glare (Osterhaus, 2005). Discomfort glare can be experienced if one part of the visual field is much brighter than the general brightness of the environment, which can result in eye strain and headache (Winterbottom & Wilkins, 2009). The light setting highly varied during the entire experiment, and therefore no reliable conclusions could be drawn from the results.

Besides the influence of daylight, there were some more limitations of this study. Because we could only make use of the current lighting system in the school, we could not set the light on the preferred settings. Four fixed settings of the lighting system could be chosen. The four settings differed both in light intensity and color temperature. We selected two settings which differed highly in light intensity (300 lx vs 1000 lx) and minimally in color temperature (4000 K vs 6500 K). However, we could not test the effect of light intensity independently from color temperature in this study. In addition, 1000 lx is higher than the illumination level which was used in the light intervention study of Aarås et al. (1998), which was 600 lx. One study even found a reduction in visual comfort when illuminance levels exceeded 1000 lx (Smith & Rea, 1980). The optimal light intensity to increase visual comfort in children should be further elaborated upon in future research.
5. General discussion

The goal of the present study was twofold. In the first part of the study, input was gathered through expert interviews and focus group sessions to improve newly proposed laser-guided exercises which were set up to improve the current Chinese eye exercises. A set of body exercises was created in accordance with expert interviews with physiotherapists and literature reviews. In the second part of this study two requirements for the laser-guided exercises were separately tested in an experiment. The first requirement was that the newly proposed exercises should include body exercises that prevent and reduce posture pain related symptoms. Secondly, it was expected that a well lit classroom could reduce visual discomfort in children. For this reason the project team decided to use a laser, because a laser can still project images in a well lit environment. The effects of performing body exercises and a well lit classroom on visual comfort, musculoskeletal symptoms, emotional status and motivation were investigated in two experiments. To test these two interventions a methodology was set up, and a visual discomfort induction task, neutral task and questionnaire were designed. In a pilot study it was found that visual comfort was reduced after the visual discomfort induction task, and that visual comfort remained on the same level after a neutral task. In the first experiment we found an increase in visual comfort and positive emotional status after performing a set of body exercises. Against our expectations we found no reduction of musculoskeletal symptoms. In the second experiment we found no significant effects on the measured variables, however, the results were probably influenced by unexpected environmental factors which were outside of our control. In this section the results will be discussed and will be related to the Chinese school context.

5.1. Study 1: Qualitative exploration of class break exercises

Through literature reviews and expert interviews with physiotherapists, problems were investigated which could lead to posture related problems in primary school children. The most reported problem is prolonged static sitting. In particular a static sitting posture with flexed positions of the trunk and neck can cause posture related problems in the anatomical areas of the neck, back and shoulder. These postures are commonly observed during reading and writing tasks. To reduce posture related problems, exercises could be performed. A five minute set of body exercises was created in accordance with recommendations of the physiotherapists. They indicated that exercises should be performed using opposite movements of the positions of the joints which are fixed during sitting. The set of exercises consisted of dynamic and stretching exercises to stimulate blood flow, and to relieve the muscles used when seated, from the static load produced by sitting. Physiotherapists recommended different exercises, based on their field of expertise. However, the goal and joints/muscle groups were similar. We clustered these exercises to set up a useful set of body exercises. It is expected that a combination of these exercises could reduce posture pain symptoms in children.
A large problem of the current Chinese class break exercises is that children are not motivated to perform the exercises correctly. This could also be a problem if the proposed set of body exercises will be repeated twice a day. Therefore it is recommended to design different sets of exercises. The basic movements could be similar, but included elements can be changed. Physiotherapists recommended combining the exercises with a dance or song. In addition group interaction can play an important role to motivate children and to activate them more. These elements can differ every day to keep students motivated to move.

Chinese interns in focus group sessions indicated that the space in the Chinese classrooms is limited. Large numbers of students per classroom were mentioned (up to 80 students in one classroom). They were wondering if students would not interfere with each other while performing the exercises. In the set of body exercises, exercises were chosen in a way that students can perform them while standing behind their desks. It should be investigated in context if performing exercises in such classrooms is possible. In addition, the Chinese interns mentioned that body exercises are already included in non-compulsory morning exercises in the school yard, and doubted if it would also be necessary to include them in the class break exercises. However, we expect that performing the proposed set of exercises during the school day can have additional effects to the existing morning exercises, because these exercises relieve the body from its static sitting posture. Previous research has shown that exercise breaks can reduce musculoskeletal symptoms (Balci & Aghazadeh, 2003; Henning et al., 1997) in VDT operators. In addition, posture education programs which included class breaks exercises resulted in improved sitting postures in primary school children (Geldhof et al., 2006; Cardon et al. 2004). Therefore we expect that performing the proposed set of body exercises during the day can have positive effects in the reduction of posture pain symptoms.

5.2. Study 2: Visual discomfort induction task and measurements

In the second study a methodology was set up to test experimental interventions on visual comfort, musculoskeletal pain, emotional status and motivation. Two visual discomfort induction tasks, a neutral task and questionnaires were designed. These tasks and questionnaires were validated in a pilot study with two samples: adults (N = 14) and primary school children (age 11-12, N = 15). It was found that the visual discomfort induction task, based on stressful visual characteristics proposed by Wilkins (1995), reduced visual comfort in adults and children. In line with our expectations, visual comfort remained on the same level after a neutral task. A reliability analysis was applied to determine the internal consistency of the questionnaire. It was found that the internal consistencies of the visual comfort, musculoskeletal symptoms, emotional status and motivation scales were reliable.

The neutral task consisted of a reading task with short, funny stories. We decided to choose a reading task to simulate a regular school task. In the experiments we wanted to compare the effects of the experimental interventions, with the effects of just continuing a regular school lesson. It might be said that the neutral task should not consist of a visual reading task, because that itself can have a negative influence on visual comfort. However, with a reading task we could ensure that all children performed the same task, and were exposed to the same conditions. Furthermore, when you ask children to do nothing for five minutes, it is more likely that they will not abide resulting in differences in conditions. For instance, some children
might interfere and interact with each other while others stare out of the window. Moreover, just including extra breaks without doing anything that is ‘clearly useful’ is probably difficult to implement in the Chinese school system. Children will probably just continue studying because high performance and academic success is really important in the Chinese society (Lin & Qinghai, 1995), or they will take a power nap. These are two activities which Chinese students commonly do during breaks. Nevertheless, it might be interesting to compare a neutral task which does not include reading, with conditions which are expected to increase visual comfort, in future research. All in all, for the present study we expected that a neutral reading task was the most useful task for the neutral condition.

Besides the visual discomfort induction task and the neutral task, the designed questionnaire was found to be useful. The internal consistencies of the different scales were found to be acceptable. However, in contrast with previous research (Stone, Clarke & Slater, 1980; Sheedy and Bergstrom, 2002) musculoskeletal disorders (reported pain in the neck, back and shoulders) reduced the internal consistency in the visual comfort scale. Therefore we decided to make a different subscale for these posture pain symptoms. The visual discomfort induction task had a large influence on visual comfort and little effect on posture pain symptoms in this study. We expect that posture related symptoms are more indirect symptoms that could accompany visual discomfort. Leaning forwards to improve visual comfort can result in posture pain symptoms (Grimes & Legg, 2004), but need not be a direct effect of visual comfort due to different locations of symptoms. If the visual discomfort induction task would have taken longer, the indirect effect on posture would probably have been more salient. However, in our opinion it is unethical to expose children to visually stressful conditions for a longer time period. Therefore we have decided to make the duration of the stressful conditions only ten minutes.

To conclude, the tasks and questionnaire which were designed in this study were found to be useful. These can be utilized to investigate the effects of experimental interventions on visual comfort, musculoskeletal symptoms and emotional status. This was done in two separate experiments in the present study, which will be discussed in the next section.

### 5.3. Study 2: Experimental interventions

In the final experiments we tested the effect of two experimental interventions on visual comfort, musculoskeletal symptoms and emotional status with the previously mentioned tasks and questionnaire.

#### 5.3.1. Body exercises

The first experimental intervention was performing a set of body exercises. We found that performing a set of body exercises in the classroom increased visual comfort and led to a more positive emotional status. These effects were not found after performing a neutral task. This is in line with studies of Balci and Aghazadeh (2003) and Henning et al. (1997) who found similar results on visual comfort comparing exercise breaks with continuing to work in their study of VDT operators. In contrast with the findings of these two previous studies we did not find a positive effect on the reduction of posture related symptoms in the present study. However, as previously mentioned, the task which was used to induce symptoms had little effect on musculoskeletal pain, and therefore participants started the exercise condition without many complaints. In this study we measured the effect on symptoms in the short term. It is expected that a
reduction of musculoskeletal symptoms will occur when children perform these exercises twice daily for a longer period, because of a reduction of the duration of static sitting (Murphy & Buckle, 2004). To test this, further research in the long term is recommended with a larger sample of children who are suffering from musculoskeletal symptoms. Nevertheless, the present study provided valuable insights of the positive effects of performing body exercises on visual comfort and emotional status.

5.3.2. Light intensity
The second experimental intervention was increasing the light intensity from approximately 300 lx to approximately 1000 lx. We did not find any significant effects on visual comfort, musculoskeletal pain and emotional status. However, the results were probably influenced by unexpected environmental factors which were outside of our control (see also 4.3.4). Further research is recommended to test this condition in a more controlled environment. It should be considered if the effect of illumination should be first tested in a lab study, before testing it in a field experiment. The internal validity in a lab study is high; independent variables can be easily manipulated, and same conditions can often be repeated with different participants. On the other hand, the external validity is low, because the manipulations are not tested in a real life setting. Furthermore, if students are not working on school tasks for some hours prior to the experiment, feelings of comfort will not be representative to a regular school day. This is easier to achieve during field experiments. A combination of both research methods is probably required to get the most reliable results.

5.3.3. General
The present study had some limitations. Although it is proved in the pilot study that visual comfort reduced while performing the visually stressful tasks, it might be more relevant to assess the experiment with children who actually experience frequent symptoms during a regular school day. In previous research, values of visual comfort were measured prior to the experiment, to make a distinction between persons who suffered high or low on visual comfort measures (e.g. Singleton & Henderson, 2007; Conlon et al., 1999). It would be interesting to test the effects of the experimental interventions with people from low comfort groups, and investigate the influence in the long term. Another limitation might be that children could experience less visual comfort after performing the neutral task compared with the body exercises condition, because of other visual complaints than visual discomfort. We did not measure optometric values and clear vision, however, we expect that it is unlikely that this explains all effects we found in this study. Even though this study had some limitations, it provided valuable insights about the experimental interventions for the reduction of visual discomfort and musculoskeletal pain.

To conclude, we found that taking a short exercise break after a visual stressful task can improve visual comfort and positive emotional status in primary school children. This is a promising result which might help many children to make the school day more effective and comfortable.

5.4. Further research
Further scientific evidence is needed before the current Chinese eye relaxation exercises can be replaced by a new set. The results of the present study suggest that performing body exercises can be a promising method to improve visual comfort in children. However, further research is needed before it can become a
fully integrated part of the daily school schedule. The current study focused only on subjective measures of visual comfort. Objective measures in the long term are needed to investigate if this has also an effect on the reduction of myopia development. Many studies suggest a link between visual near work and myopia development (Ip et al., 2008; Harb, Thorn & Troilo, 2006; Rosenfield & Gilmartin, 1998). It is argued that when doing near work, the ciliary muscle of the eyes should continually contract for accommodation and convergence. When looking into the distance this is not the case, because the eyes are focused on infinity and therefore the eye muscles can remain relaxed. With performing body exercises, the view is changed from close vision, to a more distant/infinite vision. This might have some positive effects on the reduction of myopia development. However, up until now the exact role of accommodation and near work activities in the development of myopia is still unclear. Besides distant vision, also high illumination levels might have a mitigating effect on myopia development. Experimental animal research has shown that high illumination levels in which animals were reared had a significant positive effect on ocular and refractive development (Asby, Ohlenhof & Schaeffel, 2009; Asby & Schaeffel, 2010). In addition, time spent outdoors is found to be a protective factor against myopia development (Rose et al. 2008). This might be because the eyes are exposed to higher levels of illumination by sunlight outdoors. However, further research is needed to investigate the link between illumination level and myopia development in children.

The current Chinese eye relaxation exercises encounter two problems: a lack of motivation and difficulties to execute them. The current exercises are the same every day. Several different exercise schemes should be designed to overcome the problem of boredom. Ideas which are proposed by physiotherapists to make exercising more fun are already discussed (combine with dance, song and group interaction). Furthermore, participants of the focus group sessions mentioned that combining exercises with a game or involve elements of surprise could be more engaging. Moreover, to solve the problem that Chinese students do not know how to execute the exercises correctly, the focus should be on instructing children in a correct and easy way. A pediatric physiotherapist recommended that children need instructions which are focused on the external environment. By instructing them to contract or relax different parts of the body, they will not clearly understand which exact movements to make.

Laser-guided exercises can be a useful solution to overcome the problems of a lack of motivation and unclear instructions. By following a projected image, children would automatically make the correct movements. In addition, projected images can be easily combined with playful games, group interaction or music to motivate students. Furthermore, different images can be projected, so that children are not exposed to the same stimulus every day. If all these aspects will be further explored in the design of the ‘exercise recipe’ we expect promising results to optimize the current Chinese eye exercises.

Even though there is scientific evidence that new exercises have more benefits for visual comfort, myopia prevention, reduction of musculoskeletal symptoms, motivation and instructions, it will still be a challenge to fully integrate it in the Chinese daily school schedule. The current eye relaxation exercises are based upon acupuncture methods which have been taught for more than 4000 years, and are compulsory at primary and high schools for more than fifty years. People have strong beliefs that these exercises are effective and Chinese traditional medicine practice is highly integrated in the Chinese society. It will be a big challenge to change the beliefs about the current eye exercises and to convince the Chinese Education Ministry to replace them.
To conclude, many Chinese students suffer from several health problems. Although I would like to solve this problem, it is too ambitious to do this in a graduation project. However, I do think that this project made a small contribution toward solving it. This study has shown that a simple five minute exercise can already make a big difference in increasing visual comfort. It seems as though it does not have to be that difficult.
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7. Appendices

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Appendix A: Expert interview physiotherapists

A1. General physiotherapist

**Interviewee:** Physiotherapist of ‘Fysio Company Care’, Eindhoven  
**Interviewer:** Patray Lui  
**Interview conducted:** 29-05-2012

**Summary:**

You should focus on two things: you want to do exercise which invite people to leave there flexed positions and try to extend their entire body. That is one goal. And the other goal is to have something which is really dynamic. The main problem is the static position and the static load of the muscles. And when you do exercises which not exactly stretch but more like a dynamic exercises. It will stimulate the blood flow which helps you to give extra nutrition and to get away from the waste products. That will be the two goals for the exercises.

Children should stand up and leave there bended position and you can do 4-5 exercises while they are standing behind their desk. Use different parts of your body: you upper and lower body.

The main problem is the dynamic part; you need to swing around with your arms for example. You should think of a package of 5-6 exercises.

Do exercises where you extend yourself. When you sit too long especially while writing or typing with your back in a bended position and a lot of extension in there neck again. What you can do is exercises with your body but also with your arms especially with your arms as well, because than you use the big muscle groups and of course the more bigger muscle groups you use the better it is for the blood flow. When you do only one stretch exercises like the program ‘work wave’, that is not very dynamic and that don’t improve the blood flow. So dynamic is more important. And after the dynamic exercises you can focus on your breathing. When you sit your stomach is not that big so efficiently breathing is not really possible in a collapsed position. After you did some dynamic exercises you can focus on breathing and then you feel more relax and then you can focus on your eyes. I can imagine that that would be nice.

It should be a high frequency exercise.

For the productivity a mental break is more important, but when you combine a mental break with physical exercises, than it does matter what you do.

It is good to focus on breathing so now and then to be more aware on the way you breathe and also looking at the stress part of the story. When you breathe and you are aware of breathing, you have a more relax breathing pattern, this has a positive influence on you autonomic nervous system. And this is good to reduce stress symptoms in your body.
While sitting you are in a bended lower back position, in a bended thoracal spine and lumbal spine. And then again you need to compensate that with your neck, so you extend your neck. Especially when do computer work or writing. So what you want is to do exercises which stimulates the muscles allow the spine to straight out again.

Important to know what your quality of your joints is, adjust the exercises what people can handle. Range of motion. Be careful of the speed and intention of the exercises.

Some music during the dynamic exercises will be nice and maybe also to give a rhythm because you want to activate people a little bit. Also because it creates a different kind of circumstances you want to get them out of the learning setting into a more dynamic movement setting. Then again you could combine that with slower music during the breathing exercises.

Just make sure that it is fun to move around. To make it fun to interchange the static load with something else, I think that is the main target for younger children. And when they get older children it is very good to also make them become more aware of their posture. When you tell the young children that posture is a problem, they don't know where you are talking about.

Exercises proposed by physiotherapist:
A2. Physiotherapist Human Kinetic Technology

Guided conversation with: Physiotherapist of the study program ‘Human Kinetic Technology’ of the ‘The Hague University of Applied Sciences’:
Interviewer: Martine Huygens
Interview conducted: 16-10-2012

Summary:

- Focus on shoulder, hips and breathing (spine) exercises. ‘If you don’t use is, you lose it.’
- Not necessary to focus on knee or ankle movements, because you can move these joints while sitting.
You can stretch your legs and move your ankles while sitting, if you have enough space.

1. Shoulder: during writing/reading/using a computer the shoulders are in abduction and exorotation the entire time. In the body exercises you should do opposite movements: adduction, endorotation
Exercise: hands on your back, move shoulders up and down.

2. Hips: Hips are in flexion the entire time
- Good to stand up en rotate your torso
Exercise: Move one foot forward and rotate your torso. You can also put two legs next to each other, but this is less effective
3. Breathing (spine):
Should focus more on exhaling exercises instead of inhaling exercises
- In a straight thoracic spine, the thorax is in expiration (a), in a curved thoracic spine, the thorax is in inspiration (b).
- While sitting, the spine is in flexion, so it is easy to breathe in, but difficult to breathe out.
**Breathing exercise:** stand up and stretch your arms to the ceiling, stretch your spine and breath out.

The physiotherapist doesn't believe that breathing exercises have something to do with ‘being aware of your own body’. He believes more in the functionality of the joints and the body. When your body is in the same position the entire day, you should do exercises using opposite movements of the joints.

4. Neck:
Better to look behind you than to rotate your neck.
**Exercise:** Look to the one who is sitting behind you. You can only move your neck, or also rotate your torso.
- There are no exercises which could be dangerous or painful. But it is important to respect everyone’s ‘movement capabilities’. Everybody is different and has different movement amplitudes.
- Be careful that it will not be a competition to reach the furthest.

Extra notes:

Furniture: desktop is too thick, because of the space for all the books.
Result: forced position of arms and shoulders: abduction and exorotation of the shoulder.
Result: chair is too low
A3. Pediatric physiotherapist

Interviewee: Pediatric physiotherapist, Kakelbont kinderpraktijk, Bergen op Zoom
Interviewer: Martine Huygens
Interview conducted: 12 maart 2013-03-12

Full transcript:

Fysio: Wat is je doelstelling? Want anders wordt er denk ik snel gedacht dat spierkracht verbeterd wordt zodat er dan minder houdingsproblemen zijn. Als dat je doelstelling niet is dan heb je een hele andere trainingsintensiteit nodig.

Interviewer: Het is juist de bedoeling dat we op de punten doorbloeding, concentratie en bewegingsmobiliteit gaan focussen. In deze presentatie wil ik even kort laten zien wat de situatie is in een Chinese school. Je ziet al gelijk dat er veel kinderen in de klas zitten, donkere ruimtes.

Fysio: Ook zo kaal

Interviewer: ja precies, en ook te kleine meubels, niet echt goed aangepast op de kinderen.

Fysio: Dit kind heeft ook een hele rare pen. Je ziet gelijk veel te veel spierspanning in zijn hand. Hij zit ook zo (schuin) in plaats van zo (recht). En een hele stapel boeken, daardoor is zijn werkruimte ook al kleiner.

Interviewer: Ja, en sowieso zijn de klassen eigenlijk veel te klein voor het aantal kinderen wat in de klas zit.

Fysio: Ja, hij zou eigenlijk dit in een kastje moeten leggen, zodat hij zijn volledige werkblad kan gebruiken.

Interviewer: Ja, dus dit zijn zo’n beetje de problemen.

Fysio: En dit kindje heeft een jas aan, dus het zal wel koud zijn in de klas.


Fysio: Ze hebben wel twee uur pauze, wat doen ze dan in die twee uur?

Interviewer: Eerst eten ze lunch binnen. Daarna gaan ze soms nog even basketballen of ze blijven gewoon in de klas zitten en aan het einde doen ze meestal een powernapje, met hun armen op de tafel.
Fysio: Ook weer in die rugflexie.

Interviewer: Ja precies. En middelbare scholieren hebben soms zelfs avond sessies tot 11 uur.

Fysio: ooh…

Interviewer: Ja ik ben ook blij dat ik in Nederland op school heb gezeten.

Fysio: En moeten ze om 7 uur weer starten die kinderen! Die zijn toch steen kapot en uitgeput.

Interviewer: Ja dat is ook een groot probleem.

Fysio: Dat heeft toch helemaal geen zin meer.

Interviewer: Ze zijn ook heel erg gestrest en heel erg vermoeid. En iedereen wil daar naar de beste universiteiten, er staat heel veel druk op die kinderen. Ze zijn meestal enigs kind. Dus dan komt al die druk op dat ene kind te staan. Dus dit zijn een beetje de problemen. Ze beginnen de ochtend wel met wat ochtendoefeningen.

Fysio: Oh dat gaat echt op z’ n chinees.

Interviewer: Ja het is ook wel leuk om te zien. De ochtendoefeningen zijn trouwens niet verplicht.

**Film laten zien morning exercises**

Interviewer: Dit is dus echt ochtend gymnastiek.

Fysio: Gammastyle, dat ga je toch beter snappen als je dit zo ziet!

Interviewer: precies!

Fysio: Wat een groep! Kijk hij staat er bij maar doet niks. Er is helemaal geen controle op de uitvoering.

Interviewer: Nee, ze proberen het gewoon na te doen, maar niemand controleert het. En dan doen ze voor de rest nog twee keer per dag oogoefeningen, 5-10 minuten per keer. En dat is vooral om de oogvermoeidheid te verminderen. En dat is vooral gebaseerd op de Chinese acupunctuur. Bepaalde drukpunten in het gezicht kunnen de oogspieren ontspannen. Er zijn ook nog bepaalde drukpunten in de nek die goed zijn voor de rest van je organen.

**Film eye relaxation exercises.**

Fysio: Vanuit de fysiotherapie zijn dit ook de punten om de musculatuur op de schedel ook los te maken. Dus wat dat betreft vind ik het wel logische punten die ze nemen. De musculatuur die je vaak gaat aanspannen als je fronst, die maak je hiermee los (punt boven je wenkbrauwen). En ook vaak als je met opgetrokken schouders met je hoofd naar voor zit bouw je hier heel veel spanning mee op, en dat maak je met die punt los (punt in de nek). Dus wat dat betreft vind ik het wel een logische massage techniek.

Interviewer: Ok dat is heel interessant om te horen.
Fysio: Maar het ging even te snel voor mij: 60% van de kinderen is dus beperkt met het zicht.

Interviewer: Soms zijn de getallen nog hoger, en ligt ook heel erg aan je opleidingsniveau. Vooral bijziendheid komt daar voor. Dat je goed dichtbij kunt kijken, maar moeite hebt om veraf te kijken.

Fysio: En wat is het percentage van bijziendheid in Europese landen?

Interviewer: Dat is ongeveer 30-40%, maar dat hangt ook weer erg af aan opleidingsniveau. Universitair geschoolde hebben een hoger percentage. En dat is waarschijnlijk te wijten aan dat mensen veel dichtbij kijken en minder veraf, veel computerwerk doen. Maar het is nog niet in alle onderzoeken gebleken dat dat ook echt daadwerkelijk zo is.

Fysio: Ok, maar dat percentage is dus beduidend minder inderdaad. Dus die zijn gewoon getraind in die motoriek.

Interviewer: ja dat wordt wel verwacht.

Fysio: Wij doen soms ook spelletjes om spieren rond het oog te versterken voor kinderen. En meestal het scheel kijken, en dat ook kunnen fixeren voor een langere tijd, daarmee kun je echt die training krijgen van de oogspieren. Dit techniek komt uit de optometrie, daar hebben we het een beetje van gepikt.

Interviewer: En wat zijn dan precies de klachten waar kinderen mee komen?

Fysio: Waar wij het voor doen is voor het volgen van het oog. Je oog moet goed kunnen volgen in zijn oogkas om waar je mee bezig bent en je eigen schrijven, je vinger motoriek, of de bal die eraan komt goed te kunnen volgen in de beweging. En dan kan oogmotoriek een voorwaarde zijn. Als een kind hele slappe wegedraaiende ogen heeft kun je trainen met de handen, maar dan heeft het geen zin.

Interviewer: Dan pak je niet de oorzaak aan.

Fysio: ja nouja de oorzaak, wat is de oorzaak, het is vaak een combinatie van beide. Je gaat ook nooit alleen ogen training met fysiotherapie, dat doet een optometrist wel, maar dat stukje pak je er toch wel bij.

Interviewer: En wat zijn dan precies de massagepunten?

Fysio: Het gaat om de spieren in het oog die je traant, die de oogbol aansturen.

Interviewer: Ok, maar welke punten masseer je precies?

Fysio: Vooral hier (boven het oog). De spanning die je voelt als je lang zit te turen, de spieren die grimassen trekken, daar kun je hoofdpijn van krijgen en concentratieverlies. Maar dat is meer iets wat ik bij volwassenen zou doen met hoofdpijn. Dan ga ik dit masseren. Dan kun je echt je hele hoofdhuid los maken van de schedel

Interviewer: Ok dat is interessant om te weten.

Fysio: ja dus dat ze die oefeningen doen vind ik op zich niet raar. Maar ik heb wel zoiets van ja, om dat even los te maken, maar het heeft niks te maken met het oog naar mijn idee, wel om het geconcentreerd te
kunnen kijken met het oog als het wegdraait, maar wil je het zicht van het kind verbeteren, wat ik weet heeft dat tot 4 jaar zin, daarna is die oogzenuw uitontwikkeld. Maar dat is voor mij allemaal bij kennis, als je dat specifiek wil weten zou ik met een optometrist of een oogarts gaan spreken.

Interviewer: Ja natuurlijk, dat heb ik ook al gedaan. Maar het probleem met deze oefeningen is ook eigenlijk dat kinderen zelf niet zo goed weten welke punten ze moeten masseren. Ze moeten deze oefeningen twee keer per dag uitvoeren, elke dag. Dus ze zijn eigenlijk ook helemaal niet meer gemotiveerd om die oefeningen goed uit te voeren. Zij zien het meer als een pauze, en ze doen zomaar wat, dan dat ze het echt effectief uitoefenen.

Fysio: Ik denk dat een pauze, en maar even iets doen, net zo effectief kan zijn voor deze doelgroep. En dan heb je een andere doelstelling eigenlijk

Interviewer: Het idee wat wij meer hebben is in plaats van deze oefeningen voor 5-10 minuten andere oefeningen te bedenken, die niet alleen oogproblemen, maar ook houdingsproblemen kunnen oplossen.

Fysio: Maar zodra jij dag in dag uit precies hetzelfde doet, ga je tegen dezelfde punten aanlopen.

Interviewer: Precies, maar dat stukje motivatie zullen we moeten zien op te lossen.

Fysio: Maar als je kijkt naar leerstrategieën, juist door de variatie in de oefening gaan kinderen leren. Door herhaling van de hetzelfde… Peter van Beek, heb je die naam wel eens voorbij horen komen?

Interviewer: Um nee.

Fysio: Hij is volgens mij docent aan de Universiteit van Amsterdam, die heeft daar in Nederland veel onderzoek naar gedaan. Bewegingsleer. Die gaf juist aan dat hoe meer variatie je hebt, hij had een heel mooi voorbeeld van een onderzoek uit Engeland, die cricket worp is heel complex. Eén groep het heel traditioneel geleerd, de beweging is stukjes hakken en stukje voor stukje coördineren, aanleren, heel erg op de beweging gericht. De andere groep had gewoon de swing geleerd van de arm en was verschillende dingen aan het trainen. Hinkelend gooien, in een raar parcours gooien, ze raar mogelijk gooien. En het bleek dus dat de groep die zo raar mogelijk gooien had, de coördinatie van de beweging was kwalitatief hoger, plus onder wedstrijd stress bleef die groep ook constanter in zijn uitvoering, dan de groep die het op een hele cognitieve manier had aangeleerd. Op dit moment lopen er heel veel van dat soort onderzoeken. En hij is een beetje degene in Nederland die daar veel onderzoek naar doet. Maar ook wel veel contact heeft wereldwijd. Ten eerste moet je je instructie niet over het lijf geven. Zo hebben wij het allemaal geleerd, maar dat blijkt nu, heeft helemaal geen zin. En eigenlijk waren we daar ook al aan het achterkomen, omdat die kinderen met concentratie problemen, die snappen al helemaal niks van dat lijf, dus daar moet je al helemaal niet over praten, maar geef die instructie over de ruimte, waar wil je iets raken. Daar moet je je op focussen. Als jij op een wiebel tol staat, en zegt sta stil, dan denkt dat kind, hoe doe ik dat. Maar als je zegt: hou de tol stil, dan denkt hij, de tol ohja. Dat zijn nu een beetje de twee omslagpunten bij ons van het denken over trainingsleer, en ook bij coördinatie trainingsleer. Heb het niet over het lijf, maar heb het over de omgeving. En hoe gekker, hoe meer effect.

Interviewer: Ok dat is heel interessant, ook voor dit onderzoek. En die Peter van Beek, is dat een bewegingswetenschapper?
Fysio: Ik denk het wel, ik heb een keer een lezing gehad op een congres van hem, en die naam is me bijgebleven. En wij merken het ook binnen de trainingsleer van de kinderfysiotherapie, dan heb je het niet zozeer over de fysiologische trainingsleer, maar meer over NTT, psychologisch psychofunctioneel, dat soort dingen, daar wordt dit nu heel veel toegepast deze kennis.

Interviewer: Ok, ik zal die naam eens opzoeken, bedankt

Fysio: Ja uit mijn hoofd was het Peter van Beek

Interviewer: Daar moet ik zeker wat over kunnen vinden.

Fysio: Ik denk dat je wel aardig op weg zou kunnen helpen naar de kunst, ik denk in deze cultuur is het heel belangrijk: hoe bied je het aan. Dat het gewoon een roterend schema wordt.

Interviewer: ja precies, dat is heel belangrijk. En dat is ook het stukje waar Philips wat aan zou kunnen doen, hoe je het met andere stimuli kan aanbieden.

Fysio: Wat belangrijk is, is om iets onverwachts aan te bieden.

Interviewer: Ja precies. En dan over de oefeningen die we zouden kunnen aanbieden. Zijn er in Nederland trouwens veel kinderen die met nek, rug en schouderklachten naar de fysio komen?

Fysio: Dat is niet een probleem waar een kind functioneel mee komt. Een kind heeft er last van als hij niet mee kan in de groep, en het kind heeft er last van als zijn schrijven altijd slordig is. Of het hoofd doet zeer, of ik kan mijn aandacht er niet bijhouden. Dat is waar een kind over klaagt. Een leerkracht klaagt ook over het resultaat. Ouders ook, die klagen ook over het resultaat. En de houding is in Nederland het middel om te komen tot een goed resultaat en daarom is soms ook lastig om dat zo te stellen. Niet wat is goed of wat is niet goed maar spelvorm zou je bij een Nederlands kind doen. In Nederlandse schrijf les methodes heb je ook oefeningen. Bijvoorbeeld het rupsje kruipt over het potlood. Dan moeten ze een potlood helemaal naar boven of helemaal naar beneden laten kruipen en daar moet je natuurlijk ook een goede basisstabiliteit voor hebben. Of de regen laten vallen, dat soort spelletjes, die zijn meer gericht op de vinger motoriek.

Interviewer: Meer de fijne motoriek.

Fysio: ja. En het buiten spelen en vrij bewegen en de rug opstrekken. Met name dat opstrekken van de rug, met name ook met gestrekte heupen, zal het veel meer effect hebben. Ik zou als gekke Hollander zeggen, klim op je stoel, klim op je tafel en klim er weer af, dat zou naar mijn mening meer effect hebben dan alleen maar je ogen masseren. Of je maakt er weer meer een dans of een liedje van. Wat ook een hele leuke lesmethode is, is om de grove motoriek op het voorbereiden van het schrijven te oefenen. Dat is de schrijfdans, een Zweedse lesmethode. Het is niet echt een methode, maar een programma. De schrijfdans is echt voorbereidend bewegen met muziek en liedjes om kinderen van heel grof motorisch: de vulkaan gaat uitbarsten, je hebt overal lavastenen, dan beginnen ze staand met papier op de ramen te plakken en die lava, en op een gegeven moment moeten ze het klei aan tafel kunnen en wordt het papier ook steeds kleiner. Dus je begint vanuit die staande houding vanuit die schoudergordel en je gaat steeds meer vanuit de elleboog naar de pols.
Interviewer: Ok, dus eerst meer wat dynamische bewegingen.

Fysio: ja, en dat is een lesprogramma wat bij kleuters en groep drie soms wel groep 4 wordt gebruikt in Nederland. Dat is een programma wat in Zweden is ontwikkeld, maar heel veel scholen in Nederland passen het toe. Daar zou je hele leuke oefenstof met muziek uit kunnen halen. En dan zit er ook een verhaal of fantasie achter en die fantasie en dat verhaal wordt omgezet naar bewegingsresultaten.

Interviewer: Ok, dus vooral die grove, of dynamische oefeningen waar zijn die dan precies goed voor?

Fysio: Het verbeteren van de doorbloeding, alleen al dat zou ik in je oefeningen toepassen. Het is ook een coördinatie oefening maar dan moet je echt met grote frequenties herhalen. Maar in jou schema kan ik me voorstellen om die doorbloeding op gang te krijgen waardoor je minder snel verbindweefseling van spieren en ligamenten krijgt en er dus minder snel op gewrichtsniveau een bewegingsbeperking zal ontstaan.

Interviewer: Ja, en wat zijn dan de belangrijkste spiergroepen of gewrichten waar we ons op moeten richten?

Fysio: De electrotrunki, het opstrekken van de rug, maar wel het actief opstrekken. Want de electrotrunci wordt vaak heel zwaar belast. Als je zo een bal tilt, of zo, zo is hij minder zwaar, maar dat hoofd dat hangt naar voor, en die elektrotrunci is continu bezig dat hoofd op je romp te houden, maar dat is continu anorobe aanspanning, terwijl je hem juist aeroob moet aanspannen, en al die ligamenten van de schedel naar de bovenste nekwervels, daar heb je er een heleboel die makkelijk snel vast kunnen zitten door deze knik en door je hoofd op te strekken rek je dat weer op, en op segmentaal niveau, alle ligammentjes rond je wervels, die passief gerekt worden wat ook weer instabiliteit geeft. En aan de andere kant natuurlijk ook verkorte. En de spieren rond het bekken zou ik ook heel erg actief opstrekken vanuit het been, de bekkenbodem spieren, de schuine buikspieren, de pyramidalis, dat soort spieren, en die train je juist weer door het zitten op een bal, dan moet je die aanspannen. Daar heb je speciale ballen van, maar je hebt ook speciale bal kussens, ik weet niet of jij die kent.

Interviewer: um, nee.

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Interviewer: um, nee.

Fysio: Ik zal even kijken of ik er eentje hier heb liggen. Die leg je gewoon op een stoel en dan heb je al een beetje dat gevoel en je hebt ze ook in wigvorm. Zal ik er een pakken voor je?

Interviewer: Ja ik vind het wel heel interessant.

Fysio: Al moet je er een kind niet heel de dag opzetten, alleen maar bij een bepaalde activiteit. Een uurtje zeg maar. Dit is het wigkussen, het wigkussen dwingt je bekken om voorover te kantelen, waardoor je dus ook meer druk om je voeten gaat nemen en zeker die zintuigelijke prikkeling vanuit je voetzool geeft ook weer een prikkel om je aalterheids niveau te verbeteren. Je hebt de units van activatie, door te gapen, door te bewegen, door de druk te ervaren, activeer je je hele hersenschors en dat lukt dit kussen heel erg uit. De druk vanuit je voeten verhoogt kanteling van je bekken, en dan ga je ook al meer naar je voeten toe om te steunen en daar krijg je dus die verbeterde activatie door. En dit is een beetje een combinatie van de twee. Je hebt kinderen en die hebben juist behoefte aan die bekken aanspanning en vandaar uit het verbeteren van opstrekken en alertheid en dat soort dingen en dat zijn vaak de over bewegelijke kinderen die van een
stoel afvallen, die moeten dan al de beweging in de stoel stoppen om niet te vallen die geef je vaak zo’n balkussen en kinderen die juist heel slap zitten die je juist op hun voeten wil laten aarden, die wil je juist zo’n wig aan de slag. Dat is dus een beetje voor het combikind. Van te voren zeggen wij altijd, er is niet een juist of een slecht kussen, maar het verschilt per kind.

Interviewer: En zijn die kussens er ook voor dat ze niet l statische zithouding hebben, maar steeds een beetje van houding veranderen?

Fysio: Hier komen kinderen met een hele andere problematiek. Bij ons komen ze met het schrijven gaat niet, ze kunnen niet bijhouden is de klas, meer dat soort lichamelijke oorzaken. In Nederland zijn kinderen gelukkig veel bewegelijker dan in China. Dus in Nederland is dat niet het hoofdprobleem.

Interviewer: ja ze zullen hier veel meer buitenspelen.

Fysio: De leerkracht zal ook sneller zeggen als de klas in kakt, kom we gaan met zn allen naar buiten. Wat ook heel leuk is voor jou misschien, daar ben ik zelf heel benieuwd naar, want ik weet niet of daar wetenschappelijk onderzoek naar is, om uit de zintuiglijke prikkelverwerking kijken, hoe ontstaan die, hoe ga je die verwerken, wat voor effect dat heeft op je plannen van je handelingen. Daar wordt altijd over geroepen zout en zuur geeft activatie, en zoet geeft down, maakt je duf en droezelig. En wat wij dus weleens zeggen is geef mensen kauwgum, kauw met je kaakspieren, dat geeft weer units van activatie. Geef mensen een heel zuur, of heel zout snoepje, geeft ook activatie, maar dat is iets wat misschien juist in China, in dat klassikale ook heel leuk zou kunnen uitproberen. Waar Philips eigenlijk bezig is met heel erg licht, maar wat doen de andere zintuigen daarin?

Interviewer: ja dat kan heel interessant zijn. En nu we het toch over licht hebben, denk je dat dat ook een rol zou kunnen spelen?

Fysio: Ja, maar daarin denk ik ook variatie van licht en ook geur.

Interviewer: Dus meer om alle zintuigen te stimuleren.

Fysio: Ja maar dat zijn allemaal empatische onderzoeken, nooit heel wetenschappelijk bewezen. Maar er zijn geuren van lavendel wat meer rustgevend werkt, er zijn geuren als citroengras en basilikum, smaak soms ook, die juist werken om je eigen ik te versterken en concentratie te verhogen. En dat is iets wat wij dus ook wel eens gebruiken bij kinderen, dat we tegen ouders zeggen, goh ga dat eens proberen. Juist de over actieve kinderen worden overactief doordat ze zelf een bepaalde neurotransmitter te weinig aanmaken. En dat zijn dus de ritalin kinderen zeg maar. Die hebben eigenlijk gewoon een pepper nodig, want ritalin in eigenlijk gewoon een pepper om zichzelf tot rust te kunnen krijgen. Dan voelt dat lijf zich pas ok, in een goede alertheidsfase. Nu kan ik gaan presteren. En ik denk zo ook met licht, bepaalde frequenties en sterktes heb je zeker nodig. Een verversing van lucht, zuurstof gehaltes, daar kan Philips ook zijn ei in kwijt denk ik zo.

Interviewer: ja, dus vooral afwisseling van omgeving, omgevingsfactoren, stimuli

Fysio: Ja, ja.
Interviewer: Ok, erg interessant. We hebben ook al met wat andere mensen gesproken, en die zeiden dat ademhalingsoefeningen ook goed zouden kunnen zijn om dat tussen de schoollessen in te voeren. Heeft u daar een idee over?

Fysio: Um ja, daar heb ik een idee over. Om ademhalingsoefeningen uit te voeren om je weer bewust te maken van je eigen ik, van je eigen basisbeweging. Maar meer vanuit fysiotherapie en ook vanuit kinderpedagogiek, kinderen met stress gaan uit zichzelf adoxaal ademen. Dus hoog ademen, meer op borstniveau, je buik ademhaling gaat juist tegengesteld werken waardoor het minder effectief is. En vaak blijkt door de stress juist weg te nemen dat een kind vanzelf omschakelt naar een effectieve ademhaling. Maar ga je ademhalingstechnieken gebruiken zoals geeuwen juist om dat alertheids niveau weer in te brengen, dat kan wel. Maar ik denk dat ademhalingsoefeningen zonder de stress weg te nemen niet het gewenste effect zal hebben. En zeker als jij verteld hoeveel stress er in deze kinderen zit. Dan zal ik het wel in een liedje, een muziekje met gekke bewegingen over ademhaling, want dan ontlaat je door het muziekje en liedje het fantasieverhaal de stress ook even. Dan zou ik het wel zo combineren.

Interviewer: Ok, en meer om ademhalingsoefeningen uit te voeren om meer je lichaam te strekken, want als je gebogen zit dan heb je meer moeite met ademhalen.

Fysio: ja op het moment dat je ademt, beweegt je borstkas, en dus ook je wervelkolom, dat zit aan elkaar vast en dan krijg je ook de verbetering van de doorbloeding in de kleine gewrichtjes daar. Dat zeker.

Interviewer: En dat in combinatie met stress wegnemen zou kunnen helpen.

Fysio: Ja.

Interviewer: In de presentatie kon je ook zien dat er niet heel veel ruimte is in het klaslokaal. Als kinderen hun stoel aanschuiven en achter hun bureau gaan staan, blijft er al niet veel ruimte over. Welke oefeningen zouden dan alsnog uitgevoerd kunnen worden? Want ik neem aan dat het nog wel belangrijk is om op te staan?

Fysio: ja.

Interviewer: Of zijn er ook oefeningen die zittend gedaan kunnen worden?


Interviewer: En voor de meer oudere kinderen? Groep 7/8 bijvoorbeeld?


Interviewer: Dus met zn allen de oefening uitvoeren?
Fysio: Ja, en misschien ook contact maken, dat je ook iets doet dat je met zn tweeën elkaar in spiegelbeeld moet kunnen volgen, die uitdaging kun je ook nog geven. Als je ze zo met zn tweeën naar elkaar laat draaien.

Interviewer: Ok, dat is ook wel een leuk idee. Dan heb je ook meer interactie.

Fysio: Ja meer interactie, waardoor je ook meer je alertheidsniveau verhoogt.

Interviewer: Ok, en hoe geef je die kinderen eigenlijk feedback?

Fysio: Ja uit het lichaam, grote en mooie, de fantasie erin.

Interviewer: Ok, dus helemaal niks gericht op het lichaam.

Fysio: Nee niet op het lijf. En dan moet je inderdaad maar eens kijken of je stukken van Peter van Beek kunt vinden. Die heeft daar hele leuke stukken over.

Interviewer: ja dat klinkt inderdaad wel interessant. Want ik wil graag experimenten gaan uitvoeren om te kijken of het werkt. Ik heb wat taken gemaakt waar kinderen meer vermoeid van raken, en die werken ook al. En nu willen we kijken waardoor kinderen minder vermoeid kunnen raken. Het idee was meer om een filmpje te maken en daar wat bewegingen in laten zien, die die kinderen na moeten doen en moeten volgen.


Interviewer: Ja we willen in eerste instantie het nog wel bij Nederlandse kinderen gaan testen. En dan zou goede instructie tijdens het filmpje ook wel belangrijk zijn.

Fysio: Alleen als je instructies geeft bij kinderen over motoriek moet je eigenlijk een kleine afstand hebben. Dus het nadeel van een instructie via een filmpje is dan wat doet de rest van de klas ermee. Dat is ook afhankelijk van hoe oud kinderen zijn. Hoe ouder kinderen zijn, hoe makkelijker dat het wordt. Maar doe je het bij jongere kinderen, de onderbouw, dan moet je eigenlijk toch iemand in de klas hebben waar die kinderen op gericht zijn. Dan zou je misschien kunnen proberen, of juist testen wat is het verschil als je het met een filmpje doen, om simpel iets wat een leerkracht kan doen.

Interviewer: De kinderen waar we nu mee willen testen zijn 9-10 jaar oud, groep 6/7.

Fysio: Dat is dus net die wip. Het cognitieve denken komt rond 9 jaar. En vanaf dan kunnen kinderen veel beter abstracte informatie naar hun eigen lijf ook vertalen. Dus dat zit net op de wip.

Interviewer: ja het voordeel van een filmpje is dat je bij iedereen dezelfde instructies geeft.

Fysio: ja dan moet je daar gewoon mee beginnen en als blijkt dat het toch minder werkt dan gehoopt, dan kun je altijd nog uitzoeken van goh, wat nou als een aantal mensen gewoon hun handelingen standaardiseren. En jullie de eerste keer de instructie geven aan die groep en daarna het filmpje. Dat kan dan ook al een heel ander resultaat geven.
Interviewer: ja daar zullen we even naar moeten kijken. Zijn er trouwens nog bewegingen die afgeraden worden aan kinderen? Dat ze misschien buiten hun maximale bewegingsuitslag komen?


Interviewer: En zit er dan ook nog een verschil tussen de nek en de schouder wat gevaarlijker regio’s zouden kunnen zijn?

Fysio: Dat zou je echt per beweging moeten kijken, maar hou gewoon rekening met de fysiologische mogelijkheden van het lichaam. En de bewegingen met je nek naar achter is altijd minder goed dan naar voor. En de heupen niet, dat is een heel sterk gewricht, daar hoef je bij kinderen niet zo bang over te zijn. Of er is al iets aan de hand met de heup. Laat ze niet aan elkaars hoofd trekken of aan elkaars armen duwen. Maar ik weet niet aan wat bewegingen je aan zit te denken?

Interviewer: nou ik heb al wat informatie verzameld, dat is meer het vooronderzoek wat al gedaan is. Het idee is om nu voor het experiment om 5 minuten verschillende oefeningen achter elkaar te laten uitvoeren.

**Oefeningen vooronderzoek laten zien.**

Fysio: Deze beweging zou ik dus niet doen (nek). Alleen maar zo draaien in je nek dat is vaak heel pijnlijk. Wat vaak veel effectiever is, is om naar je oksel en schuin naar achter kijken. Dat is veel meer in de fysiologische bewegingen in hoe je nekgewrichtjes opgebouwd zijn. Het draaien, je kunt het wel, maar op een gegeven moment botsen de zijkanten van je wervels, de processes transversi gaan tegen elkaar botsen. Die zijn zo aangelegd dat het eigenlijk als een wenteltrap ten opzichte van elkaar beweegt. Dus als je deze beweging doet, dan ga je veel meer de doorbloeding aanzetten dan met deze bewegingen, dan krijg je vaak zelfs een exchemische reactie, waardoor de doorbloeding dus afgekneld wordt.

Interviewer: Ok dat is goed om te weten.

Fysio: En deze ook niet, dan ga je weer de gewrichten juist afknellen. Wat je wel kan doen is juist het opstrekken maak jezelf lang, maar niet zo juist, niet je kin naar voren, want dan knel je het hier hoog C0 C1 af. Of deze, en dan schuin naar achteren kijken dat kan wel. Dat doe je ook automatisch als je naar boven kijkt, dan draai je je hoofd. Dan rek je wel het naar achter bewegen van de nek, maar zonder afknelling te krijgen. Als je het precies wilt weten, moet je het aan een manueel therapeut of een osteopaat vragen. Die kijken weer echt naar ligamenten niveau.

Interviewer: Ok, dus dat over de nek. Dus dit was wat ik net zei over de ademhalingsoefeningen. Dus meer de wervelkolom strekken.

Fysio: ja ik zag net al Tai Chi op je blaadje staan, of dat soort dingen, daar zitten zoveel ademhalingstechnieken, ook in die cultuur, daar zou ik gewoon gebruik van maken.

Interviewer: Wordt dat hier ook vele toegepast?

Interviewer: Gaan bellen blazen?


Interviewer: Dus ook meer dat ze zelf meer bewust worden van hun ademhaling?

Fysio: Ja, en zo doe je het met jongere kinderen. Het trainen van ademhalingstechnieken. Als kinderen astmatisch zijn dan ga je echt met spelletjes aan de slag. Dan loop ik ook weer gewoon de speelgoed winkel in om te kijken. Dat heeft bij de jongere kinderen veel meer effect dan het cognitief oefenen.

Interviewer: Maar dan zou deze ademhalingsoefening wel nog steeds kunnen om meer de wervelkolom te strekken.

Fysio: maar dan zou ik ook meer hebben van laat de leerkracht de bellen hoog blazen en dat ze die zouden moeten pakken uit de lucht. Voordat ze op de tafel komen.

Interviewer: ja, dus echt een spel element toevoegen.

Fysio: ja en dus ook weer de focus buiten het lijf leggen met het spel.

Interviewer: En als je bijvoorbeeld deze vergelijk met deze oefening?

Fysio: Dit zijn gewoon de basis rek oefeningen van schouder gordel en het bovenste deel van je wervelkolom, van je borstwervels.

Interviewer: En dan de heup.

Fysio: Ik snap hem niet.

Interviewer: Je staat in schrede positie en dan draai je je romp.

Fysio: ja ja, maar dan ben je je lendewervels aan het bewegen en niet het heup gewricht. Ja, deze beweging bedoel je dan?

Interviewer: Ja meer met je benen uit elkaar, 1 voet naar voren.

Fysio: Ja ok, zo krijg je al meer strekking van de heup. Maar dan ligt het accent wel meer op dit stuk van je lijf, maar dat kan ook geen kwaad. Maar ik zou dan eerder een zwaai oefening pakken, dan ben je gelijk meer met stabiliteit bezig. Zijwaarts zwaaien, je schuine buikspieren weer aanspannen.
Interviewer: ja dit was meer omdat mensen snel beperkt worden in hun heup gewricht, is mij verteld dan in ieder geval.

Fysio: Ja maar met deze oefening ben je dus meer je lendewervels aan het mobiliseren, en niet zo zeer het heup gewricht. En met name de beweging naar achter, en dan krijg je maximale aanspanning van je gluteus en dat is de spier die helemaal opgerekt zit, en zo wordt die geactiveerd. En de stabiliteit bewaar je hier en je bekken bodem spier en je schuine buikspieren bij nodig, en dan heb je twee vliegen in 1 klap. En helemaal bij deze beweging, die schuine buikspieren, en dat kun je ook achterlangs weer doen. Of met 1 voet je naam laten schrijven. Ik weet niet hoe ze dat met Chinese tekens doen.

Interviewer: Dat is inderdaad een goede vraag. Maar dan heb je inderdaad weer meer dat spel effect. Ja en dan nog de schouder.

Fysio: ja je pectorale ook lekker oprekken, ja dat zijn prima oefeningen.

Interviewer: En zijn er nog andere oefeningen waar je misschien aan zit te denken?

Fysio: Nee ik denk dat dit wel voldoende is zo.

Interviewer: En over de volgorde. Heb je bijvoorbeeld eerst een soort warming up nodig?

Fysio: ja misschien eerst even beginnen met een springvorm om ook echt die druk op de voeten te krijgen. Alles even lekker activeren. Ook weer die focus er beter bij hebben.

Interviewer: Ok, dus eerst meer dynamische oefeningen en daarna meer strekking.

Fysio: Ja, want als een spier langdurig dezelfde inspanningen levert, is er ook weinig doorbloeding in die spier, en is die spier ook koud, en heb je dus ook eerder risico op microtraumata. Als je dan eerst die spier opwarmt, waar ook de warming-up ook vandaan komt, is de doorbloeding op gang en is de spier ook weer warmer, waardoor je dus ook minder snel overbelasting krijgt.

Interviewer: Ok, dan kan ik me dus voorstellen om eerst meer een beetje de dynamische oefeningen te doen, en dan meer strekking en dan misschien te eindigen met wat ademhalingsoefeningen?

Fysio: met kracht training moet je altijd eindigen. Ik zou het ademhalen gebruiken als dynamische oefening.

Interviewer: Ok, dus dat meer om mee te beginnen.

Fsysio: En dan eindigen met kracht. In je trainingsleer moet je altijd eindigen met krachttraining.

Interviewer: Ok, en wat is daar de reden voor?

Fysio: Omdat je als je echt kracht wilt verbeteren, moet je naar het maximale doel gaan en daarna is een spier zo vermoed, dan moet je geen coördinatie verbetering meer willen, dat kan nou eenmaal niet.

Interviewer: Ok, en de krachttraining, wat voor oefeningen zijn dat dan?
Fysio: Dat is echt 6-10 keer to je maximale gaan, totdat je echt niet meer kan. Bijvoorbeeld de knievering, en dat soort ouderwetse oefeningen.

Interviewer: En wat zou er voor dit onderzoek relevant zijn?

Fysio: Bijvoorbeeld de knieveringen of haasjes hup, dat ze echt op hun hurken moeten gaan. Huppelen achter elkaar totdat je weer bij je stoel bent, hups klaar, kracht training geslaagd.

Interviewer: haha ok, ik weet niet hoe dat toepasbaar kan zijn in China, maar dat is dan weer een volgende stap. Ik zal het voorstellen. Ok, dankjewel, ik denk dat ik al de belangrijkste dingen gevraagd heb. Dus we moeten ons vooral richten op de bloedtoevoer.

Fysio: Als je daar nog even rekening mee houdt, dat je die niet in bewegingen gaat afknijpen juist. Dus met die nek bewegingen vooral, die zijn het gevaarlijkste daarvoor.

Interviewer: Ok, en dan tenslotte heb ik nog wat kaartjes, wat exercise ingredients, meer de ideeën die al zijn gevonden.

Fysio: ja zo’n sprongvorm is ook weer een kracht vorm. En deze nek oefening zou ik dus gelijk afkeuren vanuit fysiotherapeutisch oogpunt.

Interviewer: En als je deze op volgorde zou moeten leggen om een oefen programma op te zetten. Welke volgorde lijkt u dan het beste?

Fysio: De dynamische oefeningen eerst (extend entire body to change the fixed position) en dan pak je gelijk de ademhalingsoefeningen mee, om mensen bewust te maken van, let er op bij inademen goed je buik dik en bij uitademen wordt je buik juist dun. Wat je bij jonge kinderen ook nog kunt doen is band met klittenband om de lage onderste ribben, en dan slap klittenband, en kinderen heel hard laten inademen zodat ze het klittenband kunnen horen kraken. Dan weten ze, dan doe ik het goed.

Interviewer: ja, dat zijn wel leuke tips.

Fysio: En zeker om kinderen bewust te laten worden over hun ademhaling daar bestaan ook allerlei hulpmiddelen voor, vanuit de longfunctietraining. (Laat voorbeelden zien).

Interviewer: ok, bedankt. Dan nog een laatste vraag, ken je toevallig verder nog iets van websites, boeken of papers wat wel interessant zou kunnen zijn voor mijn onderzoek?

Fysio: Ik zou als ik jou was nog naar de schrijfdans gaan kijken wat je daarvan kan gebruiken. Dat zijn echt hele duidelijk omschreven oefeningen met muziek en bewegingen die erbij horen. En verder dus die Peter van Beek. En mocht je het niet gevonden krijgen, dan ga ik zelf nog wel zoeken.

Interviewer: ok, bedankt leuk. Ik zal er naar zoeken.

Fysio: En misschien moet je eerst even naar de trainingsleer kijken, wat wil je verbeteren. Want een houding verbeteren is een einddoel, maar dat is geen trainingsdoel.
Interviewer: ja het is meer ook de bedoeling dat het een ontspannen pauze wordt, dat ze af gaan van hun stoel en wat actiever worden. Dus ons doel is meer om de bloeddoorstroming te verbeteren, mobiliteit te verbeteren, en concentratie en activatie.

Fysio: ja dat denk ik ook. Ik denk dat je je ook veel meer moet focussen in de ontspanning algemeen, dan in de ontspanning in het oog.

Interviewer: ja dan denk ik dat ik weer wel even aan de slag kan.

Fysio: succes, ik ben heel benieuwd! Hou je me wel op de hoogte, ik vind het een heel leuk project!

Interviewer: ja, de informatie die ik mag delen, zal ik zeker delen.

Fysio: Succes, ik ben benieuwd!

Interviewer: ja bedankt, heel erg bedankt voor uw tijd.
Appendix B: Focus group sessions

B1. Focus group schedule:

<table>
<thead>
<tr>
<th>Task</th>
<th>Supplementary questions</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to the project</td>
<td></td>
<td>14.00-14.10</td>
</tr>
<tr>
<td>2. Part 1: Discuss current Chinese eye care exercise (15 min)</td>
<td>1. Why did you think of ……? (if there is a quiet moment or if an intern is non talkative)</td>
<td>14.10-14.25</td>
</tr>
<tr>
<td>- Show movie current Chinese eye care exercises</td>
<td>2. Imagine that you are 10 years old and doing the exercises twice a day.</td>
<td></td>
</tr>
<tr>
<td>- Questions:</td>
<td>3. Did/do you sometimes do a part of the eye exercises, for example massage your eye muscle or neck?</td>
<td></td>
</tr>
<tr>
<td>1. Write down some words (on post-its) you immediately thought of, after watching the movie of the current Chinese eye exercises.</td>
<td>4. Or was it more fun? Just a nice break. Do you think you always correctly execute the eye exercises?</td>
<td></td>
</tr>
<tr>
<td>2. When you were a student in China, did you like to do the eye exercises? Explain why.</td>
<td>5. Or did you only perform the exercises because they were compulsory?</td>
<td></td>
</tr>
<tr>
<td>3. Did you sometimes do the exercises after school (for example while studying)? Are you still doing the exercises? Explain why.</td>
<td>6. Or do you think eye care exercises should be abolished?</td>
<td></td>
</tr>
<tr>
<td>4. Were you motivated to do these exercises?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Did/do you believe that the eye care exercises can reduce the development of myopia? Did they work for you? Explain why.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Do you think it is needed to replace the current eye care exercises with new exercises? Explain why.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Explain new ideas: laser-guided exercise (10 min)</td>
<td></td>
<td>14.25-14.35</td>
</tr>
<tr>
<td>- Eye care exercise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Body exercise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Part 2: Discuss new ideas: ‘Bird exercise’ (20 min)</td>
<td>1. Why did you think of…? (if there is a quiet moment or if an intern is non talkative)</td>
<td>14.35-14.55</td>
</tr>
<tr>
<td>- Show movie ‘Bird exercises’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Questions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Write down some words (on post-its) you immediately thought of, after watching the movie of the ‘Bird exercise’. What do you think about the ‘bird exercise’?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. How would you compare the ‘Bird exercise’ with the current eye care exercise?

3a. Do you think children will be engaged to do this body exercise? Explain why.

3b. How can we engage them more?

4. Do you have any suggestions to refine the exercise steps so that we can include the wisdom of Traditional Chinese Medicine (for example Tai Chi)?

5. We know that there are 2 class breaks to do the eye exercises. One in the morning and one in the afternoon. Do you think there are different needs in the morning than in the afternoon?

6. What do you think of the bird? (fun-smart-attractive-dangerous etc.) Do you have other suggestions for the projected content?

7. Do you have some ideas for the name of the bird?

8. Do you think children like the bird? What can we add to make the exercises more attractive to follow?

9. With the ‘Bird Exercise’, do you think it will be able to stimulate the interest of students? Will they be more engaged? Explain why.

2. More fun/more based on scientific evidence/easier to perform/more relaxing etc.?

3a. Compare with the current morning exercises? What are the differences? Imagine that you are a 9 years old child.


4. Give some examples of Tai Chi exercises. Are they also included in morning exercises?

5. For example other (more active) exercises in the afternoon? Other music? Other design? The reason is to avoid repetitions and also cover different body needs. Do you think this is a good approach?

6. Other bird, other animal, or for example another moving objects (airplane/sun/person etc.)?

7. Chinese name or English name? Refer to familiar game? Healthy related? Related to the eye?

8. More simple or more detailed drawing? Other facial expression (more smiling, bigger/smaller eyes etc.) More active movements? Faster music? More popular music?

Break

<table>
<thead>
<tr>
<th>Break</th>
<th>10 minutes (14.55-15.05)</th>
<th>15.05</th>
</tr>
</thead>
</table>

5. Explain ideas to make the exercises more attractive? (motivation and engagement) (10 min)
- Movies / cartoons
- Games
- Sport
- Music
- Education

6. Part 3: Motivation and engagement (more creative session) (45 min)
1. show moodboards sport-games-movies-education-music (question 1)
   - What do 9 year old Chinese children like?
   - How can we make the exercises more attractive?
   **Question 1a:** After discussing the homework assignments, what do you think is the best way to stimulate the interest of 9 year old students?
   **Question 1b:** How about stimulating students in middle school (13-15 years old). Something different?

2. Show stories: ‘Journey to Beijing’ and ‘Journey to Chengdu, Sichuan’
   **Question 2:** We stimulate students to follow the far-sighting exercise by introducing themes. The first one is “journey to Beijing”, you can imagine it with other themes. Do you have other suggestions to the themes? Try to write down your own story (or make a drawing of the story).

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1. Combine with a popular game/video game? More social interaction? More educative? Do you think it will be interesting and effective if we introduce exercise that plays in groups?

2. Try to image what Chinese children like? What kind of themes could be interesting? Journey to a city/information about food/journey to wildlife park etc.?
   We have an idea to allow students to design some themes of the exercise by themselves. For example, they can design the “journey” by collecting relevant images. Do you think this will stimulate their interest?
B2. Focus group session 1

**Moderator:** Martine Huygens  
**Assistant moderator:** Patray Lui  
**Number of participants:** 4 (3 females, 1 male)  
**Date:** 02-11-2012

**Participant 1:** My name is … I work in this department. When I was little I am born and raised in Singapore. I left Singapore when I was 17 years old. Till now I’m not far away from the Chinese culture, so I hope I can contribute.

**Participant 2:** My name is … I was born in the northern part of China. When I was 10 years old I did this kind of exercises.

**Participant 3:** My name is … and I’m also from China. I’m here for a master thesis study, and I’m now working as an intern at building 30.

**Moderator:** My name is Martine, I’m studying Human Technology Interaction and I’m doing this project for my graduation.

**Assistant Moderator:** I am … I am originally from Hongkong. I can speak some Madarine, but with a funny Hong Kongy accent. But now we speak English so we can understand each other. I’m working at Philips Design for 7 years. Martine also join the project since some couple of months and as Martine already said this is part of a program and we are really looking at the school context in China and looking to enhance the performance and healthy development in general of Chinese schools. But we are going in that in detail later.

**Participant 4:** My name is … and I was born in China, in the northern part of China. I did these exercises when I was in primary school, so I hope I can help.

**Moderator:** So our project is about the Chinese class break exercises. And with this exercises we try to reduce the myopia rate, try to reduce the development of myopia and visual fatigue. So first I can explain...
something about myopia. Myopia is better known as nearsightedness. The causes of myopia are widely debated. It is related to genetic factors but also to environmental factors. There is high grade myopia and low grade myopia. Low grade myopia is more related to environmental factors, so that is where we are more focusing on. The myopia rate is really high in China. For primary students it is more than 40 percent and for high school students it is almost 80 percent. So it is really a major problem in China. I will explain a little bit more how it works. If you have myopic eyes you have problems in looking at distant objects. For close objects it is not a problem, you can see this on the right picture. But for distant objects, the objects are projected in front of the retina. You cannot accommodate, or bring it into focus. Accommodation is the process in which the eye changes its optical power. The shape can be changed. For distant objects you don’t need to accommodate, because of the refraction to bring objects into focus. But with close objects you really need to accommodate because it’s requires more refraction for focusing. Do you understand it? For distant objects your eye muscles are relax, but for short focusing you need to accommodate.

**P2:** I do not understand. If you have myopia, you cannot relax right, because you cannot see what is in a distance.

**Moderator:** The shape of your eyes is changed, because your eye is the entire time in accommodation, so you cannot really relax your eyes anymore. If you look at something like this you stretch your eye muscles to accommodate to read this. For a long time doing this it will fixate your eye muscles and you cannot longer release it anymore. When you look at something far away, you don’t need to accommodate, so you don’t need to stretch your eye muscles, so you can relax your eye. You need to keep a balance, and not doing this all the time.

**P2:** Ah ok.

**Moderator:** In this project we will focus on the environmental factors. The two most important are that Chinese students work indoor for almost the entire day, and they are doing a lot of near focusing, reading books, writing. So there is a lot near focusing, but not much distant focusing.

**Assistant Moderator:** By the way, do you all have myopia? You have I guess?

**P3:** Yes

**Assistant Moderator:** And you?

**P4 and P2:** No

**P1:** Yes

**Assistant Moderator:** Me neither.

**Moderator:** So that is not really the 80 percent. Ok, another problem is that they sit in the same posture for almost the entire day. So they got some problems with their neck and shoulders. And there is a fixed viewing direction, only to the black board or white board. And if you compare it to for example Europe of the Netherlands, the Chinese school days are a lot longer, you all know that I guess. It start sometimes at
7 at it ends at 11, that is not really the case in the Netherlands, so these are more the environmental factors. Now the solution, the morning exercises. Do you have some experiences with that?

P1, P2, P3, P4: Yes.

Moderator: And of course the eye relaxation exercises for 5 five minutes, twice a day. So in this focus group session we would like to discuss the current eye care exercises. I will show you a movie with the current eye exercises, but I think you all know how it works. I would like to ask if you would like to write down some words you immediately thought of after watching the movie. We would like to understand your opinion and motivation to do these exercises. You can just write down everything you can think of.

Assistant Moderator: It is just a general discussion, there a no wrong or right answers.

Movie current eye relaxation excises

Moderator: So now we would like to know your opinion about the current eye relaxation exercises.

Assistant Moderator: So just if you liked it, if it was fun, what about the music, if it was bad or I don’t know, just anything. Just some kind of idea, did you actually enjoy it. If was enjoyable you can write down enjoyable and I don’t know, just anything.

Time to write down words after the movie

Assistant Moderator: By the way, do you all remember how to do it?

P3: Oh yes, we did it day after day after day…

Assistant Moderator: ok very good.

Moderator: So now we can discuss what you have written down. So maybe you can start?

P3: Yes personally I think it is kind of relaxing just as a break between lectures, just as a 5 minutes break. But to be honest, it is not fun. We have to repeat for times and times. And also I think the accuracy of pointing to the required position may be a problem for elementary school students. I don’t know if they are pointing on the right position.

Moderator: So you don’t know if they do the exercises in a correct way?

P3: Yes, actually it might be a problem for me as well. This is my general view of these exercises.

Moderator: Do you have the same experiences?

P4: Yes, I did this day after day. These are boring exercises. It just made me so sleepy. Everything is the same. Actually the exercise is a good exercise, because if you pointing on the right position it really help a lot because I did some sorts of Chinese medicines for 1 year and I think it can really help. But I don’t think everyone can find the right positions, because the positions are small and little on the joints. Sometimes it is just impossible.
Moderator: Is the teacher helping to correct is?

P4: The teacher is even wrong.

P3: Indeed.

Assistant Moderator: That is good to know.

P2: I think the others have covered my points. When I do the exercises, I feel kind of relax. I am comfortable. The music, it is not really fast. We became a little bit sleepy.

P1: Two of my points are the same. I became quite sleepy. I was a bit naughty that time, I was just looking around to others, but they wanted to do it basically. I was also wearing glasses and I had to remove my glasses during exercises.

Moderator: Ok, but it was still nice to have a break in between classes?

P1: Ok I forgot to mention, my was only in the morning, instead of the morning exercises. We had the national anthem and also the announcement for exercises and the eye exercises.

Moderator: But you did it in the class room?

P1: No outside with the whole class. We have our own individual physical education time slots.

Assistant Moderator: So you were standing, when you did the exercises?

P1: No sitting down.

Assistant Moderator: Like in the play ground? That is interesting.

P1: And they played the music over the public announcements.

Moderator: The same kind of music like in the movie?

P1: Yes kind of the same.

Moderator: Ok thanks, ok so you did these exercises at school two times a day or one time a day, but did you also do it for example when you where studying or at home after school. When you thought now I really need to do these exercises?

P1 – P2 – P3 – P4: No

Assistant Moderator: By the way, did you ever question your teacher why we do these exercises?

P1 – P2 – P3 – P4: No

P3: No because it was compulsory.

P1: No now I questioned myself. It is only for eye sight. Why just do it ones, instead of so many steps.
Assistant Moderator: But did you ever raised your hand and asked your teacher?

P1: No

Assistant Moderator: No ok, I was just curious.

Moderator: So what was the main reason why you did these exercises? Because you had to do it or?

P2: Because it was compulsory. And supervisors where walking around and checked which guys had their eyes open. I think that helped.

Assistant Moderator: I remember in the school visit, sometimes there is a class captain, just go in front of the class room and do the demonstration. Did it happen at your school? Is it the same that somebody would really demonstrate how it works?

P4: Only at primary school, first year or second year.

Assistant Moderator: Ah ok. And afterwards you did it every day so you don’t need ok.

Moderator: You said when you did the exercises in a correct way you really had the feeling that it worked for you?

P4: Normally when you do it in the right position it really kind of helps you to relax your eyes. Only when you take it serious.

Assistant Moderator: But for your own experience. That you know which point you actually pressing it, do you feel the effect immediately or is it like because you understand the principle. After lets see two weeks you understand the principle and ok I can feel better.

P4: No, in the long-term

Assistant Moderator: Because you studied Chinese medicine and you have some background information so you know where to press.

P4: Yes.

Moderator: Actually you all said that the exercises where boring, maybe because of the music or because you did it every day. So do you think it is needed to replace these exercises for some other exercises or make it more playful or something else?

P3: Sure, I agree to play outside in an open area and we can look at the distance, instead of just sitting in the classroom.

Moderator: ah yes I understand, but if you should do something in the 5 minutes of the exercises?

P3: Yes that would be a problem. Better to do a more time break.

Moderator: Ok, and what are your opinions?
P2: I think a new set of eye exercises have been invented. I think it will be implemented soon.

P4: New eye exercises are implemented 2 years ago.

Assistant Moderator: Yes but the video we showed was just a small part of the video, we didn’t show the whole thing. We did a research last year in China in Chinese schools and that is what they are doing. But I know that there were some changes a certain moment in time, I don’t remember, that you only have one exercises in the morning or during the day and then nowadays they have two times the exercise, so that is the main difference we understand, but so far we don’t see that there is any invention in the exercise step over the time. Maybe they made some little changes, but so far the education agency and schools and teachers we talked to they say now we do it two times. That is the only thing we know. But if you have other information please let us know after this discussion.

Moderator: So anything else about this?

P1: If I know for the age at that time that it was efficient, I would continue the exercises.

Moderator: So if you know that it works you would like to do the exercises?

P1: Yes

Moderator: So than you are maybe more motivated?

P1: Yes

Moderator: So these are the current Chinese eye exercises. We also asked the opinion of some eye experts and they said that these current eye exercises are more based on common beliefs rather than on scientific evidence and they use these exercises for almost 40 years, and maybe it worked 40 years ago but maybe the current exercises are no longer sufficient because of the change of the environment. So maybe it works for some people, or maybe it only works if you do it in a correct way, but maybe it is not working for everybody. This is more about the experts. So that is why we would like to propose some new ideas for these eye care exercises. We would like to focus, as I already explained, you relax your eye accommodation when you look at distant objects. So we try to implement far focusing, varying size of the image to simulate far focusing or distant vision and we also find in literature that bright light can relax accommodation so we tried to implement these things in new eye care exercises. So these are the new ideas. Another idea is to also include some body exercises because we found that students lack the ability to do all kind of sports. So maybe education is more important than sports because it is really important to go to the best universities I think. So we also heard that they sometime squeezed the physical exercise classes to one or even none. So that is why we thought it is also important to implement some body exercises to the new class break exercises. And because of the bad posture, if you are sitting for the entire day, you have more neck, back and shoulder symptoms, so that is why we are also thinking to include the body exercises.

Assistant Moderator: And as we already mentioned it is maybe better to go to the playground to play to get the sunlight and to adjust the viewing for different objects. But the thing is we also try to work within the constrains, because you cannot say now every kid need to play outside so we also need to think about
what we can do within the classroom within the time they already have in the eye exercises. That is the starting point of this project as well.

**Moderator:** So we also have some new ideas for the body exercises. These are more to increase the energy level or to reduce body stress. So we are thinking about dynamic movements, stretching or breathing exercises. The idea is to also include this in this 5 minute exercises. So what do we propose? I also have a movie with the new ideas. We propose that using animating content, projected on a classroom wall we can guide students to do eye and body exercises and these animated graphics will change in focal depth and contrast also helps student to relax their eyes to relax their accommodation and to reduce eye strain and visual fatigue. So the goals of this project are to reduce eye fatigue, this is pain of discomfort in or around the eyes. To reduce neck back and shoulder symptoms, and to increase motivation. You all said it was really boring so maybe we should engage them more to do the exercises in a correct way. And more a long term solution to improve eye sight. We already made some new ideas and these ideas are based on nine years old kids. I made this slide more that you get some insights how nine years old kids are and what they like. So the ideas are focused on nine year old kids, this is really important to keep this in mind during this session.

**Assistant Moderator:** Maybe important to tell why we are focusing on nine year old kids. This is the age when you still can do something, when you are older, in middle school or high school you cannot do so much anymore, you already have the myopia situation. So that is why we choose this group.

**Moderator:** So these are the new ideas. In the new propose exercises we would like to start with the body exercises and after that do the eye exercises. I also have a movie about these new ideas.

Show the movie.

**Moderator:** So these are the new ideas, maybe you can also write down your opinion about this on post-its. So think about the bird or the music or anything.

**Assistant Moderator:** maybe we can play the music again.

Time to write down opinions about the new ideas.

**Moderator:** Now we can discuss again what you have written down. Maybe you can start?

**P2:** I think your experiment has many advantages. The first is that these graphics will keep the students motivated. I guess that they like it. When you want to instruct the children to do one exercise you can highlight the section you want to. That is very cool I think. The music is more like pop music.

**Moderator:** You think that is better?

**P2:** yeah yeah.

**Moderator:** Ok

**P2:** And another thing, no hands are involved in this set of exercises, this is maybe more healthier. Because it happens that the hand is not that clean, and we need to touch our eyes.
Moderator: Ok

P2: The thing I worry about is when the children are on their feed, they might interfere with each other. Because a lot of people are in 1 class.

P3: The space per person is limited.

P2: For my case we had 80 students in one class.

Assistant Moderator: 80? wow is a huge number

P4: I had 92 in the primary school

P2: This is common

Assistant Moderator: How big is the room? About?

P2: Half of this room.

Assistant Moderator: eight zero or 18?

P2: eight zero

Assistant Moderator: How can this happen?

P4: The mine was the same as this room I guess.

Assistant Moderator: An how many students?

P4: 92

Moderator: But wow, ok, how big where the tables than?

P4: Pretty big, something like this, but we share with two people.

Assistant Moderator: Ok wow, interesting. Another condition is better; we looked at 50 people usually in a space of about 5 by 5 square meters. That is pretty much what we know now.

Moderator: Ok thank you, good point; the limited space can be a problem.

P1: For me if I think I was 9 years old, I was not willing to do the exercises, because I don’t see it as a problem. In fact I think I choose to wear glasses, because I thought it was cool, because everybody wears glasses in my school. So because I don’t think this is a problem, just mainly about it. When I was looking at the video I was wondering if I should move my eye when the thing moves or should I move my neck?

Moderator: It is more the idea that you are really following the bird, but you cannot only do it with your eyes, so therefore you also have to move your neck. That is also good to hold it in another position. It is more a combination of moving your eyes and your neck.
P1: So if I move my neck, I don’t need my eyes (joke). That is about it. : And I’m also wondering if it is not too predictable, if everyday will be the same…

Moderator: Yes we should think about that, and what do you think about the bird, the projection. Do you think the children like it?

P1: I’m not sure.

Moderator: No, why not?

P1: For me I like it, but I’m just wonder, you can also use a cartoon or movie. There are also birds flying around.

Moderator: O, and about the music maybe?

P1: I was more listening about the words, I did not listen the music.

Moderator: Ok

P1: It was quite attractive the visual, and I was following the instruction, I did not hear the music.

Moderator: And for you listening the instruction together with the visuals, do you think it is easy to follow, if you have to do the exercises, or not? Do you think you actually understand what you need to move?

P1: Yes

Assistant Moderator: ok.

P1: I was paying very much attention to the instruction.

Assistant Moderator: very good student!

Moderator: yes! Do you share these opinions?

P4: Yes, well the only thing is that I think the neck part is not that clear, because you only changed the line of the point to the dot line. And I also think the graphics is cute, but the color is too simple. There is only one color. Only when you have color blinded people in your class.

Moderator: So you think we should make it more…

P4: Most times these kinds of kids are attractive to colors. If the color variables it will be better I think, but I am not sure.

P3: Also I have to add a technical detail. I think the exercises for kids are relaxing. But it is a little slow, at least for me. I prefer to do it faster. Because I see you in the clip that you hold the movement for 1 second. I think it that way the muscle will be stressed.

Moderator: ok, but do you think it is good to include also body exercises?
P3: Yes that is cool, but the details might be adjusted somehow.

Moderator: And why do you think it is good to include it?

P3: Personally I prefer doing physical exercises, more than just doing eye exercises. Just a personal preference.

P1: For me it is the same. I guess I like doing sports. To keep the body full of energy.

Moderator: So you think it is nice to do it during the day.

P1: Yes

Moderator: Ok. How would you compare the new exercises with the current eye exercises? Because we changed a lot. Do you think it is maybe needed to include some parts of the old exercises?

P3: I think it is a little hard to combine these two kinds of exercises but I think you might need some experimental evidence, evidence to support the new design.

Moderator: Yes yes, of course. But do you think if we have some evidence people will use these exercises at school?

P3: yes yes, the effect of this new design is …… with no worries than the original one, it will be a higher rating for the preference, than it is cool.

Assistant Moderator: But how about your personal experiences. If I tell you that both exercises have the same effects, maybe they are both good let’s say, which one would you prefer, or maybe better 9 year old kids will prefer?

P3: I think the new one, because this is more funny.

Moderator: And the others?

P4: I think this is better for nine years old.

Moderator: And what is the main reason for that?

P4: The music is quite playful and combined with the animations it really increased the motivation for children. You include some body exercises, that is also an advantage. Because I think it is very hard to keep nine years old kids stand still and do those kind of thinks, that is impossible.

Moderator: Ok, that is interesting. How do you think if you do these exercises two times a day, do you think it is still more motivated to do these exercises, compared with the old exercises?

P4: Is it every day still the same or?

Assistant Moderator: No we just ask your opinion. We don’t know, well we have some ideas, but we would like to know what you think, or how we can make it more interesting over time. What will be the best for you?
P4: If you change the graphics, the flying part of the graphics that would be interesting, like every day not the same.

P3: yes yes. I agree with you.

Moderator: And for example the music?

P4: Um music, if you can change that every day/week, it would be cool.

Moderator: Ok. And do you have some opinions about that?

P2: I think I am willing to do it twice a day. One in the morning and one after lunch. I think the eye exercise part is longer in the current exercises. Maybe it is too short in the new exercises.

Moderator: So we should focus more on the eye exercises?

Assistant Moderator: In the proposal we currently have is that the whole exercise is like 5 minutes. So the body part will be about 1,5 minutes and the eye part 3,5 minutes. But it is also good to know that longer eye exercises are better.

Moderator: How do you think we can engage them more to do the exercises? Can we add something? For example make it more social, or make it more playful?

P4: I think make it more playful.

Moderator: And why?

P4: If you involve games in these kind of exercise, that would be better. Better than just stand still and doing this kind of boring exercises.

Moderator: Ok, and what do you think?

P3: Yes maybe you can displace this animation demo with some popular cartoons. Children might like that better.

Moderator: Ok, and about the bird. You said it was cute, or you think children think it is cute. Do you think we should add something to make it nicer or?

P3: maybe you can develop five different models, one for each day. Maybe you can choose different models for each day, so children might be interested in guessing what will be the model each day.

Moderator: Ok, that’s a good idea. So make it more interacting.

P3: yes

P1: The children are already quite big I think. This is probably too childish for them. My nephew is already playing Ipad, already advanced thinks, and he is three years old.

Moderator: wow ok. So you think this is too simple?
**P1:** I remember when I was nine years old I did not appreciate something like this. More high level animations.

**Assistant Moderator:** If we are using this kind of set up, what do you think would be more attractive to nine years old kids. What type of content, would it be, I don’t know, transformers, or robot or I don’t know. Would you have some ideas?

**P1:** Nine years old is primary 6

**Assistant Moderator:** No I think it is primary 3

**P1:** I think this is more for primary 1 and 2, primary 3 I don’t know. I watched antinational cartoons as well. Like human figure which slam down.

**Moderator:** And about the body exercises, are these the same exercises you do in the morning exercises? Or are there some differences?

**P3:** They are similar I think. For the morning exercises we have series of different movements, which also include this kind of movements.

**Moderator:** Ok, so do you think it is ok to include these kind of movements?

**P3:** Yes it is ok. But you are replacing the old exercise with the new one, but the body exercises are still there?

**Moderator:** Yes

**Assistant Moderator:** So for you looking at you that you are going to repeat something that you do in the morning in the class room, you would like it to do some body movements in the class room, but maybe something else could be more interesting.

**P3:** Yes that could be.

**Assistant Moderator:** Ok.

**Moderator:** Do you know what kind of exercises?

**P3:** Yes I have no idea at this moment. Because I mean the body exercise also include a lot of kinds of movements, so it is hard to come up with interesting way.

**P1:** I was thinking maybe you have many figures rather than just one figure. Because in Asia we do thinks in groups. When I see my friends around me not doing it right I don’t want to do it right as well. That’s why you see a Chinese singing contest they have dancers and groups of people on stage.

**Moderator:** so you would imagine if you exercise together just in small groups it will be more fun and also you would do it better?
P1: That is really dependent of the group. If the group is motivated you will do it good as well. If they are not good you try to be as bad as you can.

Moderator: We know that this is for the Chinese students. We talked about the movements, do you think it is also needed to include something like Tai Chi or do you have some experience about that?

P1-P4: Not really

Assistant Moderator: But do you think it will be more exciting if it will include some wisdom of the traditional Chinese medicine? Or do you think it is really uncool? Just a general question.

P4: It is more for old guys I think.

Moderator: And there are two class break exercises, do you think it is good to do other exercises in the morning, than in the afternoon? For example after lunch I can imagine that you are a little bit tired, so maybe the exercises can be more active or? What is your opinion about that?

P3: It depends on when you are giving them this exercise, because usually you have the nap in the afternoon.

Assistant Moderator: Now the time that the first eye exercise is given is about 10.30 a.m. in the morning. Another possible one can be 2.45 or 3 o’clock. And then you still have the normal nap break that the students have. This is the time we look at. In the morning you are already quite alert or you already have a lot of energy, we don’t know. And in the afternoon you get very sleepy or maybe you also have a lot of energy, I don’t know. We are just wondering if you think there are different needs in your point of view.

P4: Yes I think so, because in the first afternoon class, I feel so sleepy or tired or not able to do anything. In the morning it is quite different.

P1: Because the weather is so hot, everybody is dying in the afternoon.

Assistant Moderator: So in the afternoon, when you want to focus in the classroom you need to wake up a little bit first. Can I say that or not?

P2: I don’t know what it is now but in my junior school it we started at 13.30 in the summer and 14.00 o’clock in the winter. Maybe exercises at 16.00 p.m. is good.

Assistant Moderator: So for you it is better to do it later, because before you already had to sleep.

P2: Yes

Moderator: And the exercises in the afternoon for example. What do you think is the most important? Is this maybe to wake up a little bit or we should include something different in the afternoon compared with the morning?
P3: I think you might change the time slot for the eye exercises and the body exercises. In the morning you can make the eye exercises longer and in the afternoon you can make the body exercises longer. You can have two different steps.

Moderator: Yes of course this is possible.

P1: But why do you have exercises again when you already taken a nap. Because during the nap you already relaxes your eyes.

Moderator: Yes that is true, but for example I can imagine that after the nap you are still a little bit sleepy or a little bit tired so than it is good to be more active or to do some exercises, we don’t know.

P1: Yes but I would like to have it instead before I can go home, like a cooling down activity.

Assistant Moderator: that is good to know. One last question: what do you think, do the teachers like these exercises or not? Just a general question. Do you think the teacher also like to do these exercises for the students or not? We are wondering if the kids see such a content they get over excited or really bored and maybe move around or touch other students. I really don’t know the situation. Could you imagine when you was on primary school, if the teacher would actually like these exercises for the students?

P3: If I was the teacher, I would like it.

Moderator: why?

P3: I think children will be more motivated to do these exercises. No more concern of guiding them through the exercises, they can do it their selves.

Assistant Moderator: Ok, and you, do you have some ideas?

P4: It depends on the age of the teacher.

Assistant Moderator: No it is just about your expectations, for example your teacher let's say. Just anybody from your perspective only.

P4: It’s good.

Moderator: Ok, for the same reason or just something different? Why do you think it is maybe good?

P4: If the system is easy to operate it is good.

Assistant Moderator: ok that is very practical, good to know.

Moderator: But do you think children do the exercises in a correct way, so that teacher do not have to control them?

P3: Yes that is my idea.

Moderator: So you think this is good enough to guide them through the exercises?
P3: Yes, but you have to test it.

Moderator: Yes of course

P1: I will prefer my teacher to conduct this exercise.

Moderator: Ok, and we were also thinking about a name for the exercises. So when you see this, what could be a possible name for these exercises, or a name for the bird?

P3: In Chinese or English?

Moderator: That is the question, if you think it is better to give it a Chinese name you can think of a Chinese name, or English name of course.

P3: I prefer to give it a Chinese name.

Moderator: Ok do you share this opinion?

Assistant Moderator: Maybe keep this question in mind. We would like to get your help. I can give you a post-it and if you come up with a name you can write it down. So you can just add it, maybe later on.

Moderator: You can also think about it if it should be related to healthy or something. It can be anything.

Ok thank you, we can have a short break now. We have one more session after the break.

Moderator: So we know that Chinese students are not really motivated to do these exercises, so we are thinking to add something, so that we can motivate and engage them more. We already have some ideas. We can combine it with education, make it more co-creative or add some nice music. We already tried that. So these are some ideas for the motivation. I already ask you before this session what children with an age 9-10 like. I received some reactions, and put everything together on this slide. So if you see these examples, what do you think will be nice to combine with the new eye relaxation exercises? Do you have any ideas? Now we have the bird, but maybe you can think of something better or different? Just anything.

P4: For me it is important that something change over time.

Moderator: Ok that is good. And about the cartoons or? Now it is an animal, maybe we can think of something else? It can be an airplane, I don’t know, it can be anything. Any ideas?

P4: Maybe sowby, form Hello Kitty.

P3: Yes and then the cartoon figure can teach the children what to do.

P4: yes. Something cute will be nice.

Moderator: Ok, so you think it is nice to combine it with something popular, that children already know.

P2: Yes maybe something they know from tv. But a cartoon figure can be nice for girls, but for boys I don’t know.
Assistant Moderator: What do you think if we ask the students to design a character? Do you think that will be fun for them?

P2-P3-P4: Yes, that could be.

Assistant Moderator: and if you were a student, and I ask you know to design something, what is it? So you are very good students and you get the opportunity to design a character, what would it be?

P3: cartoon character.

Moderator: other suggestions?

P4: a pony maybe?

P1: it is really hard, subjective

Moderator: yes of course, but we just ask your opinion, it can be anything.

P1: Maybe if it is too funny, people do not think that it is serious. And if it is too political, students also not want to perform the exercises. If I think about myself as a child.

P3: Or maybe their pets. And then their pets can talk to them. They can be use their pets as a model in the exercise.

Assistant Moderator: Do a lot of children have pets?

P3: Yes some of them.

Moderator: so for example they can make a picture of them.

P3: yes and maybe they will be proud of their pets if it will be presented in front of the class.

Moderator: interesting, nice.

P3: one pet can be presented on Monday, another can be presented on Tuesday etc.

Moderator: so do you also think we can motivate them more if they can create their own figures, or do you think that doesn’t matter?

P4: Yes it will be nice if they can create their own figures.

P2: Yes that is a nice idea.

Moderator: and a little bit of back ground, were you proud if the teacher said this is the best row. Do you think it is important to have some competition?

P3: To me it is not important to have a competition, but just to let everyone be involved in this kind of activity.

Moderator: so maybe they can create some drawing together or?
P3: Yes maybe, or one student for one student, but let everybody involved.

P2: I have a question, how can this input be involved in the system?

Moderator: we can design it of course, but we are now just brainstorming about new things, we would like to know your opinions, so we can take that into account during the design of the system.

P4: A 3D version would be nice.

Moderator: Ok, and for example, education is really important, so maybe we can combine the exercises with some information about for example the nature or something about food. Do you think this would be nice?

P3: Yes I think it is possible. For example you can provide the corn, and that the corn speaks for himself, for example there is a lack of food in some parts of the world. So they get some information about this.

Moderator: Ok that is a nice idea.

P4: Maybe it is nice to combine it with animal protection, if you show some short movies for different kind of animals that would be nice I guess.

Moderator: So you think that can motivate students, because they can learn some interesting facts?

P4: Yes

Moderator: but during the class you already have a lot of information. So during this kind of breaks, what content can be more interesting? So you are not supposed to study anymore, you should be relaxed. In that kind of time what type of information would be more motivating? Or keep you attentive? Is it about food, or animal protection or other things?

P3: I think some everyday themes can help. For example how to make you look more beautiful, because I think they are quite insecure.

P4: Cute little thinks will always cheer me up.

Moderator: and you guys?

P1: Story, we always asked our teacher to tell ghost stories. Because my teacher had a vision to see ghosts. Or maybe just classic stories. And I also have some ideas about the cartoon. I think maybe the Beijing meskon cartoon. There are different names, different characters for different stories. And it is very neutral, not too childish.

Assistant Moderator: so something that is both appealing to adults as to kids you prefer.

P2: During the break we chat to each other and maybe go outside to play fooball or roof jumping. That what we do when we were young. But how to combine this with exercises is difficult.
Moderator: Yes this slide show an impression what kind may be like when they are 9 years old. No we can show some ideas for the themes. Our idea was to combine the exercises with a theme. For example a journey to Beijing. So we can show some pictures about the city, but also tell them some facts about it, give them some more information about the city. So maybe we thought it is nice to combine it with a story. You remember in the video that the students should look around to the bird. We would like to stimulate the students to also follow the bird. So every day we can make a different theme. For example to Beijing or Shanghai. And then we can give them some information. What do you think will be interesting for them? What kind of information? Could it be something like this or something else?

P3: I think this is a good idea, but don’t make it too complicated. You have to focus on the bird that is the most important part.

Moderator: But if you think about a journey of the bird, which is not too complicated?

P3: Yes than it’s good.

Moderator: Do you have some ideas for the content or the journey?

P3: To my understanding the nature can be more helpful. Because nature elements are more beneficial for restoring our mental energy compared with the build environment. Like forest and grasses.

Moderator: So this can be good for the relaxing part.

P3: Yes

Moderator: Do you think this is also interesting for them?

P3: Yes, because the elements are funny. For example fishes.

P2: For me it does not have to be related with China, but maybe more world wide. Journey to for example Paris.

Moderator: So you are more thinking about the cities or countries or can it also be something else?

P2: umm

Moderator: So do you think the student would like it more if there is a journey to for example Amsterdam or Paris. You think they like something like this or not, or something else?

P2: Yes, we all want to see something new.

Assistant Moderator: because this type of topic is outside the textbook you have during classes’ right?

P2: Yes

Moderator: and for example if we do a journey to Paris, what would be interesting to show?

P2: Umm I never been there.
Moderator: But should it be more like facts or pictures.

P2: I think some fiction stories can be interesting.

P3: Or some landmarks. But I don’t know if it is too much for the kids.

P1: Under water word is maybe nice. And for the music you can have some water sounds. Fishing swims around. So you can have forest theme, fishing theme etc.

P4: Hmm yes that would be nice.

Moderator: And do you think it is good to have another theme every day or maybe every week?

P3: that is quite difficult to say.

Assistant moderator: actually we had the idea to create a little bit of framework. The students could design the themes. So every week they can have a little project and information about for example Paris. Do you think this can be interesting?

P3: Yes I like that idea.

P4: Yes that is good.

Moderator: Do you have anything to add, or some other ideas?

P4: No I think this one is good.

P1: For how long should they design? Every week of the year or is this a one time?

Moderator: We don’t know.

P1: I think I would get tired and lose my motivation. But if you have already an underwater world and fishes come and go, that is quite dynamic.

Moderator: So you think it is good to have a balance about how often you change the theme and not too much but also you have some changes.

P1: Yes too much changes would be predictable.

Moderator: And you said also that we can change the music.

P1: Yes, not really music, but just an ambient sound.

Moderator: ok

P1: I have a lot of sounds on my Iphone, ambient music: waterfall, sea.

Assistant Moderator: so if we need a sound we come back to you. Do you think it will be interesting to have some kind of virtual nature in the classroom?
P1-P2-p3-p4: Yes

**Moderator:** Do you think this is also nice for 9 year old kids?

**P3:** Yes I think they like it, they also like pets and animals.

**Moderator:** Do any of you have any more ideas?

**P3:** Do not overwhelm them. Because it is supposed to let them relaxed. Because complex stories requires a lot of concentration.

**Moderator:** So too much educational information is maybe not that good.

**P3:** Yes, you should really think what information you want to show them.

**Moderator:** And for example when a bird is flying to the corner, and then it stops and gives you some information about something, we don’t know. Do you think that is nice? So they are motivated to follow the bird, and then there happens something?

**P1:** Yes I think it is good to have an element of surprise. When something pops up.

**Moderator:** And what do you think is nice to surprise them?

**P3:** The bird can disappears and then some information can be given.

**P1:** Maybe a nice game. For example the first surprise kids with white socks need to raise their hands and with the next surprise kids with black shirts need to raise their hand etc. Something different.

**Moderator:** Yes that is a nice idea to combine it with a game. Other thoughts? No? Maybe we ask too much. Ok last questions, if we give some information about something, should it be something that is outside their textbook, outside their curriculum, or should it be something related to schoolwork?

**P4:** It should be something what they don’t know yet, outside the curriculum. Because they are already so bored during the lessons.

**Moderator:** So something new at least.

**P1:** But we are so academic, if there is no grade, than I don’t want to do it. So if it is related to the course it will be better, if not, students will not participate I think.

**Assistant moderator:** That is a very different opinion. Ok, and if we give the students a challenge after every exercise, if we for example tell them something about Paris, show them some museums and stuff, and after that we ask some questions about that. Should they be more motivated do you think? Or does it give too much pressure or will it be too much or would it be nice?

**P2:** Maybe you can teach them English. Maybe it can help them to remember vocabularies.

**Moderator:** Yes nice idea. And what do you think about a competition who is the best?
P3: It depends on the teacher. The teacher has to guide them to focus on the important information and not on the competition itself.

Assistant moderator: Do you have any ideas of the role of the teacher in this exercise? What should the teacher do. Do you have any idea?

P3: In a rural school, the teacher can read stories, because they don’t have the equipment

P2: Maybe they can make different animals of foam and then make a story with it.

Moderator: And about the voice instruction. Do you think it is necessary or not or do you have some ideas? What kind of instructions will be easier for 9 year old students? Do you think it is good to have some voice which can guide them through the exercises or is it enough to for example follow the bird? Or it doesn’t matter.

P3: I think it is good that the teacher show how to do it before the exercises. And then they can do it their selves.

Assistant moderator: and about the annotation?

P3: I think a human voice is boring.

P1: But an instruction is good, otherwise you don’t know what to do. If you do it not right the first times, than you would never do it right. And I’m also thinking when you go to the next level of a game, you have a sound. So that will keep people try to achieve to go up to the next level. And we also get a badge for certain thinks we do well at school, so if you achieve some goals everybody can receive a badge as a reward.

Moderator: yes thanks, nice. Would you like to add something or maybe you have a nice name for the bird?

P3: Yes I have a name, health exercises.

Moderator: So you think it is important to relate it to health?

P3: Yes, it is not only about the eyes, but about the general health.

Moderator: and you

P2: bird, just bird.

Assistant moderator: Ok thank you, we also already thought about the name, its confidential: EBE bird, which stands for eye body exercise.

P3: Sounds cute!

P4: Yes nice.

Moderator: Ok thank you for participating is this focus group. We really appreciate your help.
B3. Focus group session 2

Moderator: Martine Huygens
Number of participants: 3 (1 female, 2 males)
Date: 16-01-2013

Moderator: I will first explain something about the project. This project is about class break exercises for Chinese students and this is part of a bigger project to enhance healthy development in Chinese schools. My name is Martine Huygens. I’m studying Human Technology Interaction and I’m doing this project for my graduation. And I’m a graduation intern for 4 months now. So maybe we can do a short introduction round.

P1: Yes, I’m doing a 6 months project here. Actually I’m an employee of Shanghai Philips. Here I stay 6 months for the innovation open project. This is my third project. The first one was in healthcare, the second project was a lighting project in Shanghai.

Moderator: Ok, thanks, interesting.

P2: My name is … I come from TU/e. This is also my final graduation project. It is a master project. It has been two months. In total it is six months. I’m doing signal processing, about sound and the ears.

P3: I’m doing my final graduation project now. My topic is about algorithms of the 3D tv. And I’m also a student of the TU/e.

Moderator: Ok thanks, and you al did eye exercises at school?

P1-P2-P3: Yes.

Moderator: Ok, at primary school and high school?

P2: 12 years, primary school, secondary school, junior high school…

P1: Me too.

P3: I cannot remember, only that I did it at primary school, for middle and high school I don’t know.

P2: I’m sure we had it for 12 years. But studied 12 years in the same city and we have the same rules I think.
Moderator: Ok, so I don’t know what you know about myopia and nearsightedness. So you had to perform the eye exercises to reduce the development of myopia. The causes of myopia is widely debated. It is clear that a small proportion of childhood myopia is genetic, however there is also evidence for environmental factor playing a role in the development of myopia. So you see here the myopia rate, it is really high, more than 40 percent for primary school students and almost 80% for high school students. So that is a lot. Are you also myopic?

P3: Only 80%? It is 100% here.

P2: Somehow it is over 90%. Maybe it is different per high school. In China the high school is different. You have different levels. My high school was a top level high school. In lower level high school the myopia rate is lower I think. In my school was the rate almost 100%

Moderator: Wow, that is a lot.

P3: They studied harder I think.

P2: Yes.

Moderator: So I think the 80% is the more average number. So in this project we are more focusing on the environmental factors, which can cause myopia. We are more focusing on the low level myopia. There is also high level myopia, but that is more genetic. Myopia starts to grow at an age of 10. And then something about the eyes.

P1-P2-P3: Yes we know how it works.

Moderator: So than I don’t have to explain much about it. In myopic eyes there is a refractive error.

P1: Yes I know my problem.

Moderator: yes, ok than I don’t have to explain much about it. Than about the problem, why is it a major problem in China compared with Europe, or for example the Netherlands. For this project they did some school visits last year and they found out that Chinese students work indoor for almost the entire day, they are not playing outside a lot. There is a lot of near focusing during reading or writing. They sit also in the same posture during almost the entire day, where the back is in a curved position. And there is a fixed viewing position, only to the blackboard and to their books. And this in combination with really long school days. I don’t know if you also had classes till 11 o’clock?

P2: No not really

P1: Probably

P3: We started at 6 a.m. in the morning.

Moderator: There is a lot evidence that there is much pressure among students; everybody wants to go to the best universities. So this is why this is maybe a major problem in China, compared with for example Europe. So the current solution: you already told me, the morning exercises. Every morning. Was it compulsory in your schools?
P1: Compulsory yes.

P2-P3: yes.

Moderator: And also the eye exercises.

P1: Also compulsory. Twice a day.

P2: Once a day.

P3: Twice a day on my school.

P1: In my situation twice a day.

P2: For me once a day.

Moderator: Ok. I have a short movie about the eye exercises. Maybe you can watch it and after the movie you can write some words you thought of during watching the movie. For example what do you think about the exercises, about the music etc.

P1: So about our feelings about everything?

Moderator: Yes about feelings about the exercises.

P1: Including the music or something.

Moderator: yes, so you can write it on some post-its. And then we can discuss it after the movie.

Watching the movie.

Moderator: So just imagine that you are a student again.

P2: I have to say that it is not the same with what I did in school. It is totally different.

Moderator: They are massaging the eye muscle and also the points in the neck.

P2: It is very different than what I did.

Moderator: So what did you do?

P1: When I was in school I did something totally different.

P2: Not massaging the neck.

P1: Only the area around the eyes. On your nose, and something here. Here here and around your eyes.

P2-P3: Yes we had the same.

P1: That was only for the eyes. The area around the neck is maybe only for a new generation.

P2-P3: Yes maybe.
**Moderator:** Ok, in the exercises now they also massage the eyes as you said, but also the neck. Because some acupuncture points in the neck are good for some organs, the kidney for example.

**P1:** I’ve got tree words, can I start?

**Moderator:** Maybe we can wait for the others and have some kind of group discussion. Here is a picture of the exercises.

**P1:** Yes that is what I did, that was a long time ago.

**P2:** Maybe they changed.

**Moderator:** I think massaging the neck area is a new part, which is added to the eye exercises.

**P1:** I graduated from university 10 years ago. I was in primary school 1968 in 1998 I finished my high school. But what is on the picture is what I did in school time.

Time to write down opinions.

**Moderator:** Yes are you ready?

**P1-P2-P3:** Yes. Maybe you can start?

**P1:** Yes I can start. I’ve got three key words. One is formality, passionately and effectiveness. Here some explanation. Formality is from my own observation and experience. Sometimes if it is compulsory so you have to do it. So sometimes it is formality it is not really what you want to do. If you don’t want to do it it is maybe not that effective.

**Moderator:** So the main reason that you did the eye exercises was because it was compulsory.

**P1-P2-P3:** yes

**P1:** Than we talk about effectiveness. One is because it is formality you don’t have any effect. Another reason they never told us how to do it rightly. I mean you have to find the right acupuncture points, but nobody told me where they are.

**Moderator:** Not the teachers?

**P1:** The teachers told something, but I think the teachers self’s where not that sure. That is my feeling. Some people do it here, some people here. Nobody was sure what to do.

**Moderator:** So nobody checked?

**P1:** No doctor or no professional people come to tell us how to do. If we did it wrong, nobody told us that we were wrong. Or you need to do something like this or that. That is only my own experience, I don’t know how it is in other cities or schools.

**Moderator:** No no, but we are interested in your opinion.
P1: And than about passion. I know now that it is quite effective and that it is good for your eyes for your health. But when I was in primary school I was too young, I couldn’t understand why I had to do it. So for the young children, they want to do it because it is interesting or funny. But obviously it was not nice. It wasn’t attractive for me. When I observed, I didn’t see any passion for the students, they were just doing something, because they are too young to understand the goodness for them. If it is not fun nobody will like it.

Moderator: And do you think if they give better information about the exercises…

P1: If only better information if given, I don’t think so. I was too young to understand the thing behind it. But when I was wearing glasses I recognized that I had to do something earlier, something better, but before that, I didn’t realize.

Moderator: So you just did the exercises because you had to.

P1: Yes because I had to.

Moderator: Ok, thanks, that is clear.

P2: I think I have the similar opinions. First, I don’t know if it is useful or not because nobody really tells you. I mean, they tell you that it is useful, but nobody knows how to do it. Maybe it can protect your eyes or something like that, but we don’t know. There is no control group and experimental groups to tell you that people who do this exercise have better eyes or something like that.

Moderator: Do you believe that it works? Or at that time did you believe it was good?

P2: I think we were young and we didn’t think about it. It was just compulsory. We did it, because the teacher told us to do that. So that is our problem. And also we don’t know the exact position where we should put our fingers on, how to do the exercise.

Moderator: So yes, like the same as she said.

P2: Yes. And also it is not fun it is not an interesting exercise. I think a lot of students just sit there and pretend to do the exercise. But they are just a sleep or.

Moderator: But was it nice to have a break in between the lectures?

P2: Yes nice to have a break or to just listen to the music, although it is not good music. Maybe they can just sit and close their eyes and enjoy the break. You just put your finger on somewhere on the face, but you don’t know the exact position and then you did that and it was ok. So that is my experience.

Moderator: So you didn’t like it?

P2: No, for a break yes, but for the exercise no.

Moderator: Ok yes clear, thank you.
P3: I totally agree. I think for myself it is useless. Everybody has glasses. Everybody do the same exercises for 12 years and at the end all of us have glasses. In high school I think everybody grow up, but nobody believe it. There is an interesting sentence before the eye exercises. It is somehow for the revolutionary protecting your eye views and with the eye exercises. So everybody thinks it is for the revolutionary for the country, so everybody just do it for the country, but no one cares. And another thing is the music or the noise. I think the loud speaker or radio in every class room is very bad. The girl has a high frequency voice and it is somehow very sharp. At my time it was a little girl.

Moderator: So it was not the same as in the movie?

P3: No a little girl, and very very sharp. And for me another solution is outer environment. I think we should focus on the outer environment. Not to coach the little children which position is correct. I think for my experience only on the first year on primary school a teacher told us where the position is. And that was the only time and for the rest of the 12 years nobody told us where the position is. Maybe the position is changed because you have grown up, but nobody tells you. We actually don’t know how to do it correctly. And also some experts mention that your fingers are really dirty for little boy and then you do it like this and do it like this (touching your face). And maybe the dirty thinks will injure you eyes. And that is very bad I think. So I think we should focus on the outer environment. For me another reason to mention is the light. The light in my primary school, middle school and high school is very bad. It is hard to see and my eye view became worse. In the university it was much better, and there I kept the same eye views. And now my eyes had a laser operation, so I don’t have glasses now. But actually in high school I had glasses.

Moderator: Ok thank you, and maybe for all of you when you were sitting at home, and doing your homework for example and your eyes were really hurting, did you also do the eye exercises again?

P2: Sometimes

P1: Yes I did it sometimes, but the problem is I cannot make it a habit and do it every day. And if you do it every day, you even cannot find the exactly acupuncture points that really gave you some benefits. But the problem is I always forgot to do it. But I believe if I continue to do it, it will give me some benefits.

Moderator: And the benefits are than that it feels relaxed or..

P1: Yes sometimes my eyes are really tired after searching on the internet, or watching tv you using your eyes yes.

Moderator: But are you still doing it sometimes?

P1: Yes sometimes, but most time I forgot. Only if I remember I do it.

Moderator: Ok, and you two?

P2: Yes the same I think, after some work and my eyes got tired, it is good to relax your eyes and you follow the exercise. I think I believe it works. But at primary school we don’t believe it worked, but now if I feel tired with my eyes I will do this.
**Moderator:** so the reason why you do the exercises is changed, at primary school you did it because you had to and now when you do it correctly..

**P2:** Yes I think it can relax your eyes. Feel better. And also, after the exercise I look into the distance, to some trees for example.

**Moderator:** Just looking out of the window?

**P2:** Yes out of the window, look far, to adjust the view. Look to some close stuff, but also look to distance stuff. Yes I do that when my eyes got tired.

**P3:** For me after high school, when I felt tired I will have some medicine, some liquid for the eye. And also stand on the top of a building and watch something. Yes I sometimes did that after high school.

**Moderator:** Did you learn that at school that it is good to look into the distance?

**P2-P3:** Yes

**P1:** Long time ago I downloaded the music to do the exercises at home, but I think it is a too old version and the quality was not good enough. But I really want to download the music, and try to follow it.

**P2:** I think you can just count.

**P1:** No but it is different.

**Moderator:** So you need the voice instructions?

**P1:** Yes and I need the rhythm to do it.

**Moderator:** Ok interesting, and another question, do you think it is needed to replace these exercises into new exercises? What is your opinion about that?

**P1:** I don’t know much about the Chinese medicine, about the acupuncture points, so I’m not sure about that field, but if Chinese medicine suggests there is a better exercise, I think it is good to learn new things. But the old one is still ok for me. I think the problem for me is the passion to do it every day. It should be more fun, more interesting.

**Moderator:** Ok, so that is also important to focus on.

**P2:** For me, when I was a child I didn’t know if it worked or not, but now I am curious about some experiments to show that this exercise will work or not. So than I believe or not believe in this exercise. If I have a child, and I know that it works, I suggest my child to do it. I think it is not needed to invent another exercise if it is proved that the old exercise works. So I have to see a paper.

**Moderator:** So for you scientific evidence is important.

**P2:** Yes.
P3: I think for my personal experience I ever tried some kind of device to put it on the eyes and it could shake in a changeable frequency and it massaged your eyes instead of your fingers. The position than is more accurate I think. The pressure, position and frequency is more accurate. I use it, it really works, or I feel it really works.

Moderator: So you think that is better than the old exercises.

P3: Yes they sell this product, and found some volunteers to try it for free. And I tried it one time. And I can remember that I felt it works. I only remember that is works. When I put off the glasses I could see clear in the distance. So I suggest to replace the old exercises with a new device according to our face and our age and the shape of our face I think somehow it will be useful.

Moderator: Ok, so a device based on the same principle.

P3: yes yes

P2: That could be a product of Philips.

P1: I also bought such a product. It has something to do with eye massage. There are two brands in China. One is Assam, the other one I know only the Chinese name. I can check what the English name of this company is. The product is the same, but a different brand. I bought the lower price one. Sometimes when I sit down on a sofa or lying down in bed I will put it on my head. I just like glasses, but you cannot see, so it drops your eye sight. It has something inside for eye massage. It is something like the eye exercise. You can choose for 10-20cm. You can choose for how long, and there is some music so you can feel relax. You can also choose the music.

Moderator: Ok nice, and that worked for you?

P1: Yeah, I don’t know if it really benefits my eye sight but at least it makes me feel relax and release the pain. And it is quite easy; you just sit down and listen to some music.

Moderator: Ok, that will be interesting for in the class room.

P2: Is the product personised? Is it specially made for the costumer?

P1: Like different sizes? No, I think it cannot exactly touch your acupuncture points but at least there is no harm for your eyes. Even it is not exactly the points, it really make you feel relax. Even if you do body massage, it is difficult to exactly massage the correct points, but at least you feel relax.

Moderator: Ok nice, thank you. So that was it about the current exercises. We also have some opinions of the experts. So we spoke to some eye experts and they said that the current eye exercises are more based on common believes rather than on scientific evidence. And they said maybe it works for some students, but maybe because of the change in environment in is not sufficient anymore. They do the eye exercises for 40 years now and they still do kind of the same exercises, so they say maybe it works for some students, but not for all. And they also say that it is a problem that they are not doing it correctly. As you also all mentioned, and that is really important for this exercise. So that is about the eye experts. We have some new ideas for the eye exercises. You also mentioned it: looking to the distance so that the
accommodation is more relax, or that the eye muscle is more relax. And also bright light and a better contrast can reduce the eye strain. In our new proposed exercise we combine far focusing and varying size of an image to stimulate distant vision and combine it with bright light and high contrast. So these are the most important things for our new exercises. Our idea was also to include some body exercises to the eye exercises, because the experts said also that the Chinese students lack the ability to do all types of sports, because they think studying is more important than for example physical education or play basketball outside. So that is the reason why we also want to include some body exercises. These are the ideas for the body exercises. We would like to enhance the blood flow to increase the energy level with some dynamic movements and stretching and breathing exercises for a more mental break. So these are the ideas. So what do we propose: we would like to use a projection to create moving graphics on the wall, which can guide students to do the eye and body exercises. These animations will change in focal depth and contrast and can also help students to relax their eyes more. So looking into the distance is the most important thing we are focusing on. We hope that we can reduce eye strain and with the body exercises we hope we can release neck and back pain, more posture pain. And as you already mentioned, motivation is also a big problem in the current eye exercises, so we would like to increase the motivation, and make it more fun, and maybe on the long term we can also reduce the development of myopia. The first ideas are focused on 9 year old kids. I also have a movie of the new proposed exercises, so maybe you can keep it in mind that it is for 9 year old students. So maybe we can do the same thing as in the beginning. I can show you the movie and after the movie you can write down your opinion you immediately think of. Just your ideas of the new proposed eye and body exercises.

Show movie

Moderator: So these were the ideas, now we would like to know your opinion. By the way if you would like to have some cookie, you can take one.

Time to write down opinion.

Moderator: So maybe we can start the discussion.

P3: It is very interesting. I think the ideas are new. It is somehow possible for 9 year old primary school children. I mean, in the video I noticed a large classroom, only one desk. It is possible. But for the primary school it is very narrow I think. I take an example. Somehow, when we stand up, all of us stand up together, no one feel comfortable, because it is very very narrow. One body occupy only 0,5 square meter, and that is even a large space. The classroom is very narrow.

Moderator: With how many students did you share a classroom?

P3: My class was only 40 square meter including 70 people. The resource is very limited for high level students. Even in primary school I have to say. It is very narrow, everybody feels very painful. And if you let them all stand up and stretch their arms it is not possible. But I think the idea is quite good. Another thing is try to make some background for the bird. Maybe you can have some blue sky and green grass land or ocean.

Moderator: To make it more attractive?
P3: Yes, and if we focus on 9 year old children we can design another game. And the children can get some bonus for the game. We can use this matter to make it more attractive. Just something easy. The bird, one time it can start form the left part and it flies and disappear and appear again in the right down corner. And the children should try to report it and write it down. And if the children do it correct, they can get some bonus. Try to design such things, that will be more attractive. And if the children everyday follows the same rules they will lose their attraction.

Moderator: So it is important to combine it with something. Not the same exercise every day.

P3: yes yes, but I think the idea is very interesting.

Moderator: Ok thank you.

P2: I think the idea is also really great. It is funnier and more attractive and the music is good. I think it is kind of Chinese music?

Moderator: yes, we tried to include some nice music.

P2: And the color green is good, it is a color which can help the eye?

Moderator: Yes it is.

P2: Yes we also learned to look at some green stuff. Now you have only some green lines. Maybe a greener picture will help more. And about the character, you can change the character daily, which make the children more interesting. They can expect new characters every day. This is for the primary school children, but for the high school students maybe it is too childish. Another problem is about the far focusing problem, it is still unsolved. In the classroom the distance is not changing that much. And I think this kind of distance is not enough to change the focusing of your eye.

Moderator: Yes, that is why we try to change the focal distance and change the size of the picture.

P2: Yes I understand, but it is maybe better to make your eyes believe that they are really looking to something in the distance.

Moderator: Yes that is exactly the underlying idea, and we should test if it really works. But yes that is the idea.

P2: And that will be better because now when the character moves, I think the children will just move their body instead of their eyes. But in fact they don’t change the eye, but the body.

Moderator: The idea was to make it more a combination of eye and body exercises. That you change your eyes, but also to exercise your neck. But good point, yes.

P2: Ok, that’s all.

Moderator: Thanks.
P1: I would like to talk about something different. I think this exercise will be more interesting, especially the first time, because than it is exciting what comes next and next and you try to focus. But for me, I don’t know, for a 9 year old students it is maybe too slow. I mean, when we try to look to the bird, I was also lost patience. But that is for me, maybe children have different thoughts. And also, the bird is cute, but maybe we can have some more cute figures. Maybe something they know, popular figures.

Moderator: a cartoon or?

P1: Yes a cartoon. And I don’t know, for me if we replace the current exercise with this one, for the problem is that it is still indoor, no outdoor exercise, not in the open air. If you are sitting the whole day indoor you can feel some kind of depression or something. This room in the video really makes me feel depressed. There is only one door there is no window.

Moderator: The windows are on the right side, but ok, I know what you mean. And it is also, we had to develop something for a 5 minute exercise in a class room. The same time as the old exercise. So they cannot go outside for 5 minutes and then go back. My opinion is of course also that it is better to play outside for half an hour every day, but think that is not possible in the Chinese school system.

P1: Ah ok, I see. And also, this is exercising while using your eyes. In the traditional exercises at least you close your eyes. And even if you don’t do anything and close your eyes and you open your eyes again, you feel you have a better eye sight or something. But that is maybe only a psychological effect. But sometimes I close my eyes for only 5 minutes, you know during work or at home, and I think I feel better. But also when using your eyes, you don’t have time to close your eyes.

Moderator: Ok, so you think it is good to include something of the old exercises?

P1: Yes, for example when you listen to really good music, you know for you guys you have something to close your eyes and listen to the music and you follow and relax your body and mind. If we all have the same exercise for 40 years it is not quite attractive anymore. So maybe primary school children, grade 3, you can have something different than for grade 4. So when they are going to the next grade they have something new. Or you have two semesters of grade 3 and the first semester you can have something and the second semester something different. I don’t know if children expecting something.

Moderator: Yes yes, that is a good thing. But do you think the bird is attractive for 9 year old kids?

P2- P3: Yes for children I think it is good.

P1: I think it can be maybe more colorful, for example we have a cartoon figure and that is very colorful.

Moderator: I have here some examples of cartoon figures.

P1: Yes I think this will be very nice for children. Yes I mean that one.

P2: I think the children will be very happy about this.

P3: It is really really famous among the children. And this one is like ten years ago.

P1: Yes this is something from my generation. And this is more for the new generation.
Moderator: Ok, so you think it is nice to combine it with some popular figure?

P1-P2-P3: yes yes.

Moderator: Ok, and another question, now the exercises are twice a day, do you think it is needed to do another exercise in the morning than in the afternoon? Or do you think there are other needs in the morning?

P2: I think twice a day is good for 5 minutes each.

P1: I think the old exercises are 5-10 minutes. For me it takes a very long time. When I was in a school I think it was really long. Because it was formality for me, probably. But I really think it was long. And for my experience, when I was in high school we had four classes in the morning. So we have body exercises after finishing the second class, so in the middle. And we had the eye exercise at the beginning of the first class. So two exercises in the morning, and I think that is ok. And after the fourth hour you do some exercises on the playground. And I think before the second class in the afternoon, we have the second eye exercise. So for me one body exercise, two eye exercises are enough.

Moderator: So you think it is not needed to include it in the new eye exercise?

P1: For me the morning exercises are ok.

Moderator: And in the morning exercises, are that the same kind of exercises as in the new proposed eye-body exercises?

P1: No it is different, it stretch your body. It has nothing to do with the eyes.

Moderator: Ok, but also the same kind of body exercises as in the movie? The neck movements etc.

P2: No it is more complicated. The body exercises are more active. You can jump and also stretching your body.

P1: It is also not only for the students but for the whole country. Because last year, when I was in Philips Shanghai, we have a sport game, a competition of doing body exercises. It is for the whole country, also for old people, everyone can do it. It is even international.

Moderator: Ok, and they also do it at work than?

P1: In some factories I think, also in Japanese factories. The do exercises in the morning. And I belief that is also compulsory. But I belief it is really good.

Moderator: Yes it can be a good start of the morning I think.

P2: Yes some companies do it together in a group and that can be good for the group.

Moderator: Group spirit.

P2: Yes indeed.
Moderator: And did you also did the body exercises in between the lectures?

P2-P3: yes yes, around 10 I think.

Moderator: So do you think it is therefore better to focus on the eyes instead of the entire body?

P3: Um yes if students already have the body exercises, it can be separated.

Moderator: Ok, thank you. Ok, and you also already mentioned how we can make the exercise more attractive, with a game or a nice character. So maybe we can now think about how we can make it more attractive. So you said a game or..

P3: Yes, you can try to design an interesting game, it will be much better. And try to design a bonus system. How to give the little students a bonus.

P1: In primary school, when you do something good, the teacher give you something. There is a poster on the wall, and you get some small tiny flowers and can put it on the poster. And you can see who has the most.

P3: Yes such kind of bonus.

Moderator: But then it is also more like a competition between the students.

P1: Yes, but you feel proud on the flower you got. But it is not really a competition. You do not compete against other students. Everyone just wants to do something good, so they just reward you with a small flower.

Moderator: Ah ok, otherwise it may also be kind of stressful.

P2: I have maybe an idea. When the bird is flying it can disappear and you look for it. And then it disappears, and you should be the first one who find it. So people will just move the body and the eyes to find it. And then it appears, and then you should do a movement.

Moderator: Yes that is a nice idea. Interesting idea.

P2: Yes I think it can be interesting, because it is different compared with other games.

Moderator: yes, we also had the idea to combine the exercises with education. For example to educate students about nature or for example food culture. I made a poster about it.

P2: Good idea

Moderator: What is your opinion about that?

P3: How can you combine that with exercises?

Moderator: Yes that is the question, maybe with some questions or tasks. Or that they have to follow the bird and then the teacher tells something about for example a fish, and then the bird has the answer of the
question. Just an example. We don’t know if or how we can implement this. Or do you maybe think it is better to do the exercises as a nice break and do not anything with education or?

P2: I think the idea to let people feel relax is good. Now they do some much stuff at school. Because if you combine it with education, people have to think. I think it is better to just do the exercise.

P1: I think it can be good to combine it with education. Because then there is something new for them. You can call it education, or you can tell them that it is just some interesting thing to introduce to them. I think it can be good to add it to the exercises because it will attract them and also learn something. Maybe we should not call it education.

P3: I think for 9 year old students they are too young. Maybe for 11-12 years old I guess it is better.

P2: Yes I think for 9 years old students the character is more attractive.

P3: I think the project focus is on the eye exercises. I think for 9 years old they are still very young, but for 11-12 year old if we can combine the education with eye exercises together, the idea seems good.

Moderator: Yes, because we want to develop something new, and if you do it every day the students should keep motivated to do it. So that’s why we are thinking to combine it with something. So that’s why we ask these questions.

P2: This will be a lot of work to do that education every day. They have to be different, I don’t know every day or week or something like that, and that will be a lot of work.

Moderator: We were also thinking to combine the exercises with some nice stories. So what do you think which topics could be interesting for the students.

P1: I don’t know, maybe something different for boys and girls. I just try to think when I was young, I think fairytale stories. And when we are young there were some cartoons and everybody knew them so we try to play the role of the cartoons. So that could be an idea.

P2: We are not their parents and it is a long time ago, so that is difficult.

P1: At our time the transformers were on tv, that was really popular. And also princes chibi.

Moderator: So combine it with a popular cartoon.

P2: yes cartoon or animation. But I am afraid if you use a movie, they still use their eyes while watching. It won’t work.

Moderator: No no, it is then the idea to just replace the animation we have, the bird, with some popular animation.

Show them the posters

Moderator: For example the journey to Beijing, the bird is flying to Beijing and then you see also a picture of Beijing.
P2: Yes this could be an interesting idea I think.

P3: Yes this is a very interesting idea.

Moderator: And maybe we can educate them something about the city or something.

P2: Yes it will also be interesting to tell something about the world.

Moderator: Yes, you think this is good?

P1: Yes definitely good. Good to combine it with the exercise. For example, tell the first semester something about Chendu and another semester something about Beijing and Shanghai.

P2: Yes there are a lot of cities in the world.

P1: I think it is also a good idea to introduce Europe.

Moderator: Yes I think we have enough information now, I’m very happy with all your opinions.

P2: I hope it is useful.

Moderator: Yes of course it is. I have no experience with the current eye exercises, because we never did something like that at school. And I think there is also a difference between cultures, so that is why I invited you guys.

P3: So you have no experience with any eye exercises?

Moderator: No nothing.

P3: So what do you do when your eyes feel tired.

Moderator: Good question, actually I we didn’t do anything like that at school.

P1: But you do a lot of outdoor exercises at school so maybe that is different compare with China.

Moderator: Yes, and of course we cycle every day to school and we have the physical education two times a week, and most kids play some sports.

P3: Are there a lot of students with myopia?

Moderator: I think in primary school it is 30 percent, something like that.

P1: I think in my generation it is quite serious, because the workload is really high. But for the new generation the government tries to improve the situation. They have less workload, and compared with the past it is easier to go to university. So the competition is not so fears and the workload is decreased. And in big cities and in villages there is also a difference. Because in small villages the environment is not very good. They have poor lighting or poor environment and they have to work harder to go to the universities. But for example for Shanghai or Beijing it is easier. It is different. It depends on your location and on the generation.
Moderator: Ok, so there are some changes happening?
P2: Yes, always

Moderator: Good. Thank you very much.
P1-P2: You’re welcome

Moderator: And if you have some more ideas, you can always contact me.
P2: Yes sure.

Moderator: Ok thanks.
Appendix C: Questionnaire pilot study

Vragenlijst over vermoeidheid

Geef aan hoe je op dit moment voelt:

1. Voelen je ogen moe of uitgerust aan?

   super moe  erg moe  een beetje moe  erg uitgerust  super uitgerust
   Ik kan deze vraag niet beantwoorden

2. Doen je ogen pijn?

   super veel pijn  erg veel pijn  een beetje pijn  bijna geen pijn  helemaal geen pijn
   Ik kan deze vraag niet beantwoorden

3. Zie je scherp (helder) of onscherp (wazig, alsof je water in je ogen hebt)?

   super onscherp  erg onscherp  een beetje onscherp  erg scherp  super scherp
   Ik kan deze vraag niet beantwoorden
4. Moet je op dit moment veel knipperen met je ogen (meer dan normaal)?

- ik moet super vaak knipperen
- ik moet erg vaak knipperen
- ik hoef maar een beetje te knipperen (net als normaal)
- ik hoef minder vaak te knipperen dan normaal
- ik hoef veel minder vaak te knipperen dan normaal

Ik kan deze vraag niet beantwoorden

5. Zou je je ogen nu graag dicht willen doen?

- ik wil mijn ogen super graag dichtdoen
- ik wil mijn ogen graag dicht doen
- ik wil mijn ogen een beetje dichtdoen
- ik wil mijn ogen graag open houden
- ik wil mijn ogen super graag open houden

Ik kan deze vraag niet beantwoorden

6. Heb je hoofdpijn?

- super erge hoofdpijn
- erge hoofdpijn
- een beetje hoofdpijn
- bijna geen hoofdpijn
- helemaal geen hoofdpijn

Ik kan deze vraag niet beantwoorden
7. Als je de kans zou krijgen om nu een pauze te nemen, zou je dat dan doen?

![Emoticons showing different levels of willingness to take a break](image)

ik wil super graag een pauze
ik wil graag een pauze
ik wil een beetje graag een pauze
ik wil graag doorgaan
ik wil super graag doorgaan

Ik kan deze vraag niet beantwoorden

8. Heb je last van je:

- Nek

![Emoticons showing different levels of neck pain](image)

super veel last
erg veel last
een beetje last
bijna geen last
helemaal geen last

Ik kan deze vraag niet beantwoorden

- Rug

![Emoticons showing different levels of back pain](image)

super veel last
erg veel last
een beetje last
bijna geen last
helemaal geen last

Ik kan deze vraag niet beantwoorden

- Schouders

![Emoticons showing different levels of shoulder pain](image)

super veel last
erg veel last
een beetje last
bijna geen last
helemaal geen last

Ik kan deze vraag niet beantwoorden
Vragenlijst over motivatie

1. Ik vond de taak/oefening:

   helemaal niet leuk  niet leuk  leuk  heel leuk  super leuk

   ik kan deze vraag niet beantwoorden

2. Ik vond de taak/oefening:

   super moeilijk  moeilijk  een beetje moeilijk  makkelijk  super makkelijk

   ik kan deze vraag niet beantwoorden

3. Ik zou de taak/oefening tijdens de schoolles:

   nooit meer willen doen  niet vaak willen doen  af en toe willen doen  vaak willen doen  super vaak willen doen

   ik kan deze vraag niet beantwoorden
Vragenlijst over hoe je je voelt

Geef aan hoe je je op dit moment voelt:

1. Hoe uitgerust/slaperig voel je je op dit moment?

   - super slaperig
   - slaperig
   - niet slaperig/niet uitgerust
   - uitgerust
   - super uitgerust
   - Ik kan deze vraag niet beantwoorden

2. Hoe onrustig/rustig voel je je op dit moment?

   - super onrustig
   - onrustig
   - niet onrustig/niet rustig
   - rustig
   - super rustig
   - Ik kan deze vraag niet beantwoorden

3. Hoe vrolijk/boos voel je je op dit moment?

   - super boos
   - boos
   - niet boos/niet vrolijk
   - vrolijk
   - super vrolijk
   - ik kan deze vraag niet beantwoorden

4. Hoe zenuwachtig/ontspannen voel je je op dit moment?

   - super zenuwachtig
   - zenuwachtig
   - niet zenuwachtig/ontspannen
   - ontspannen
   - super ontspannen
   - ik kan deze vraag niet beantwoorden
5. Vind je het moeilijk om je aandacht bij deze vragenlijst te houden?

Ik kan deze vraag niet beantwoorden

6. Hoe verdrietig/blij ben je?

Ik kan deze vraag niet beantwoorden
Appendix D: Reliability analysis questionnaire

**D1. Adult sample**
Cronbach’s Alphas for the different questionnaires in the pilot study with adults.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Visual comfort all items included</th>
<th>Visual comfort items 7-10 excluded</th>
<th>Posture pain items 8,9 and 10</th>
<th>Emotional status All items included</th>
<th>Emotional status items 1 and 5 excluded</th>
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<tbody>
<tr>
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<td>.267</td>
<td>.702</td>
<td>.828</td>
<td>.697</td>
<td>.766</td>
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<tr>
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<td>.592</td>
<td>.867</td>
<td>.353</td>
<td>.649</td>
</tr>
<tr>
<td>Questionnaire 3</td>
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<td>.593</td>
<td>.917</td>
<td>.176</td>
<td>.537</td>
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<tr>
<td>Questionnaire 4</td>
<td>.672</td>
<td>.697</td>
<td>.821</td>
<td>.000</td>
<td>.435</td>
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<tr>
<td>Questionnaire 5</td>
<td>.735</td>
<td>.721</td>
<td>.907</td>
<td>.629</td>
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</table>

**D2. Children sample**
Cronbach’s Alphas for the different questionnaires in the pilot study with children.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Visual comfort All 10 items included</th>
<th>Visual comfort items 8-10 excluded</th>
<th>Posture pain items 8,9 and 10</th>
<th>Emotional status All 6 items included</th>
<th>Motivation All 3 items</th>
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<tbody>
<tr>
<td>Questionnaire 1</td>
<td>.386</td>
<td>.462</td>
<td>.340</td>
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