Faculty of Mechanical Engineering
Department of Machinery
Master Thesis Code MED70LT

Gina Metssalu

20 MINUTES. FLEXIBLE ELEMENTARY SCHOOL ROOM FOR ACTIVE LEARNING METHODS

20 MINUTIT. AKTIIVÕPPE MEETODITELE KOHANDUV RUUM ALGKLASSIDELE

Author applies for degree of Master of Technical Sciences (M.Sc.)

Tallinn 2015

Master thesis objective and task

2014/2015 academic year, 4th semester
Student: Gina Metssalu, 132818MADMM
Field of study: Design and Engineering
Supervisor: Ruth-Helene Melioranski, PhD researcher
Consultant: Martin Pärn, visiting professor, Head of Design in Design and Engineering

Master thesis topic:
20 Minutes. Flexible Elementary School Room for Active Learning Methods
20 Minutit. Aktiivõppe meetoditele kohanduv ruum algklassidele

Tasks and timeframe for their completion:

Nr	Task description	Completion date
1	Preliminary research. Reaching insights and understanding background.	28.02. 2015
2	Observations and user group interviews.	15.03. 2015
3	Concept proposition.	01.04. 2015
4	Preliminary concept development and rapid prototyping, test in terms of structure, measures and ergoonomics	27.05.2015
5	Finalizing Master Thesis	27.05.2015

Design and Engineering problems to be solved:

The outcome of the master thesis is a novel approach to design classroom furniture and a concept of radically different classroom furniture set is introduced.

Defense application submitted to deanery not later than   27.05.2015

Student Gina Metssalu /signature/   27.05.2015

Supervisor Ruth-Helene Melioranski /signature/   27.05.2015

Gina Metssalu   Ruth-Helene Melioranski
Phone: +372 51 33909   Phone: +372 5660 3440
gina.metssalu@gmail.com   ruth@meliorad.com

Table of contents

List of figures

Introduction

Estonian National Institute for Health Development has revealed data which shows that some of the biggest health problems for school children are related to posture problems, it also shows increasing tendencies in this area. (Tervise Arengu Instituut, 2015)

Human posture develops in childhood, where there is an intensive growth and development of the skeletal system. As children spend most of their day in a classroom, our school system has an important role in the formation of good posture.

Children aged 7-12 years spend on average 5-8 hours a day in school and most of the time they have to sit in fixed positions. The overall mentality is that they have to sit as still as possible. It is very usual that children get remarks if they move "too much".

The government has set rules for purchasing and producing school furniture, the most important point being the requirement for adjustment possibilities. However, common practice is that as these adjustments need special tools, nobody really does them.

Many companies have tried to solve the problem by producing more and more ergonomic school furniture, but still the health trends show us increased rate of children's posture problems.

Even more, if you look at the class environment and school furniture today, it does not differ much from the picture that opened 10, 20 or 50 years ago.

Today's schools are mainly built in the 1950s. They were created to turn out obedient specialists - adults who could work in factories, assembling components etc., not people who needed to think for themselves.

However, when thinking about the aim of schools – preparing students for the labour market, the picture should be radically different. Children who start school this autumn have to start jobs that do not even exist yet. They must be quickly adaptable, get to know technologies that develop with each minute, be able to find the necessary knowledge from an enormous amount of information.

Needs are changing and behaviours are changing! Are spaces changing too?

Every country has a set curriculum with standards and expectations that are legislated. Teachers have to cover the curriculum, as well as prepare students for standardized tests. It takes a lot of time, initiative and enthusiasm to integrate add-ons and active learning methods into an already packed curriculum. Most teachers would like to do that, but it depends on variables such as on how many students they have in their classes, whether these students have special needs and what those needs are, how much time does the rearrangement of hard and clumsy furniture take. The reality is that sometimes it's just not possible.

There are examples of projects where physical activities have been integrated systematically and effectively into the school programme (see chapter 3.6.1), where the use of environmental components in the classroom (e.g. standing desks, therapy balls) showed promising effects on sitting posture and sedentary behaviours. Cardon et.al (2004) claims that the students in this project did not do less reading or writing activities than the students of the traditional school as reading and writing are not necessarily

static sitting activities but can also be done effectively standing up at a desk or lying on the floor.

A human being's behaviour can be easily impacted by the environment.

It is possible to design spaces intentionally for the behaviours and actions that we want to encourage or the opposite. (Cannon Design, 2010; Scott-Webber, Strickland, & Kapitula, 2013)

Both problems described above require radical change in the school environment. The ideal "solution" would be building completely new buildings designed as 21st century learning centers from the start. However, it is often impossible to start this kind of large-scale changes instantly. Planning new buildings would take decades while the environment and needs would be changing with tremendous speed.

It would be wise to start with the changes as soon as possible, finding solutions already for the classrooms we use today and were designed and built last century.

In this master thesis I will be analyzing the background of the problem and already offered solutions in order to identify their weaknesses and by doing so get better understanding of which constraints need to be fulfilled when offering a solution that would change something in our traditional classroom that could support new students, new pedagogies and new behaviours.

The study is based on document analysis, interviews and empirical observations.

The interviews and consultations that took place for this study provided immensely valuable data based on the experiences and professional knowledge of the interviewees.

The study begins with a short overview of background for the thesis and a research objective. In the second chapter, the main methods used in this research are explained. After defining the methods, research begins, concentrating mainly on two wider topics mentioned above - how sitting time in school and overall activity influences children's health indicators and is our education system, that has mainly remained unchanged up to the last century, fulfilling our needs today. The research part ends with analyses of some of the most common active learning methods. After that the design research starts finding the best solutions based on most common needs. This process narrows down to a more defined idea and a prototype testing. The first set of prototypes is used for testing and getting feedback for further development.

The outcome of the master thesis is a novel approach to designing classroom furniture and a concept of radically different classroom furniture set is introduced.

1. Background and research objective

The topic of my master thesis came to me after I heard the results of a research done by TLU Haapsalu College's Centre of Excellence in Health Promotion and Rehabilitation. A research with the aim of evaluating preschool children's posture condition in Estonia was conducted. The result was grave: over 90% of the preschool children have some kind of a posture problem: the core muscles are weak or damaged or the spine already has some kind of a deviation. (Proovel, 2015)

This result left me concerned as I am a parent of two children from the same age group. There have been a lot of articles in media lately about how remedies and policies related to children's and young people's health care have been applied and how making prevention of diseases more efficient is crucial. Every child's health should be a priority and a key factor for the development of a society.

An example of a contribution for improvement of school children's health in Estonia is the Network of Health Promoting Schools (Tervist Edendavate Koolide Võrgustik) that was established already in 1993. The aim of this network is to combine education and health promotion in order to realize the potential of both. The central idea of the network is to work together to make the schools better places for learning and working. The students and school staff take action to benefit the physical, mental and social health. Despite several similar networking programmes and policies there are no tendencies of improvement and Estonian students are some of the unhappiest in the world, according to an international research of health behaviour of school children. (Tervise Arengu Instituut, 2014)

Another topic that media has critically outlined is based on another shocking research result (by the Estonian Student Union). It revealed that 65 % of elementary school students' satchels were heavier than allowed. (Delfi, 2014)

The standard for producing and purchasing educationally used furniture was issued in 2007. (EVS-EN 1729- 1:2007, 2007). Since then it has been very actively supervised that schools only purchase standardized furniture. Yet we see drastically decreasing health trends. In our schools and education system there is much more to criticize.

The aim of this thesis is to provide through analysis and creative development a possibility to tackle the children's posture problems by design.

2. Methodology

This thesis is based on IDEO's design process definition according to which a design process has five phases that help navigate the development from identifying a design challenge to finding and building a solution. It's a structured approach to generating and developing ideas.

IDEO's design process covers five areas: discovery, interpretation, ideation, experimentation and evolution (see figure 2-1). The Discover phase can iterate between research and context for a time until it is clear what to pursue before moving onto the Ideate stage. The Interpretation phase in between is where it is defined the design question. Within Ideate, it can be progressed along – whilst repeatedly revising direction, until the point where it can be considered heading towards Prototyping. (IDEO, 2012)

The five steps of the process and their elements are described below.
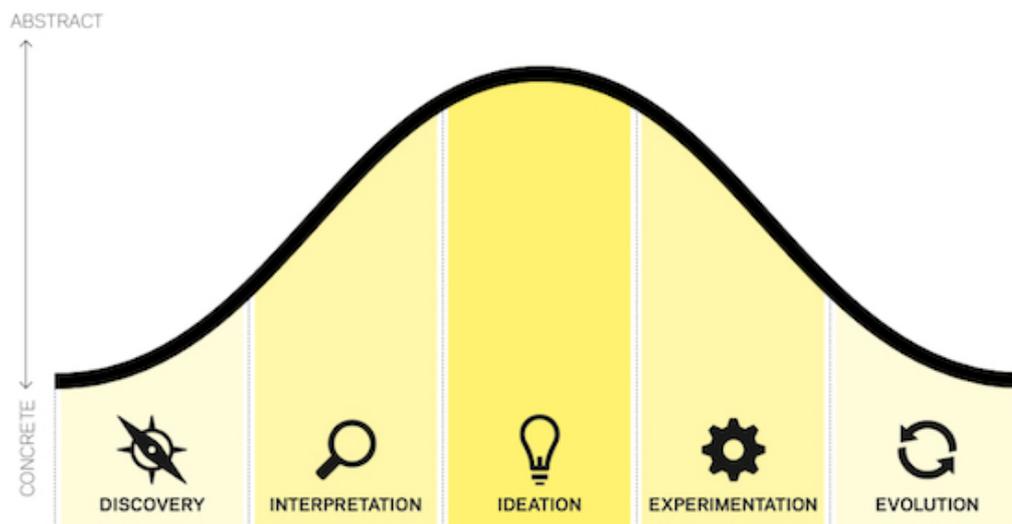
Figure 2-1. Design Process. Adapted from IDEO

This IDEO's method has also evident similarities to Double Diamond model, introduced by British Design Council in 2005.

Divided into four distinct phases – Discover, Define, Develop and Deliver – the Double Diamond is a simple visual map of the design process.

In all creative processes a number of possible ideas are created (divergent thinking) before refining and narrowing down to the best idea (convergent thinking). But the Double Diamond indicates that this happens twice – once to confirm the problem definition and once to create the solution. This kind of structure is widely used in design practice and when laid out graphically forms a distinguished double diamond shape. (Design Council, 2015)
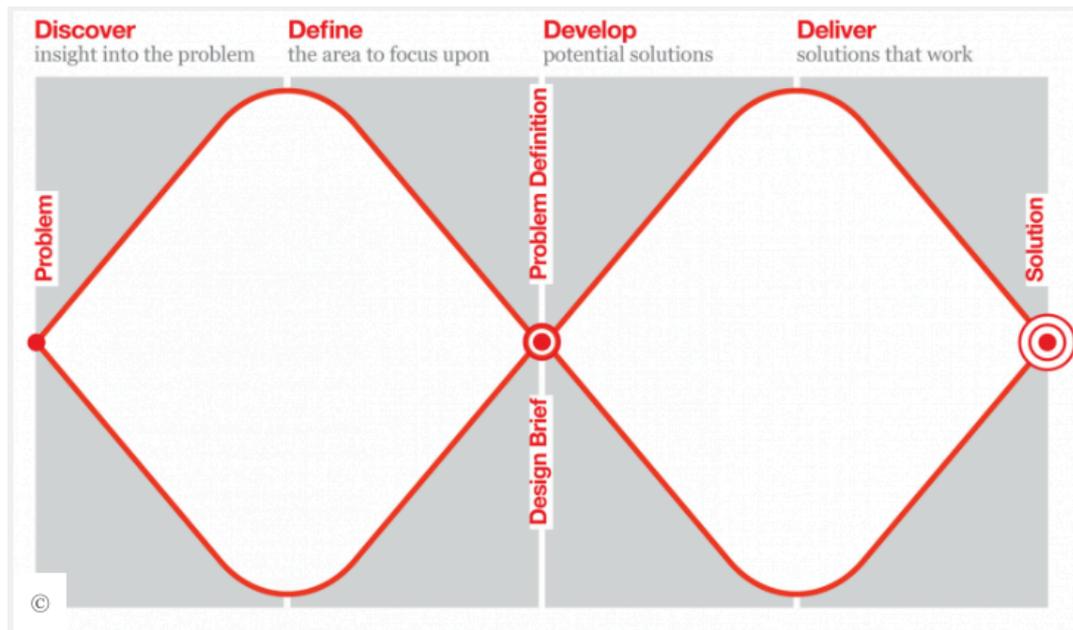
Figure 2-2. Double Diamond model. Source: Design Council (Design Council, 2015)

2.1   Discovery phase

The first phase is to explore and understand the needs. That builds a solid foundation for ideas. The discovery phase is where most of the data is collected and structured. The collected data forms a background understanding of the field and opens many possibilities for where to go on with the project.

In this phase you must ask yourself why people might need or want to engage with the topic you are investigating. A deep understanding of people's motivations and needs is the best foundation for any design solution.

In the discovery phase, it is common to observe users in order to understand where problem areas occur, testing how it is to be the user when emphatically putting yourself in the shoes of others and conducting interviews, which will help identify opportunities. (Design Council, 2015)

2.1.1   Literature reviews and media scan

In the discovery phase, I reviewed relevant literature from online research databases and libraries. The literature review was intended to distill information from published sources, capturing the essence of previous researches and projects as they inform the current project.

Media scans act as a kind of a cultural barometer registering what is happening or emerging on the cultural landscape. The method scans popular media like broadcast news, magazines, TV programmes and blog posts to find anything that seems like a noteworthy cultural activity. Media scans provide a high-level understanding of the latest trends that are on people's minds. (Kumar, 2013)

2.1.2 Interviews

There is no better way of understanding the hopes, desires, and aspirations of those you are designing for than by talking to them directly.

To gain insight from elementary school teachers and didactics specialists, unstructured in-depth interviews were used.

It was a fundamental research method for direct contact with the user group, to collect first-hand personal accounts of experiences, opinions, attitudes, and perceptions.

Altogether 8 interviews were carried out. Respondents were 3 elementary school teachers from different schools, 2 didactics specialists and 3 elementary school students of different ages.

2.1.3 Concept Mapping

In addition to above-mentioned techniques, concept mapping was used (see Appendix I)

Concept mapping is a visual framework that allows designers to absorb new concepts into an existing understanding of a domain so that new meaning can be made.

A concept map is a sense-making tool that connects a large number of ideas, objects, and events as they relate to a certain domain. It provides a scaffolding that can help designers visualize the complexities of a system, and assists them as they make and brake connections, study existing connections, and expand on what is already understood but possibly taken for granted within a particular system. The power of the concept map is that it brings new connections into focus within the context of already understood information. As new insights are formed, designers can study relationships between old and new concepts, revealing new meaning as it relates to the domain. (Martin & Bruce, 2012)

2.1.4 Observations and Video Ethnography

Video Ethnography is a method adopted from the field of visual anthropology. The objective is to capture peoples' activities and what happens in a situation through video that can be analyzed for recognizing behavioural patterns and insights. (Kumar, 2013)

There were two cameras used in two different classrooms during two schooldays in Haapsalu Elementary School's 4th and 6th grades in order to get insights from actual situations and learning environments.

2.1.5 Field visits

A field visit is the most direct means of building empathy with people. Spending time with people engaged in real-world activities helps to understand relevant behaviours firsthand.

During the field visits I spoke with teachers and children and let them talk about their emotions connected to their school and learning environment.

2.2   Interpretation phase

Interpretation transforms gathered information into meaningful insights. It involves sorting and condensing thoughts until a compelling point of view and a clear direction for ideation has been found. This is the design project phase, which helps to make sense of all the gathered information.

Insights only become valuable when they can be turned into opportunities.

2.3 Ideation phase

Ideation means generating lots of ideas.

In this phase I used a "child's eye" as a valuable input for getting new angles to my ideas. As the children would be the main users for the created solution, it was valuable to talk to them and listen to them. Most of all, I let them ask questions about my ideas. The frankness and sincerity of children let me see the angles what wouldn't be possible when asking feedback from adults. In addition I let them draw pictures of how they dream about their school and how would they like to see their classrooms. In this phase I created lot of sketches, paper mock-ups and 3D models.

2.4 Experimentation phase

Experimentation brings ideas to life. Building prototypes means making ideas tangible, learning while building them and sharing them with other people. Even with early and rough prototypes, a direct response can be received and how to further improve and refine an idea can be learned.

Physical prototypes help iron out any unanticipated problems with creative ideas. Prototypes give you insight into how your design will be used, before you create a finished version.

Physical prototypes are also particularly effective in communicating design ideas to diverse groups of stakeholders. (Design Council, 2015a)

Feedback is one of the most valuable tools in developing an idea. Sharing prototypes helps to see what really matters to people and which aspects need improvement.

In this phase I built an early rapid prototype to test the working principles, sizes, shapes and ergonomics.

2.5 Evolution

Evolution is the development of a concept over time. It involves planning next steps, communicating the idea to people who can help to realize it, and documenting the process.

The final phase starts with selected concept visualization, components fitting and first prototypes.

As a result of this thesis four sets of mock-up prototypes were sent to testing in different usage situations into a real classroom environment in order to test and refine the shapes and measures.

The purpose of this testing was also to collect proof for the concept and get feedback from the direct target user group.

Because of a limited time resource, the solution is not final. The data gathered is still used in the analyzing and concept evaluation phase.

3. Sitting and posture

3.1   Posture development

When babies are born they have a predominantly flexed (C-shaped) posture with two primary spinal curves known as the thoracic curve (mid back) and sacral curve (bottom) (figure 3-1).

Figure 3-1. Prdominantly flexed posture of newborm babies. Source: Leckey (Leckey 2011)

In the usual sequence of events, babies move through developmental stages almost seamlessly. Different development stages are shown in the figure 3-2.

rolling   sitting   crawling   pull to stand   cruising   supported walking   standing   walking
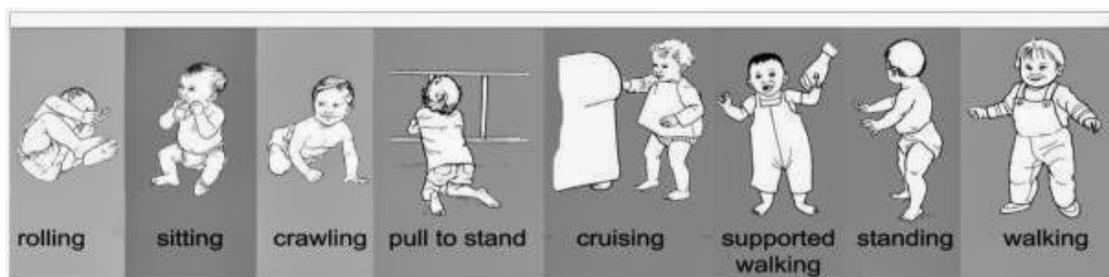
Figure 3-2. Babies development stages. Source Leckey (Leckey, 2011)

Cervical curve
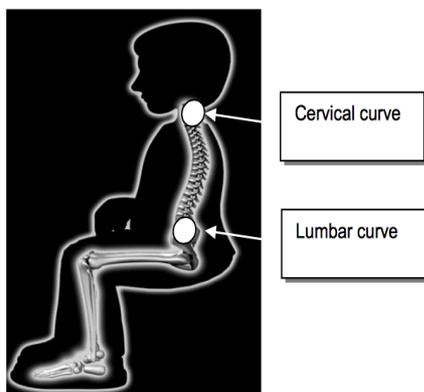
Lumbar curve

As they learn postural control against gravity their spines develop secondary extension curves in the cervical (neck) region first (holding their heads up against gravity when on their tummy or hands and knees) and lumbar region (lower back) as they gain sitting and standing balance (see figure 3-3).

Figure 3-3. Development of secondary extension curves. Source: Leckey (Leckey, 2011)

14

Children usually develop sitting posture between six and nine months. Achieving sitting posture requires the development of postural control of head, trunk and upper limbs against the pull of gravitational forces. (Leckey, 2011)

The conventional definition of good posture is the correct alignment of body parts supported by the right amount of muscle tension against gravity. A poorly aligned body uses inappropriate muscle activity to function resulting in mechanically inefficient movement of the joints. Normally, we do not consciously maintain normal posture. Instead, certain muscles do it for us, and we don't even have to think about it. Several muscle groups, including the hamstrings and large back muscles, are critically important in maintaining good posture. While the ligaments help to hold the skeleton together, these postural muscles, when functioning properly, prevent the forces of gravity from pushing us over forward. Postural muscles also maintain our posture and balance during movement. (Chiropractic Blog, 2014)

Common factors contributing to improper posture of children include: sitting in a slouched position for hours at a time, lack of exercise, carrying heavy backpacks, and sedentary hobbies such as playing video games with improper posture. (American Posture Institute, 2015)

Spine deformation can be inborn as well as acquired during the lifetime. Mostly it is acquired because of the wrong habits and the biggest risk group is children. What younger age it appears the bigger the progress of risk is. Common types of postural alinments are shown in the figure 3-4.

Kyphosis-Lordosis **Ideal** **Lordosis** **Sway Back** **Flat Back**
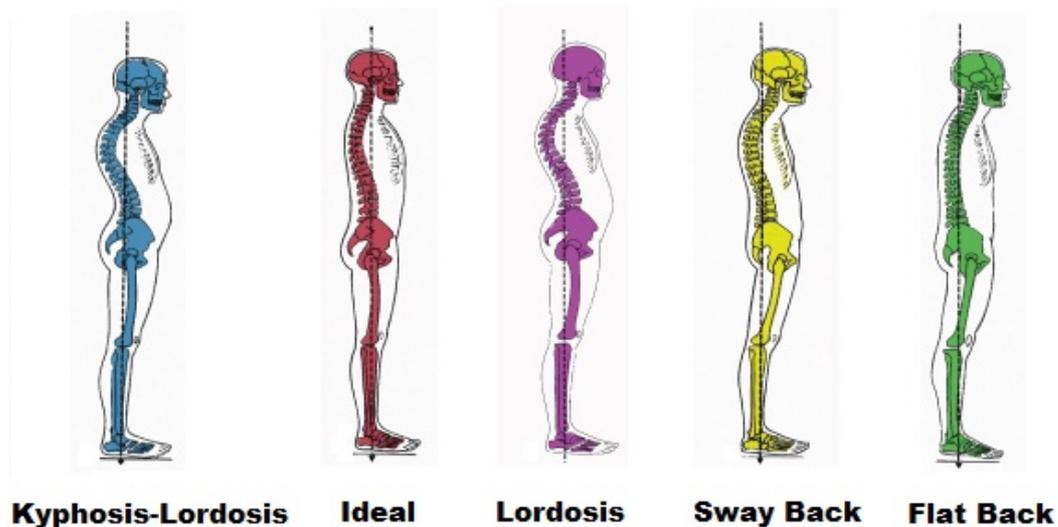
Figure 3-4. 4 Types of postural alignment and ideal posture. Source: InFitPTv (Corporate Fitness Coaching, 2014)

3.2   Changed lifestyle and physical activity

Everyday habits and lifestyle of today's children has changed. Recent studies show that children are playing on average 5 hours of video or computer games a day. 25-28 % of European children are overweight. Recent accelerometer-based data gathered among elementary school children 10–12 years of age showed that European children spend on average 65% of their waking time in sedentary activities with boys and girls spending on average 3.5 and 3 hours per day respectively on screen-time behaviors (television and computer time). (Cardon, De Craemer, De Bourdeaudhuij, & Verloigne, 2014)

It has been recommended for elementary school children to engage in at least 60 minutes per day in moderate to vigorous intensity physical activity. These guidelines propose that preschool children should engage in 180 minutes of total physical activity per day, irrespective of intensity. (Verloigne et al., 2012),

Despite the evidence that sufficient physical activity is beneficiary and healthy, it is shown that considerable number of children do not comply with the physical activity recommendations. The mean level of moderate to vigorous physical activity per day among 10-12 year old children in Europe is 32 minutes for girls and 43 minutes for boys. **Only 5% of the girls and 17% of the boys reach the recommendation**. Even in most preschool children, physical activity levels are low. (Cardon et al., 2014)

In Estonia the recommendation was met by only 14% of the students aged 14-15 (by 16% of the boys and 12% of the girls). In 2006–2010 the decline of the number of students who are physically active daily is remarkable. (Tervise Arengu Instituut, 2012)

There is also a proven connection between learning performance and physical activity. Children who perform better in school are more likely to be physically active on a regular basis and get the recommended daily 60 minutes of physical activity. (Making Health Easier, 2015)

Figure 3-5. Burn to Learn Infographic. Source: Making Health Easier webpage. (Making Health Easier, 2015)

3.3   The health hazards of sitting

Warnings about the adverse health impact of sedentary workplace behaviors have been all over the news lately. For instance, sitting for more than six hours per day makes you 40 % more likely to die within 15 years than someone who sits less than three hours, even if you exercise.

Prolonged periods of inactivity are bad regardless of how much time you also spend on officially approved high-impact stuff like jogging or pounding treadmills in the gym. What you need as well, the latest research suggests, is constant low-level activity. This can be so low-level that you might not think of it as activity at all. Even just standing up counts, for it invokes muscles that sitting does not. (The perils of sitting down. standing orders.2013)

Five or more hours of sedentary sitting, according to Dr. David Agus, is the health equivalent of smoking a pack and a quarter of cigarettes. (Agus, 2012)

Studies have shown that our bodies can benefit from simply standing up, contracting muscles, and moving. **If you stand up every 20 minutes you'll avoid any of the negative side effects of a sedentary job**. (Dunstan et al., 2012)
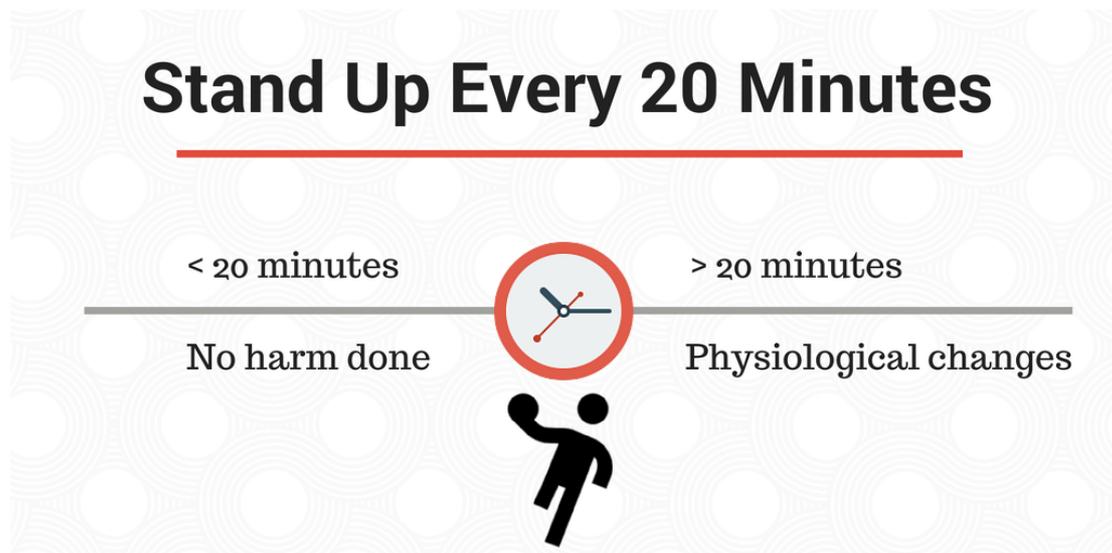
Figure 3-6. If to stand up every 20 minutes, any of the negative side effects of a sedentary job can be avoided. Source: bufferapp.com

Gretchen Reynolds, a reporter on exercise research for The New York Times, wrote a book condensing health studies down to their most essential parts. One of the key takeaways from her research was this emphasis on standing up and the golden 20-minute mark.

"f you can stand up every 20 minutes, even if you do nothing else, you change how your body responds physiologically."(Reynolds, 2012)

One variation on the standing theme is that it's not necessarily about standing up. It's about moving.

The Cornell Ergonomics lab has the following advice:

 "The absolute time isn't critical but about every 20-30 minutes take a posture break and move for a couple of minutes. Movement is important to get blood circulation through the muscles. Research shows that you don't need to do

vigorous exercise (e.g. jumping jacks) to get the benefits, just walking around is sufficient. So build in a pattern of creating greater movement variety in the workplace." (Cornell University Ergonomics Web, 2015)

The effects of spending too much time in a chair are manifold. Electrical activity in leg muscles shuts down; your body effectively stops burning calories; enzymes that break down fat drop by 90 %; HDL cholesterol production drops by 20 %; and the risk of diabetes increases 24 %.(CBC News, 2012)

Dr Wilmot combined 18 studies, covering almost 800,000 people, in 2012 and concluded that those individuals who are least active in their normal daily lives are twice as likely to develop diabetes as those who are most active. She also found that the immobile are twice as likely to die from a heart attack and two-and-a-half times as likely to suffer cardiovascular disease as the most ambulatory. Crucially, all this seemed independent of the amount of vigorous, gym-style exercise that volunteers did. (The perils of sitting down. Standing orders, 2013)

3.4 Improvements in adult workplaces

The research findings have led health care organizations all over the world to create advertisement campaigns that raise awareness of health risks of sitting and sedentary lifestyle.

Figure 3-7. Advertisement campaigns for rising awareness of health risks of sitting. Source: Google Search "sitting is killing"

Sellers of office furniture are, naturally, jumping on the latest research findings to advertise their products and offer all kinds of standing desks. Also the health care organizations all over the world recommend offices to offer alternatives to sitting, including standing desks.

Trendy offices already know that there is virtue in working standing up. And not merely standing. The trendiest offices of all have treadmill desks (see figure 3-8), which encourage people to walk while working.

Figure 3-8. Standing desk with treadmill.Source: afcindustries.com

In addition there is a wide range of chairs and seating options, what encourage moving or active posture. For example The Varier Variable Balans chair (Ergodepot, 2015) promotes constant natural movement, keeping the back and abdominal muscles active at all times. Saddle chairs are a rising trend and often used in work situations where ergonomics and mobility is important, for example for health care and clinical professionals. There is also a variety of stand-up chairs – Wilkhahn has designed a stand-up stool (Wilkhahn, 2015) that acts like a roly-poly toy. Due to its tilted stance and upside-down conical shape with tapered black base, it's not a conventional stool, but a dynamic object that encourages movement. As the last example the Rodeo (Rodeochair, 2015) is a seating concept that transfers the benefits of sitting on a therapy ball to a concept where the core muscles are strengthened and neck and back injuries are prevented (see figure 3-9).

Figure 3-9. 1.Variable Balans by Varier. (Ergodepot, 2015); 2. Saddle-chair by Global. (Globalstole, 2015); 3. Stand-up stool by Wilkhahn. (Wilkhahn, 2015); 4. Rodeo chair. (Rodeochair, 2015)

It is not only office furniture companies who have seen the business potential in these latest research findings. There are also other products with features

to address the very human need to move and stand more. In today's technological era it is natural that there are apps and electronic devices (see figure 3-10) for every important topic.

Figure 3-10. Products with features to address the very human need to move and getting to stand more. Source: 1: Stand up! application. Source iTunes (Raised Square, 2015); 2. Jawbone activity tracker. Source Jawbone homepage. (Jawbone, 2015) 3. Break Reminder application(Azur, 2015) 4. Apple Watch. Source: Apple homepage. (Apple, 2015) 5. Polar Loop activity monitor. Source: Polar homepage. (Polar, 2015)

In contrast to all other solutions RAAAF [Rietveld Architecture-Art Affordances] and visual artist Barbara Visser have developed a concept wherein the chair and desk are no longer unquestionable starting points. Instead, they let users to explore different standing positions in an experimental work landscape. The project called "The End of Sitting" marks the beginning of an experimental trial phase, exploring the possibilities of radical change for the working environment. (Rietveld Architecture-Art Affordances, 2014)

Figure 3-11. Project "The End of Sitting" by RAAAF and Barbara Visser. Source: raaaf.nl (Rietveld Architecture-Art Affordances, 2014)

3.5   Instead of avoiding, we making it less harmful

Children often show a healthy urge to move and automatically try to find solutions to compensate for the limitations of their furniture. However, these "solutions" are often discouraged or forbidden by the teacher since they are dangerous (like tipping on the back legs of the chair to sit dynamically), not healthy (like sitting on one bent leg to compensate for a chair that is too low or for a desk that is too high) or disturbing for the teacher (like putting a book straight to be able to sit more upright).

A. Asthana (2008) discusses in her article in The Guardian about hazards of chair tipping. She brings out that of the 7,000 schoolchildren admitted to hospital each year as a result of chair-related accidents, 70 per cent were rocking back dangerously.

Different teachers explain there how they deal with it and how much time it takes to tell the children not to do it and keep still. Although previous chapters show that standing, instead of sitting, is way more beneficial, some teachers even said they made children stand for 10 minutes as punishment!

It's an example of a deep-rooted wrong kind of teaching.

Dr. Dieter Breithhecker explains in his interview about body-brain connection, why this kind of antipathy towards fidgeting isn't right and why we should engourage it instead: "If someone is getting bored and you ask him to stand up and do an exercise where his vestibular system, his balance system, is challenged- for example, standing on one foot- after 5 to 10 seconds he will be able to concentrate again. Relating this to a child who starts to rock on a chair: the rocking stimulates the balance system, activates special hormones, such as neurotrophin which has a tremendous effect on brain activity."(Cannon Design, VS Furniture, Bruce Mau Design, 2010).

But instead of dealing with the very root of the problem - sitting time, a huge amount of energy has been directed towards creating solutions for how to make it less harmful. For example several untippable chairs have been designed, which eliminates all possibilities to stretch and release excess energy.

Figure 3-12. Tom Wates, a teacher, has persuaded designers to create an untippable chair. Source: The Guardian. (The Guardian, 2008)

Different kinds of hyper-ergonomic furniture, that already seems like some kind of medical device or training equipment, has been invented recently. However, keeping in mind the learning of 21st century, that doesn't offer the

needed flexibility and dynamics. Instead, it is sending out a signal that sitting for very long periods of time is safe and healthy now.

Figure 3-13. Ergonomic school furniture what encourage to sit for long periods. 1.Pixie Blue Desk. Source: Amazon. (Amazon, 2015); 2. Ergonomic furniture by Ergokid. Source: Ergokid homepage. (Ergokid, 2015); 4. Chairs by Houzz. Source: Houzz homepage. (Houzz, 2015); 5. Ergonomic School Desk Set by Ergoland. Source: Ergoland homepage. (Ergoland, 2015)

3.6   How schools can intervene

Starting school is one of the most important phases in the life of a child. While the pre-school period is characterized by the well-known daily rhythm (play-fatigue-rest), starting school changes the social situation and the dominant activity of a child. The dynamics of playing is replaced by studying. The long static load, stronger pedagogical requests, the decline of motor activity, appearance of work discipline and psycho-emotional stress, are some of the changes which each child encounters during the everyday activities. During the first months or the first year, a significant number of children develop certain functional and morphological disorders caused by inappropriate adaptation to the already mentioned changes (Ilic & Đuric, 2014).

Schools are considered to be one of the preferred intervention environments for increasing daily physical activity in children. Consequently, helping schools to fulfill their physical activity promoting role should be a public health priority, especially since a recent study among 10-12 year olds showed that only a small amount of time at school (5%) was spent in moderate to vigorous physical activity (Verloigne et al., 2012).

There have been attempts to prevent posture problems by modifications of school furniture since sitting has been found to be strongly associated with back pain in children and adolescents. Inadequate school furniture is frequently considered to be the reason behind posture and back problems. A possible explanation can be found in biomechanical studies, showing that sitting with a flexed trunk, compared to standing, increases the spinal load. **However, the evidence of protective effects of modifications on school furniture, is limited.** (Cardon et al., 2014)

Furthermore, Troussier et al. (1999) found no modification of back pain prevalence in 8−11-year-old schoolchildren using ergonomically designed furniture and Knight and Noyes (1999) found that a high level of reported posture problems was significantly related to the frequency of non-standard sitting on newly-designed furniture.

The research by (Cardon, De Clercq, De Bourdeaudhuij, & Breithecker, 2004) claims that only very few class teachers of elementary schools integrate movement into the daily classroom routine. Therefore, present and future teachers should learn more about affordable and feasible structural and organizational means to increase the postural dynamic and the back health of their pupils, like allowing pupils to interrupt sitting by letting them stand up when they like, giving pupils the opportunity to lie down, teach from different places in the classroom, implement movement breaks, interrupt frontal teaching.

From an observation video made on 04.03.2015 in Haapsalu Elementary School's 4th grade, it can be seen that in girls' handicraft class students have to get permission to feel more relaxed and take alternative postures. The initial rule is to still use chairs and as the furniture is in fixed positions, it afflicts the body and comfort is hard to find (see figure 3-14).

Figure 3-14. Screen shot from observation video. 04.03.2015

3.6.1 Examples

There are several examples of integrating and enhancing physical activity into school programmes.

A "**whole-school**" approach to physical activity involves prioritizing regular, highly-active, physical education classes; providing suitable physical environments and resources to support structured and unstructured physical activity throughout the day; supporting walk/cycle to school programs and enabling all of these actions through supportive school policy and engaging staff, students, parents and the wider community.(Van Cauwenberghe, De Bourdeaudhuij, Maes, & Cardon, 2012)

Moving school: "school as a place of work" was started from the idea that the place of work of a schoolchild should comply with the specific requirements of the individual and her/his work in the same way as an industrial workplace must (see figure 3-15). The purpose of the project is to increase the seating quality, i.e. the relationship between sitting and working as well as the sitting postures of schoolchildren. Movement is encouraged by work organization, like information stations; by creating circumstances that encourage movement, like stand-at places of work; and by behavioural influences, like good examples. The classroom has a stand-at desk and the classroom is reorganized to make more floor space available for variations in the daily working routine (corner for reclining, mats on the floor, etc.).

Comparing a traditional school to a "moving school", the use of environmental components in the classroom (e.g. standing desks, swiss balls) showed promising effects on sitting posture and sedentary behaviours.

This suggests that structural changes in the school environment are a promising strategy to change sedentary behavior.

It was observed that children from a traditional school spend an average of 97% of the lesson time sitting statically. In the "Moving school" this posture was replaced by dynamic sitting (53%), standing (31%) and walking around (see figure 3-16). (Cardon et al., 2004)
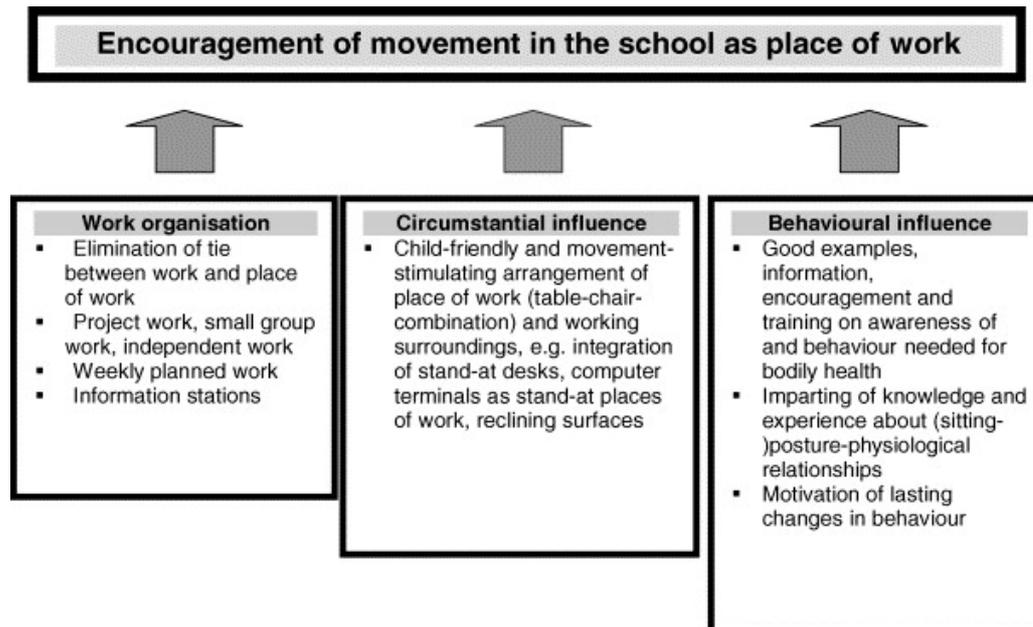
Figure 3-15. Concepts of the "Moving school" (Cardon et al., 2004)
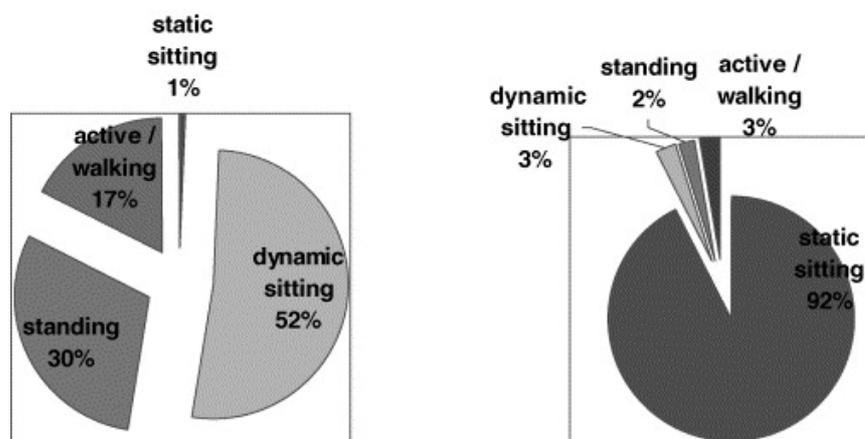
Figure 3-16. Duration in percentage of static sitting, dynamic sitting, standing and for being active or walking in the intervention group and the control group. (Cardon et al., 2004)

One would expect that less static sitting and more moving around in the classroom could result in less reading and writing activities or even in less actual learning time. However, in the present case it was observed that the pupils of the "Moving school" did not do less reading or writing activities than pupils of the traditional school**. Therefore, it seems useful to move away from the idea that reading and writing are necessarily static sitting activities since these activities can also be done standing up on a desk or lying on the floor.**

It can be concluded from the present study that sitting habits in a classroom, if implementing "Moving school" concepts, strongly differ from sitting habits in a traditional classroom. Since the differences can decrease the daily physical load in elementary schoolchildren, the "Moving school" concepts are valuable in the multidimensional approach of back health at young age. (Cardon et al., 2004)

4. Learning environment and teaching methods

In the context of school, the concept of health and safety tends to be taken literally, in terms of keeping hazardous objects and materials out of the school.

There are lots of regulations about physical elements in school environment, but it seems that all these regulations have just listed some elements and don't see the "big picture".

A child starting school this fall will graduate in the third decade of the 21st century. All we know about the world they step into is that it will have challenges and opportunities beyond what we can imagine today, problems and possibilities that will demand creativity and ingenuity, responsibility and compassion. Whether this year's student will merely survive or positively thrive in the decades to come, depends in large measure on the experiences she/he has in school. Those experiences will be shaped by adults, by peers, and ultimately by places, by the physical environments where they do their learning.

In the new knowledge economy even the heaviest manufacturing jobs require employees to use the kinds of analytical and problem solving skills that were once associated only with white-collar work. The knowledge economy will require a new educational system that recognizes that it is not what students know that is important but how knowledge and skills are used across a range of contexts. Educators must recognize what the new skills are in the changing environment. A central challenge for the education system is to find ways of embedding learning in a range of meaningful contexts where students can use their knowledge and skills creatively to make an impact on the world around them. (Seltzer, 1999)

Sir Ken Robinson, an internationally recognized leader in the development of creativity, innovation, and human resources, said in his interview about the the creativity challenge: "The whole process of public education came about primarily to meet the needs of the Industrial Revolution in the 18th and 19th centuries and the current system doesn't just represent the interests of the industrial model, it embodies them. To begin with, there's a very strong sense of conformity. Secondly, the pedagogical model is based on the idea of transmission. Teachers teach and students learn. The classroom arrangements are people sitting facing the front where someone's speaking to them. It's the factory model. " (Cannon Design, VS Furniture, Bruce Mau Design, 2010)

Studies show that factors in the built environment affect retention, attention, motivation, learning, and academic achievement (Blincoe 2008; Durán-Narucki 2008; Earthman 2004; Kumar, O'Malley, and Johnston 2008; Schneider 2002).

My observations at schools and the media scan showed that most of today's classrooms are designed with the teacher in the front.

If you compare classrooms from the 19th century and today, there's no significant difference. Classrooms certainly have improved since the 19th century, but essentially they are designed for the same traditional mode of teaching.

Figure 4-1. Classrooms from 1915 and 2015

These classrooms are mainly teacher centred and designed for single to many communication styles. Because there is a lack of flexibility to rearrange furniture, they are poorly designed for collaboration and communication. Often the classrooms are impossible to be adapted for any other purpose. Today's classrooms are mainly individual-focused rather than group-focused.

From an observation video, made in Haapsalu Elementary School's 6th grade on 02.03. 2015 (see figure 4-2), it can be seen that the teacher uses, besides traditional lecture style, also group work for collaboration. However, furniture was not rearranged and the students still use the same sitting posture as throughout the rest of the school day.

Figure 4-2 .Observation video screenshots 02.03.2015.

f you look at recently renovated schools, there have been improvements made to the facilities within the classroom. The classrooms have better desks and chairs that are more comfortable and of different sizes to accommodate the physical differences in learners. Classroom walls have spaces to decorate and display student work. The introduction of technology, like data projectors, audio and visual systems, better lighting and light control has been made. But mainly all the changes are still in the same 20th century mode.

4.1 Attention span

Attention span is the amount of concentrated time one can spend on a task without becoming distracted. Most educators and psychologists agree that the ability to focus attention on a task is crucial for the achievement of one's goals.

Selective sustained attention, also known as focused attention, is the level of attention that produces the consistent results on a task over tim. (National Center for Biotechnology Information, 2015)

Research by Dianne Dukette and David Cornish uncovered that most healthy teenagers and adults are unable to sustain attention on one thing for more than **about 20 minutes at a time**, although they can choose repeatedly to re-focus on the same thing. This ability to renew attention permits people to "pay attention" to things that last for more than a few minutes, such as long movies. The same study uncovered that the short-term response to the stimulus that attracts attention lasts for only eight seconds. (Cornish & Dukette, 2009)

What this means is that you only have eight seconds to get the students attention, and if the instruction or information that you're presenting takes more than 20 minutes, you've lost them.

Some authors, such as Neil Postman in his book, Amusing Ourselves to Death, claims that the attention span of humans is decreasing as modern technology, especially television, becomes more prevailing (Postman, 1985). Internet browsing may have a similar effect because it enables users to easily move from one page to another. Most internet users spend less than one minute on the average website

4.2   Active learning

Active learning is a process whereby students engage in activities, such as reading, writing, discussion, or problem solving that promote analysis, synthesis, and evaluation of class content. Cooperative learning, problem-based learning, and the use of case methods and simulations are some approaches that promote active learning. (Centre for Research on Learning and Teaching,)

Many schools are moving away from instruction in which students attend 45-50 minute lectures, much of which they will forget as soon as they are tested on it, if not sooner. The focus has shifted to learning how to learn.

In an active learning model the teacher's role progresses from being sage to being the guide. Instead of a dispensation of facts, a class session becomes a participatory gathering of facts. With this model classroom organization must now accommodate periods of direction, guidance, research, sharing and summary. The furnishing must be flexible to support these dynamics and enhance the opportunity for different types of learners to engage a topic from a perspective that has meaning to them. (McDonough, 2000)

Active learning method give students opportunities to speak, listen, read, write and think. The content of the lesson is learned through activities, which have students practice the knowledge, such as problem solving, informal buzz groups, simulations, case studies, drama etc. For this purpose the practice of active learning in educational environments is crucial. (Odabaşi & Kolburan, 2013)
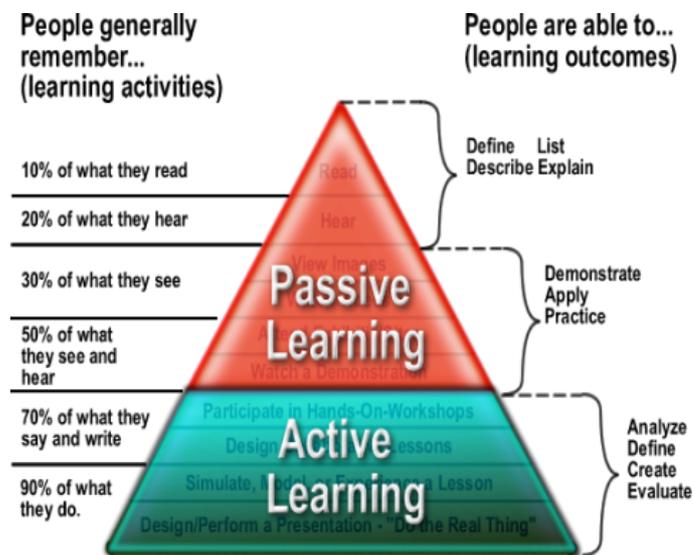
Figure 4-3 .How do children learn. Source: (Kideotals, 2012)

Based on literature reviews and personal interviews with lecturer of Mother Tongue Didactics E. Hiiepuu and teacher training department practice coordinator A.Kasesalu , I made an example list from some active learning methods what is most common and requires displacement of furniture and different use of learning space.

Number of methods how active learning can be implemented is infinite, in this thesis I give an overview only for very view of them.

4.2.1 Group discussion

Group discussion is a general unstructured discussion on an issue or topic by the group. Individual members are free to contribute or not contribute.

One form of group discussion is the "campfire" configuration.

The "campfire" configuration can dramatically impact the quality of an activity. In the absence of actual flames, the posture and arrangement of people sitting around a fire (sitting low to the ground in a tight circle) heightens the awareness of group participants and the activity topic. The contrast between seated/standing high and low, squatting posture helps to ground the conversation. It feels safe, making the campfire a great way to debrief and address sensitive topics. Low, informal seating equalizes group eye level and comfort level. This seating position is unusual in Western culture and unlike an actual campfire engagement this version is best kept relatively short. (Doorley & Witthoft, 2012)

Figure 4-4. Sitting in circle. Low, informal seating equalizes group eye level and comfort level. Source: responsiveclassroom.com

4.2.2 Work in pairs

Group discussion is a general unstructured discussion on an issue or topic by the group. Individual members are free to contribute or not contribute.

One form of group discussion is the "campfire" configuration.

The "campfire" configuration can dramatically impact the quality of an activity. In the absence of actual flames, the posture and arrangement of people sitting around a fire (sitting low to the ground in a tight circle) heightens the awareness of group participants and the activity topic. The contrast between seated/standing high and low, squatting posture helps to ground the conversation. It feels safe, making the campfire a great way to debrief and address sensitive topics. Low, informal seating equalizes group eye level and comfort level. This seating position is unusual in Western culture and unlike an actual campfire engagement this version is best kept relatively short. (Doorley & Witthoft, 2012)

Figure 4-5. Kids forking in pairs to find together a solution to a task. Source: Scholastic.(Scholastic,)

4.2.3 Cooperative Learning

Cooperative learning is a teaching strategy for organizing classroom activities. Grouped into small teams, the children work together to achieve shared goals. This structured group is an effective tool to address learning, organizational and communication problems at school (E. Hiiepuu, personal communication, 24.03.2015).

Cooperative learning shifts the focus in teaching from lecturing to interaction. The teacher serves as facilitator and observer during all cooperative learning activities. Although the teacher's role is not so overtly dominant, he or she remains actively involved. Teachers are expected to join the student groups for brief periods to facilitate the learning process and to make sure that students do not digress from the task. They should also be available to answer questions that may come from students. Cooperative learning has proved to boost academic achievement, improve behavior and attendance, increase self-esteem and motivation. (Marzano, 2012)

Figure 4-6. Kids work together to achieve shared goals. Source: experientialtools.com

4.2.4 Use of Movement to Get Kids Focused

Ask all students to stand and join in simple choreographed physical movement. Because most children find it invigorating and it's easy to monitor full participation, it may become one of your favorite ways to get the students focused and kill time.

For example, teaching hand-clapping patterns to accompany a chanted verse or a set of math facts. If you add foot stomping or hand clapping with a partner it is possible to create variety. (E. Hiiepuu, personal communication, 24.03.2015)

Kinesthetic learners, who are also known as tactile learners, grasp things in a better manner by actually doing them. Performing a physical activity associated with learning, rather than mere reading/listening helps these learners to understand things quickly. Instead of premeditating or thinking about a particular activity in advance, tactile learners resort to trying out things and understand them in the process.(Marzano, 2012)

Figure 4-7. Kids using movement for focusing. Source: escmarzano.wikispaces.com

4.2.5 Individual time

From time to time there's a need for researching and focused working. There should be a place for independent learning in classroom. Students can work alone focusing on a text, working or researching a topic in their own space. This kind of work doesn't require necessarily sitting behind a table. The students could choose more comfortable postures and alternative seating. (E. Hiiepuu, personal communication, 24.03.2015)

Figure 4-8. A student in self created "listening centre" enjoying alternative posture in classroom. Source: Pinterest (Pinterest,)

4.2.6 Theatre in the Classroom

Hand Puppets are an ideal springboard for developing speaking and listening skills. Children often communicate more easily with puppets, giving them confidence to express their ideas and feelings. Shy children can become acquainted with others through the roles they take on. Children are free to try on new personalities and take them off again, with a puppet on their hand, broadening their own in the process. Scary animal hand puppets like lions and sharks or shy ones such as a tortoise can help children master uncomfortable feelings. Puppet play provides an opportunity to gain some control over their world by working out fears and frustrations. Hand Puppet play helps young children develop creative skills by forcing them to use their imaginations. They make up the roles, the rules, the situations and the solutions. It is through imaginative play that children come to understand the differences between fantasy. Whether children write their own stories or adapt one of their favourite books into a play, story telling with hand puppets is one of the best ways for kids to build their reading, comprehension, and vocabulary skills, building on their ideas by introducing new words, their meanings and other information.(Learningtoys,)

Figure 4-9. A student perform puppet show after learning about what is needed to make a shadow. Source: Pinterest.com

5. Space as a tool

"First we shape our environments, then they shape us." – Winston Churchill

Spaces can affect us in many ways. What we sense in a space, consciously or unconsciously, can affect how we feel about ourselves, the people we interact with or the institution housed in that space. Good design takes into consideration the many ways that a space can influence the people using it and seeks to optimize desired behaviors and/or minimize undesired behaviors.

New teaching and learning styles are challenging what we have always considered standard in the traditional "classroom." Flipping courses, new technologies, and increased collaboration are driving the need for something new in learning spaces.

Regardless of whether it's a classroom or the offices of a company, space is an important instrument for innovation and collaboration. It should not be taken as an initial, given condition, but as a valuable tool that can help create deep and meaningful collaboration, what is flexible and can be changed according to actual needs in seconds.

 For example: open-air Maekong market outside of Bangkok sits atop an active train track. A commuter train runs right through the marketplace 8 times per day. Just before the train arrives in the town, the market stallholders have to pull back their awnings and remove their produce from the tracks. The second the train passes through, everything is back on their original position and business resumes as if nothing had happened.

Figure 5-1. Open-air Maekong market outside of Bangkok sits atop an active train track. Passing train doesn't disturb the market much, space adjusts just with seconds according needs. Source: Amusingplanet. (Amusingplanet, 2012)

There are about 10 billion neurons in the brain and about 1000 trillion connections. The possible combination of connections is about 10 to the one-million power. An enriched environment can contribute up to a 25% increase in the number of brain connections. Space impacts behavior! (Cannon Design, VS Furniture, Bruce Mau Design, 2010; Scott-Webber, Strickland, & Kapitula, 2013)

If you enter a room full of chairs and tables, neatly placed in rows and facing front, it will instantly give you a signal to sit town and take a passive listener's role. If you remove the desk from the equation, and give people permission to assume alternative postures then its quite usual to see, that they lie on the floor, perch on the backs of couches, bounce on their toes and pace around the room - all during "work" sessions.

Movement is not only healthy but it introduces opportunities for communication through body language.

Hasso Plattner Institute of Design at Stanford (aka the "d.school") gave out a guide book on how to set rooms for creative collaboration as a result of a five-year experiment (Doorley & Witthoft, 2012). According to this guide behaviour in an environment can be described by six different categories. Each of these spatial characteristics is adjustable and can be calibrated on a scale, as in from "open" to "closed", to radically alter the mood in a situation. These properties include features of the space itself as well as positions of the people in it.

Posture

Posture describes the position of a person's body in the midst of an activity. It signals and reinforces a spectrum of personal engagement ranging from reflective to active. Reclined or seated posture suggests a reflective and relaxed engagement with an activity, whereas an upright or standing posture signals active engagement and participation.

A reflective sitting posture, while comfortable, often disguises and diminishes the potential of body language and movement. It's static. The more comfortable people are in their seats, the less comfortable they seem to be with generating ideas, exchanging leadership roles, or moving on to the next activity. As a result, reflective posture is great for critique and reflection, but bad for generating ideas. For the same reasons it works well for team debriefs and deep discussions.

An active, standing posture encourages people to jump in and alter the dynamics of a room. This posture also leaves room for fidgeting and stretching to release tension. Body language communicates intent and emotion, and we negotiate comfort level and status relationships through our proximity to each other.

reflective ⟵⟶ excited
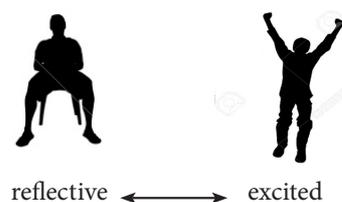
Orientation

Orientation is the relative positioning of people and assets. "Singular" orientation directs all attention on a single person (e.g., a teacher) or object (e.g., a prototype). "Multifaceted" orientation highlights all things equally: a group sitting in a circle, no single person is in focus. Orientation is often the main vehicle for directing visual attention and tuning human connection within an experience. It is also one of the easiest properties to manipulate because in many cases it requires only adjusting the direction in which people are standing or sitting.

Orientation illuminates one of the fundamental differences between a fixed-furniture and an adjustable environment. During highly focused activities such as a music performance, the orientation of the audience is often singularily focused on the source of sight and sound. The arrangement of furniture reflects the desired engagement between source and audience, like rows of fixed seats facing forward. In a contrary situation where the intent is to have participants see, hear, and engage with each other, an open, multifaceted orientation is preferable. In these latter cases, furniture that allows movement and adjustability is the key.

singular ⟷ multifaceted
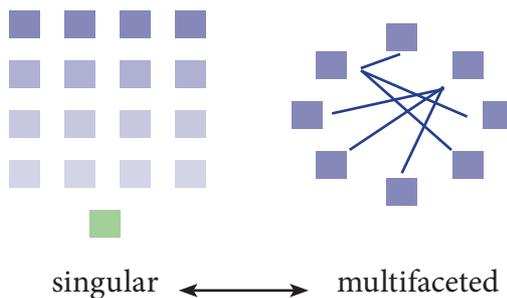
Surface

Surface describes the planes that teams and individuals work on. Are people using desks, tables, walls or floors to create or display their work? Simple changes in surface orientation can have profound impact: horizontals generally support individual authoring, while verticals put work on display for groups.

Ambience

Ambience describes the more ethereal features of environment: Lighting, textures, sounds, smells and color. Adjustments can be tailored to elicit different emotional responses from those occupying the space. Ambience is a tool in that people experience it fully but don't always notice it explicitly. For relaxed spaces, it is used plush seating, multiple points of light, quiet music and warm or dark colors. For active spaces, raw materials, bright light, bouncy music, saturated colors and open windows works well.

Density

Density characterizes how the volume of space feels in relation to an activity. Tweaking density allows to influence these impressions and control the energy level and creative potential of an experience. A sparse environment provides ample interpersonal distance in which people feel free to move about and might feel more self-reflective. A concentrated environment engages participants closely within a "cozier" space. The quality of density is separate from the size of a space and its physical dimensions. The key is to tune the feeling of energy in a space by packing it full or leaving it sparse, no matter its size. Strategic positioning of furniture and room dividers can make a large space feel concentrated even with a small number of people. Purging a room or removing unnecessary furnishing can make a smaller space feel sparse.

Storage

Storage is about accessibility of both artifacts and information. It spans the range from protected to available. Accessibility of storage is an important issue for digital and physical resources. The ability to store things in a space also links to how that space is experienced. Giving someone storage resources can be a meaningful gesture of community connectedness. Likewise, a policy of "no storage" sends a different strong message.

5.1 Innovation in education. Examples

5.1.1 Fielding Nair International

Fielding Nair International (Fielding Nair International) is the global leader for educational facilities planning and architectural design. FNI plans and designs school facilities for today and tomorrow with one primary goal in mind — to improve learning. Schools that they have planned and/or designed have won 11 international planning and design awards for excellence. Their awards recognize not just quality architecture, but vastly improved educational outcomes as well.

One of the Fielding Nair International founder, Prakesh Nair promotes the Open Concept School and presenting that model of school design as the key to re-engineering schools for 21st century learning, preparing students for the Digital Workplace. His firm, based in Minneapolis, MN, has designed 400 schools in 36 different countries.
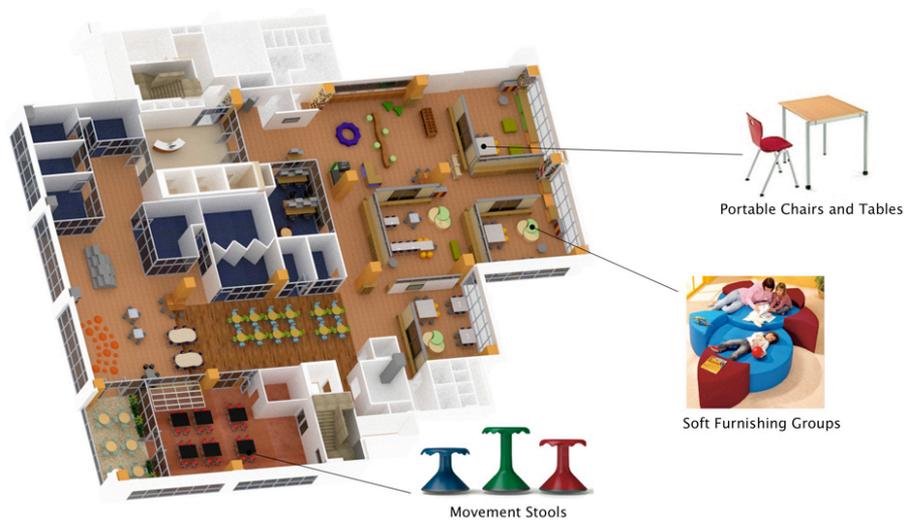
Figure 5-2 Layout of Fielding Nair Internationals designed American School of Bombay Elementary School. Source: Fielding Nair International. (Fielding Nair International)

FNI's designed physical environment is intended to encourage independent learning by allowing students to visit the adjacent areas on their own, while allowing the teachers to supervise them.

Figure 5-3. Fielding Nair Internationals Designed American School of Bombay Elementary School. Source: Fielding Nair International.)Fielding Nair International)

5.1.2 Vittra Telefonplan School

Another example of innovative school is Vittra Telefonplan School in Stockholm. It has attracted attention from around the world with its imaginative and colorful interior that supports the free school organization's educational methods in a learning environment where the laptop is considered the most important learning tool. Instead of a classic classroom setup with desks and chairs, a giant iceberg with a cinema, a platform and room for relaxation and recreation now accomodates many different types of learning situations.

Figure 5-4. Vittra Telefonplan School in Stockholm. "The Mountain" is the central point of the school. Source: Rosan Bosch homepage.(Rosanbosch, 2011)

The Swedish free school organization Vittra's new school in Stockholm has a physical design that promotes the organization's educational methods and principles.

When the new Vittra school "Telefonplan" was established in Stockholm, Rosan Bosch created the school's interior design, including space distribution and distinctive custom-designed furnishings. The interior design revolves around Vittra's educational principles and serves as an educational tool for development through everyday activities.

Vittra puts a high priority on developing new methods for teaching and interaction as a basis for educational development. Instead of a conventional classroom approach, the students are taught in groups adjusted to their achievement level based on the school's educational principles.

Figure 5-5. Interior design of Vittra Telefonplan School in Stockholm. Source: Rosan Bosch homepage. (Rosanbosch, 2011)

Vittra Telefonplan deliberately uses its interior design as a means of developing the school and its educational principles. Rosan Bosch has used challenging custom-made furnishings, learning zones and room for the individual student to facilitate differentiated teaching and learning in a school where the physical space is one of the most important tools for educational development.

The designs and the interior also accommodate Vittra's active efforts to incorporate digital media and approaches. In the Vittra schools, laptops are the children's most important tool – whether they are working sitting down, reclining or standing up.

After the project was completed, the results were translated into a design manual that will set a precedent for the design of Vittra's other schools in Sweden. (Rosanbosch, 2011)

6. Ideation

Based on the previous analysis, I'm convinced that classrooms need a solution that would differ from the traditional school furniture. I would like to create a situation when entering to a classroom would make it necessary to make a plan not only for teaching topics, but also methods and space arrangement.

Considering the fact, that humans should move or change their posture after every 20 minutes, the solution should enable the changes to happen smoothly and naturally. If you add here the knowledge that traditional methods of learning are out of date and that 21st century learning assumes quick changes and dynamics, then the first requirement for ideation is adabtability of the created solution.

My aim was to enable changing the traditional teacher-centred teaching methods, so I avoided traditional solutions while generating ideas. If the classroom is focused on the learner, then learning becomes paramount.

Following the 20-minute theory, I wanted the solution's essence to be a reminder to change position after a certain time.

There should be more than one use of classroom, it may not need to be completely and uniquely redesigned for each purpose. A room may have several general uses. Furniture plays a significant role in enabling a learning environment to be flexible.

Technologies used in learning, such as interactive whiteboards, personal learning environments, wireless networks and mobile devices, plus the internet and high-quality digital learning resources are altering the experiences and aspirations of learners.

If we're looking for new pedagogical practices, we have to have facilities that will enable those happen- flexible spaces where people can group and re-group, where you are not stuck in one configuration with teachers at the front. **Teaching and learning should shape the building, not vice versa.**

6.1   Common problems/needs

On the internet you can find a lot of solutions where teachers who are already focused on new learning styles have tried to rearrange the classroom according to their favorite active learning methods. They definitely don't seem to like traditional classrooms and the atmosphere there already looks much friendlier and more open-minded than in a usually furnished classroom.

Fortunately there are a lot of innovative teachers out there, who already know the theory of engaged learning and newer methods of teaching. From an internet search I could see teachers on the floor with their students or see students up and around the classroom while engaged in learning. Getting down on the floor can be productive during sessions that require group work, creativity or problem solving. The floor actually grounds the muscles creating a calming effect. Beanbag chairs, pillows or floor spots are great to use in this regard. Children can also lie on mats while on their backs, or be propped up on their elbows while on their stomachs for a full floor effect.

But usually these adjustments don't fulfill all the needed requirements for all desired actions.

Figure 6-1 Teachers share their ideas how to make classroom more adaptable to active learning. Source: Blog Hoppin ((Blog Hoppin, 2014)

As information about health hazards of sitting have spread a lot lately, there's already a visible tendecy of schools investing in alternative seating. Therapy balls are one of the most common and the cheapest method. But teachers often forget to deal with the sitting time. Actually sitting on a therapy ball for too long isn't a good solution. It needs constant concentration to maintain balance and after a while it might become disturbing. Children can't exercise and learn at the same time.

There's another thing that usually happens - the balls roll away, the children fall off on purpose and it causes overall distraction in the classroom.

A blog where teachers share their best practices, suggests putting the ball in a cardboard box to limit rollig (figure 6-2).

Figure 6-2. A teacher suggests to put the therapy ball in a cardboard box to limit its rolling. Source: Special-ism.com. (Special-ism.com)

There is a blog where a teacher describes how she arranged her classroom, but still felt sorry to see the children sitting uncomfortably for long days. Especially when there is a possibility to use other postures instead. So she just had kids flip their chairs around and gave them pillows to lounge on during quiet reading time (see figure 6-3).

Another teacher describes how she made privacy screens out of cardboard to guarantee the students privacy during some tests and individual tasks, because she had turned her classroom to a project-focused classroom and rearrangement of furniture seemed too bothersome (see figure 6-4).

Classrooms are noisy places. The noise is primarily generated by children talking and chairs moving on uncarpeted floors. Metal-legged chairs are the most common type of chairs in schools. The sound of one those scraping the floor of a classroom was measured at 85 dB (the sound of a motorcycle or a jackhammer is about 100 dB.)(Edwards, 2015)

Children hear more poorly than adults in noisy situations and noise interferes with their comprehension of speech.

Studies have consistently shown decreases up to 35% to 40% in children's speech recognition in a fairly quiet room up to the typical noise levels experienced in today's classroom. (Edwards, 2015)

Tennis balls are widely used as an inexpensive solution to decrease chair noise in the classroom.

A blog post of a teacher (Art with Mr.E, 2012) describes how to avoid unpleasant noise of metal-legged chairs and markings on the floor alternatively. He shares a "do it yourself" method for covering leg tips with felt and rubber band (figure 6-5). This tip finds a lot of positive feedback in commentaries:

Anonymus, July 27,2012: *"Thank you so much for this idea. I am tired of fighting with tennis balls to get them on, only for them to come off a little while later. Brilliant idea, and so simple!"*

Anonymus, August 17, 2014: *"Great idea! I have heavy science tables and we do move them around so I put felt on the bottom of those as well!"*

Figure 6-5. A teacher shares a trick how to make clumsy chairs less noisy. Source: Art with Mr.E blog. (Art with Mr.E, 2012)

6.2   Key design principles

The aim of this thesis was to change our traditional education system by design and to offer a solution by re-inventing the traditional classroom. On the basis of interviews, observations and document research I am convinced that 21st century learning spaces must change to reflect the paradigm shift we are seeing with 21st century learners and educators.

The study reveals that 20 minutes time aspect is the key factor for offering a concept solution. Health hazards and posture problems can be avoided if to limit sitting time by 20 minutes. Likewise an effectiveness of learning process if to change activities after every 20 minutes. These common insights lead to the awareness that classroom environment should offer an adaptation and flexibility in order to successively implement methods and behaviours what support these dynamic of activities.

Key design principles for generating ideas were:
- It should be quickly adaptable and learning focused - movable and adaptable according to actual learning methods.
- Child-centred. Although it would be a tool for the teacher also, the main user would be a child.
- To enhance learning, it should be possible to create small learning communities, skill-based learning groups or team teaching.
- It should be possible to operate the design functionally even in a small space. It should not take much space or it should be multi-functional, so there would be no need to store it away.
- Access for guiding.
- Adaptable to changing technologies.
- Safe and secure.
- Durable and light materials.
- Efficient and low maintenance.

7. Development of Concept Ideas

7.1   Early prototyping

In order to develop an initial concept proposal, lots of ideas were generated and iterated, putting the emphasis on the insights and possibilities gathered in the research phase.

At the very beginning I worked with an idea on how by changing the shape of an item, it can be used multi-purposely. I sketched versions of chairs and tables that can "disappear" into walls and floors. One strong idea was also a multifunctional whiteboard, that could be used as a room separator, storage unit with shelving at the back and a groupwork table that opens in the front - all in one.

Based on continuous analysis and feedback from acting teachers, it was clear that an individual working surface which is proper for standard sitting posture is necessary nevertheless. The central idea was to offer at least one standing option in addition. For testing the shape and look, I started with rapid prototypes of paper. After testing several strongest ideas, I sketched some of the models into 3D to get a better visual of them and to test placement and measures.
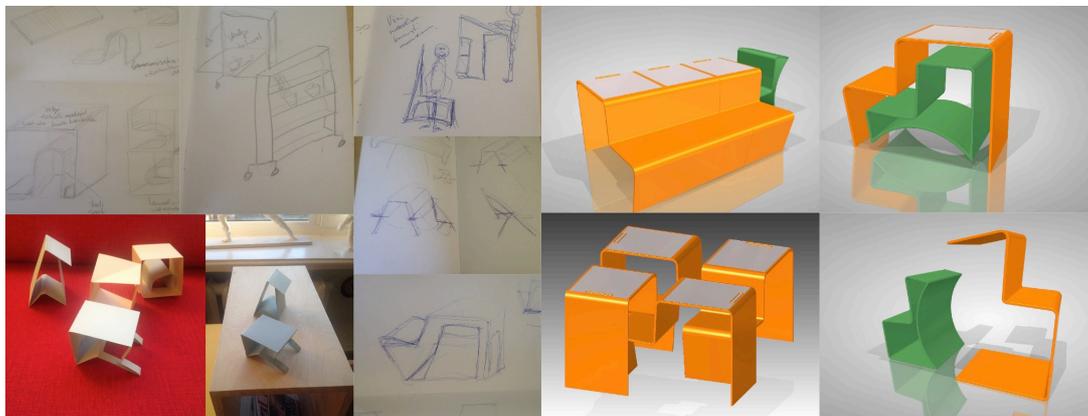
Figure 7-1. Firs sketches, paper mockups and 3d models for early concept testing.

After further development I made a real size cardboard mockup for testing its ergonomics and sizes.

Figure 7-2. Cardboard mockup

After introducing this concept to several elementary school teachers who were familiar with active learning methods, they expressed their interest in the idea and encouraged building more prototypes in order to test them in real learning situations.

Initially I made 4 sets of modules from EPS isolation plate (dimensions are seen in Appendix II).

Figure 7-3. Prototyping

7.2   Testing

The module has several positions that are derived from the active learning methods described above. But positions are not specified and they can be discovered successively during usage. Exactly this happened when I did the first testing with children - they creatively relocated the modules and discovered more and more possibilities of how to set them up.

Figure 7-4. Module as a standing desk.

Figure 7-5. Variations of placement. If placed on another side, it gives an extra surface for a smaller kid.

Figure 7-6. Placed for individual work. Room saving option.

Figure 7-7. One set consist of one big and one small module. If there is a need for standard sitting position the side bench can be used for storing things.

Figure 7-8. The module can be lift into a standing desk very easily.

Figure 7-9. Variations

Figure 7-10. Module in its top side creates a comfortable seat for working with ipad or reading.

Figure 7-11. As modules are lightweight and abstract, they inspire playing.

Figure 7-12. Modules on its longer side can be an additional seating option or if layered up, a room separator.

Figure 7-13. Modules as a wall for puppet theatre.

8. Evolution

After primary testing of these modules I introduced the concept idea to some elementary school teachers and asked for their feedback. The feedback was mainly positive. It was surprising to see that even adults instantly started "playing" with the modules while testing them.
The three main questions asked in the feedback were:
(1) Would you replace your current classroom furniture with these modules?
(2) What kind of obstacles do you see in using them?
(3) Do you have some recommendations for development?

Two respondents out of five answered to the first question that they would not replace their current classroom furniture. They explained it reasoning that they don't know how the modules fit their classrooms and they fear that offering such "freedom" to kids can cause a mess in the classroom. They explained that the most effective way to keep discipline in the classroom is by traditional seating.
Three respondents answered that they would try.

As obstacles the possible high price and inability to use the potential of these modules were mentioned. Four respondents mentioned the need to fulfill the regulated study programmes as an obstacle in the way of trying and testing new teaching methods. One teacher was doubting the ergonomics and comfort of the seat. A concern about the material was also expressed - how about the cleanability and durability?

For possible developments they suggested to think about storing tools (e.g. pencils, erasers) and consider producing them in different sizes. The needs for making seats more ergonomic and adaptive to children's weight and to work out some add-ins for supporting workbooks and art supplies were also mentioned.

Some more hesitations that were mentioned were derived from today's teaching practice, for example:
"Is it allowed to use seating without backrests?"
"What if there is a need to take a test that takes 45 minutes?"
"Workbooks have very large formats - do they fit on the tables?"
"But if I wear a skirt, how can I sit there then?"
All these questions are actually negligible if you look at the research above.
Having a backrest isn't important if the sitting takes less than 20 minutes. The kind of massive testing and exams that take more than 20 minutes are

ineffective and not suitable knowledge verification means according to active learning methodology anyway. The same applies to workbooks - education innovators are questioning the necessity of them.

The biggest concern was about sizes and whether they fit the classrooms. Some of the classrooms are quite small and must fit up to 24 sets. Therefore some of the placement options were worked out and are shown below.

8.1 Placement options

According to Estonian law regulations the classroom space must be at least 1,7 m2 for each student. Maximum number of students in one class can be 24. So the smallest class for 24 students must be at least 41 m2.
For testing possible different situations with 24 sets of modules at this space, some of the placement options were worked out (see figures 8-1 till 8-5). The options of placement are self-generative through different situations and these few are not limited templates.
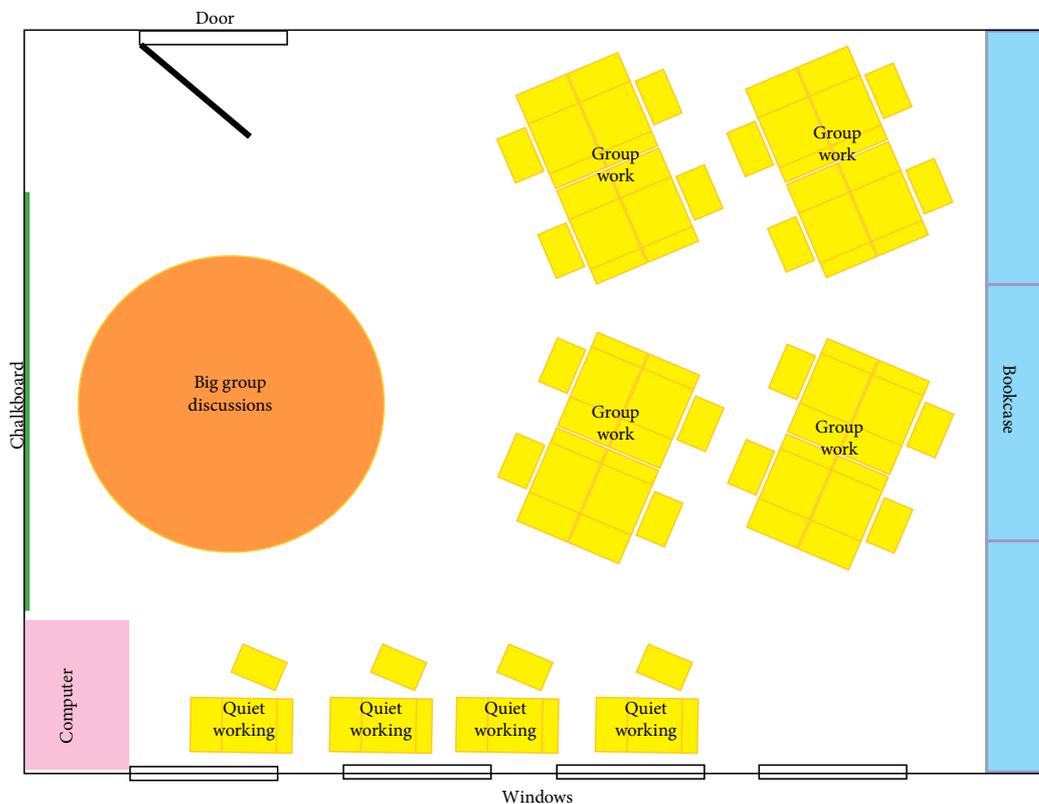
Figure 8-1. Layout for several group work stations and individual working. There is still a room for gathering to the floor for group discussion.
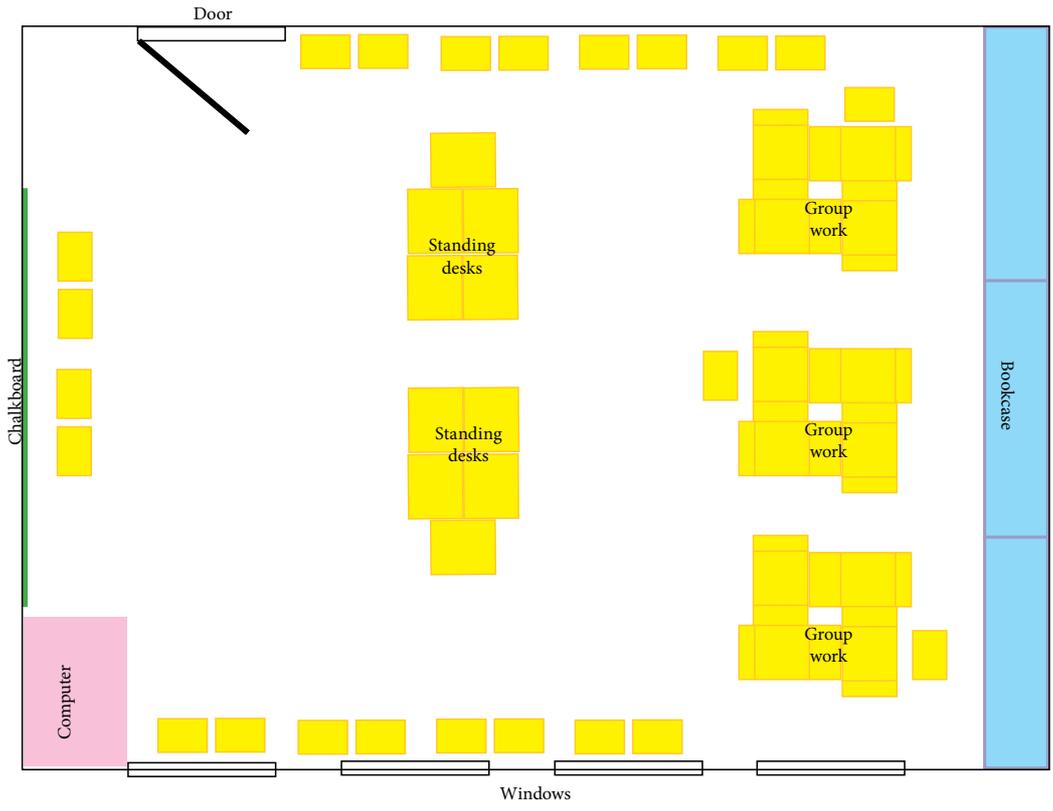
Figure 8-2. Group work can be either in sitting or standing posture.
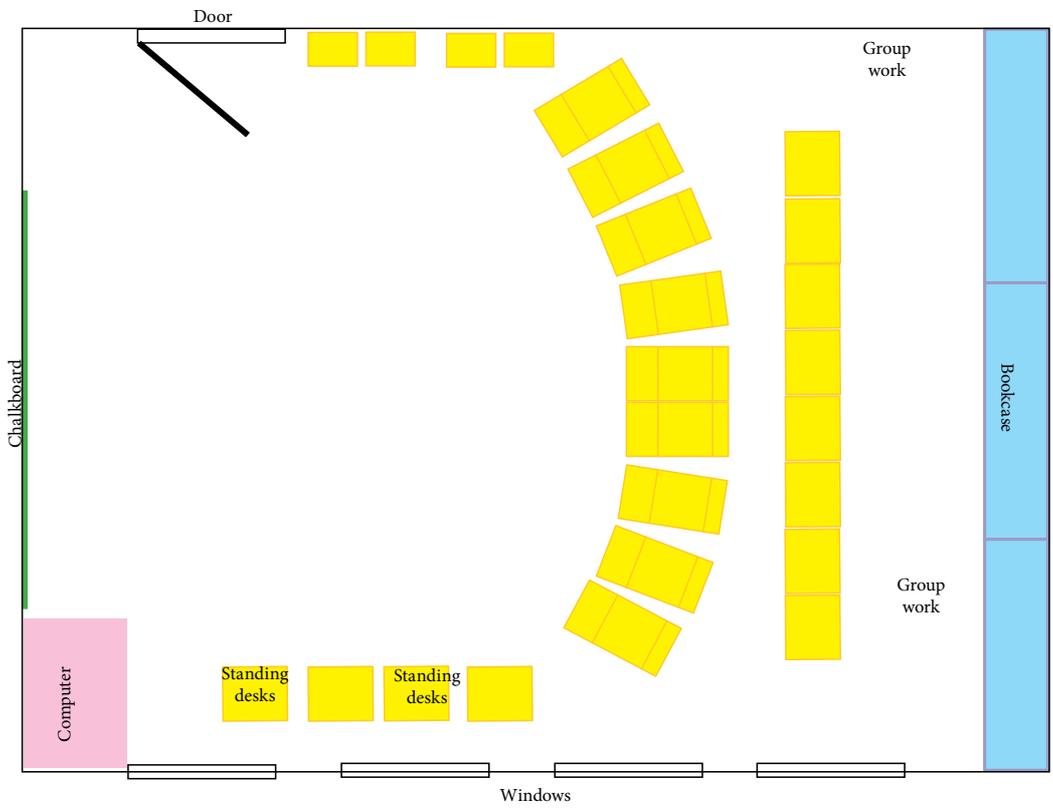
Figure 8-3. Placement for story-telling.
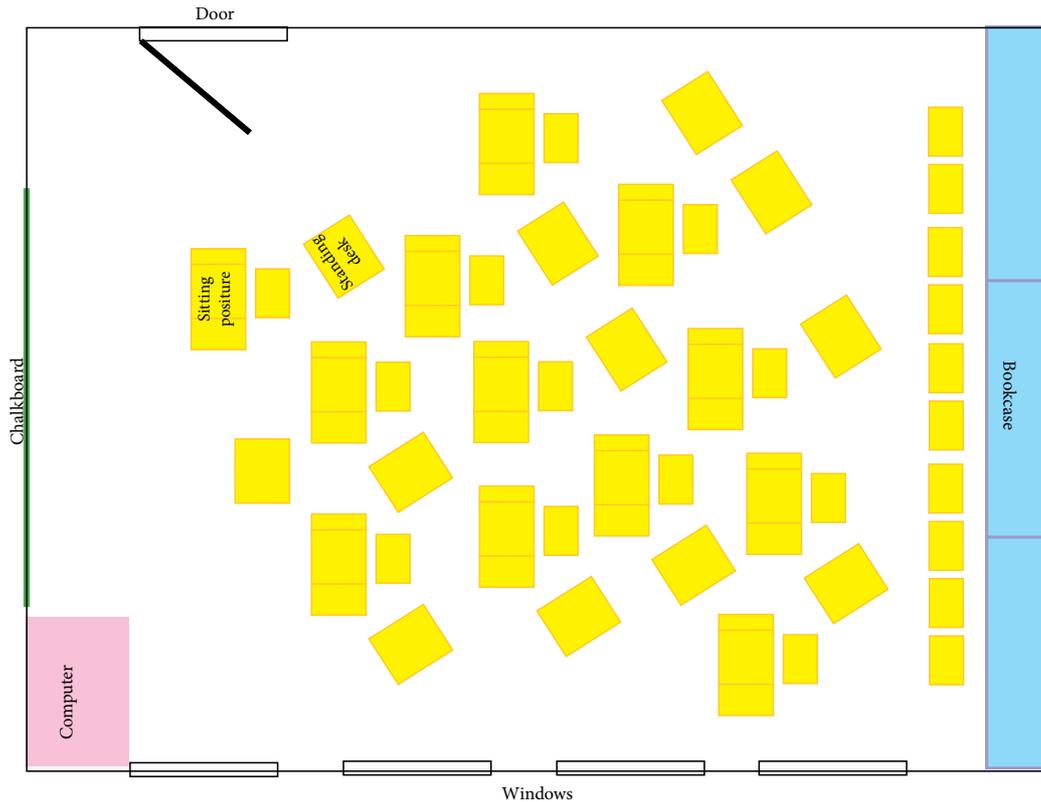
Figure 8-4. Individual work time placement, students can choose to stand up or sit down.

8.2 Further development

From the testing of prototype there appeared a few issues, what are needed to address. First of all, if to use side seating, the other side tends to lift up. There's a need to find the right weight and shape to ensure the balance and stability and still maintain the possibility to use both sides as a standing tables.

Second issue is the storage of tools (pencils, etc). If to change position from sitting to standing or vice versa, there should be a convenient solution for implements what are in use.

Also there should be consider to produce the modules in different sizes to take into account children's large growth difference.

The next step in the development will be testing the usability of the modules if they have built from more durable material and for the whole class of students. The focus would have to be aimed more towards the technical aspects. At this stage there have not been done any decisions about materials and manufacturing. While choosing the proper material for the concept, the most important thing that needed to focus on were how to make the construction lightweight and durable at the same time. Manufacturing has a very important role in this case. Rotational molding, as it is relatively inexpensive and suitable for hollow, large and one piece, is probably the best choice for this product.

Conclusion

The current thesis was initiated by the drastic results of the TLU Haapsalu College's Centre of Excellence in Health Promotion and Rehabilitation evaluation of preschool children's posture condition in Estonia (Proovel, 2015). This study showed that 92% of preschool children had some kind of a posture problem: core muscles were weak or damaged or spine had already some kind of a deviation.

The aim of this thesis is through analysis and creative development to provide a possibility to tackle children's posture problems by design.

The background research was carried out to understand the most effective possibilities in the area. The literature review brought out two main issues:

(1) Different researches (Agus, 2012; Dunstan et al., 2012; Reynolds, 2012) show that it is not the shape and features of the furniture that are crucial to children's postures, but prolonged sitting time. Sitting statically in one position is bad regardless of how much time you also spend on active training. If you stand up after every 20 minutes, all of the negative side-effects of a sedentary job can be avoided.

(2) 20 minutes is the maximum amount of time an average child is able to effectively concentrate on one topic (Cornish & Dukette, 2009).

The study reveals that the 20-minute time aspect is the key factor for both topics. Health hazards and posture problems can be avoided if sitting time is limited to 20 minutes. Likewise the effectiveness of learning process if activities are changed every 20 minutes. These common insights lead to the awareness that classroom environment should offer adaptation and flexibility in order to successfully implement methods and behaviours that support the dynamics of activities.

Comparing this knowledge to the existing school environments, it becomes evident that classrooms need radical changes to support teachers in implementing contemporary teaching methods and encouraging the change in posture positions at least after every twenty minutes. Based on this the creative development phase concentrated on offering light and flexible furniture modules to support new learning methods and new behaviours.

The study shows that there is no existing product on the market to fulfill these needs in schools. It is quite surprising, considering that there is permanently increasing pressure towards both of these topics - health and safety in the context of school and the question of expiration of traditional teaching methods.

As a result of this thesis a product concept was offered that is adaptive to classroom requirements, offers solutions for altering postures and inspires to implement active learning methods.

Hopefully this thesis has offered the possibility of raising awareness about the different aspects of classroom environment. My role as a designer was to understand which environmental characteristics support a collaborative approach of schooling and contribute to improvement of today's children's lives through classroom environments that are effective and inspiring.

Summary

Käesolev uurimustöö sai alguse Tallinna Ülikooli Haapsalu Kolledži Tervisedenduse ja Rehabilitatsioonikeskuses läbiviidud uuringu (Proovel, 2015) drastilistest tulemustest, mis uurisid prepuberteediealiste laste rühi olukorda Eestis. Uuring näitas, et üle 90 % algkooliealistest lastest esineb rühihäireid - kere lihased olid nõrgad või selgrool esines juba teatavat sorti kõrvalekaldeid.

Käesoleva magistritöö eesmärgiks on läbi analüüsiva ja loomingulise arendustöö pakkuda disainlahendus laste rühiprobleemide ja terviseriskide vähendamiseks õppetöös.

Mõistmaks kõige efektiivsemaid võimalusi, viidi läbi taustauuring. Analüüsitud kirjanduse põhjal toodi välja kaks olulisimat aspekti:

(1) lapse rühi arengus ei ole otsustavad mitte mööbli kuju ja omadused, vaid pikaajaline istumine. Kui iga 20 minuti tagant tõusta püsti või muuta kehaasendit, on võimalik vältida istumise kahjulikku mõju täielikult (Agus, 2012; Dunstan et al., 2012; Reynolds, 2012);

(2) 20 minutit on maksimaalne aeg, mille jooksul laps on keskmiselt võimeline keskenduma ühele teemale (Cornish & Dukette, 2009).

Uurimusest selgus, et võtmesõnaks mõlemal juhul on "20 minutit" - rühihäireid ja terviseriske on võimalik vähendada, kui vähendada järjest istuvas asendis veedetavat aega 20 minutini; samuti on võimalik tõsta õppimise efektiivsust, kui vahetada tegevusi iga 20 minuti tagant.

See teadmine viis tõdemuseni, et klassikeskkond peaks olema kohanduv ja paindlik, tagamaks aktiivsete ja kiirelt vahelduvate õpitegevuste efektiivse rakendamise ja pikaajalise istumisega kaasnevate terviseriskide vähendamise.

Kui võrrelda seda tõdemust tänase koolikeskkonnaga on ilmne, et klassiruumid vajaksid radikaalseid muudatusi, et õpetajatel oleks võimalik kaasaegseid õpetamismeetodeid ja asendimuutuseid iga 20 minuti järel rakendada.

Sellele tuginedes keskendus arendustöö faas kergekaalulise ja paindliku mööblimooduli lahenduse leidmisele, mis toetaks uusi õppemeetodeid ja käitumismudeleid.

Ühtegi olemasolevat konkureerivat toodet, mis oleks rajatud samu eesmärke silmas pidades, ei leitud. See on küllaltki üllatav asjaolu, kuna mõlemad teemad - nii koolitervisehoid ja turvalisus, kui ka traditsiooniliste õpetamismeetodite aja- ja asjakohasus - on suure üldsuse tähelepanu surve all.

Minu ülesanne disainerina oli mõista millised tegurid toetavad kaasavaid õpetamismeetodeid ja aitavad lastele luua parema elu läbi tulemusliku ja inspireeriva klassikeskkonna.

Magitritöö üheks eesmärgiks on ka juhtida tähelepanu traditsioonilise klassiruumi erinevatele ebatervislikele ja õppetöö efektiivsust vähendavatele aspektidele.

Magistritöö tulemusel valmis toode, mis on kiiresti klassiruumi vajadustega kohanduv, pakub võimalusi erinevate kehaasendite võtmiseks ja inspireerib kasutama erinevaid aktiivõppemeetodeid klassiruumis.

References

Agus, D. (2012). *The end of ilness* Simon & Schuster.

Amazon. (2015). *Ergonomik kids desk.* Retrieved may 19, 2015, from http://www.amazon.co.uk/Ergonomic-Desk-Adjustable-Bookstand-Children/dp/B00FZZSARK

Amusingplanet. (2012). Maeklong railway market: Marketplace with a railway track through it. Retrieved may 22, 2015, from http://www.amusingplanet.com/2012/12/maeklongrailwaymarketmarketplace.html

Apple. (2015). *Apple watch.* Retrieved may 18, 2015, from http://www.apple.com/watch/health-and-fitness/#activity

Art with Mr.E. (2012). *Chair "footies".* Retrieved may 21, 2015, from http://www.artwithmre.com/2012/07/chair-footies.html

Azur. (2015). Break reminder app. Retrieved may 18, 2015, from http://playboard.me/android/apps/com.breakreminder.app

Blog Hoppin. (2014). Small group. Retrieved may 21, 2015, from http://www.bloglovin.com/blogs/blog-hoppin-2847382?post=3612929663&group=0&frame_type=a&context=expanded_post&context_ids=&blog=2847382&frame=1&click=0&user=0&viewer=true

Cannon Design, VS Furniture, Bruce Mau Design. (2010). *The third teacher* Abrams.

Cardon, G., De Clercq, D., De Bourdeaudhuij, I., & Breithecker, D. (2004). Sitting habits in elementary schoolchildren: A traditional versus a "Moving school". *Patient Education and Counseling, 54*(2), 133-142.

Centre for Research on Learning and Teaching. *Active learning.* Retrieved may 9, 2015, from http://www.crlt.umich.edu/tstrategies/tsal

Corporate Fitness Coaching. (2014). Maintain good posture. Retrieved may 7, 2015, from http://infitptv.com/maintain_good_posture/

Delfi. (2014). *Ranitsakaalumise tulemused šokeerivad.* Retrieved 07.05, 2015, from http://www.delfi.ee/news/paevauudised/eesti/ranitsakaalumise-kampaania-tulemused-sokeerivad-ligi-65-protsenti-kotte-uletas-lubatud-kaalu?id=70097061

Design Council. (2015). *The design process: What is the double diamond?* Retrieved may 05, 2015, from http://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond

Doorley, S., & Witthoft, S. (2012). *Make space. how to set the stage for creative collaboration*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Dunstan, D. W., Kingwell, B. A., Larsen, R., Healy, G. N., Shaw, J. E., Bertovic, D. A., et al. (2012). Breaking up prolonged sitting reduces postprandial glucose and insulin responses. *Diabetes Care, 35*(5), 976-983.

Edwards, C. (2015). *Tennis balls increase children's attention.* Retrieved may 21, 2015, from http://handsandvoices.org/articles/education/ed/tennis_balls.html

Ergodepot. (2015). *Variable balance by varier.* Retrieved may 24, 2015, from http://www.ergodepot.com/Variable_balans_by_Varier_p/v100.htm

Ergokid. (2015). Kids ergonomic desks an chairs. Retrieved may 19, 2015, from http://ergokid.tumblr.com

Ergoland. (2015). *Scholar desk.* Retrieved may 19, 2015, from http://www.ergoland.com.my/workstation-solutions.html

Mööbel. Haridusasutuste Toolid Ja Lauad. Osa 1: Funktsionaalmõõtmed, (2007).

Fielding Nair International. Retrieved may 21, 2015, from http://www.fieldingnair.com

Globalstole. (2015). Dalton saddle stool. Retrieved may 24, 2015, from http://globalstole.com/462078312/?cid=90

Houzz. (2015). *Scholar kids desk chair.* Retrieved may 19, 2015, from http://www.houzz.com/photos/11942673/PostureDesks-Little-Scholar-Kids-Desk-Chair-Soccer-contemporary-kids-desks-and-desk-sets

Jawbone. (2015). *Activity trackers.* Retrieved may 18, 2015, from https://jawbone.com/up/trackers

Kideotals. (2012). *How do children learn?* Retrieved may 10, 2015, from http://kidedotals.com/book/how-do-children-learn/377/2012-04-20-2157

Kumar, V. (2013). *101 design methods. A structured approach for driving innovation in your organization* John Wiley & Sons Inc.

Learningtoys. *Explore how children learn from hand puppet play.* Retrieved may 21, 2015, from http://www.learningtoys.ca/english/benefits-puppet-play

Maketaketeach Blog. Privacy screens. Retrieved may 21, 2015, from http://blog.maketaketeach.com/category/diy-activities/page/2/

Making Health Easier. Burn to learn. Retrieved may 7, 2015, from http://makinghealtheasier.org/burntolearn

Marzano, R. J. (2012). *Kinestethic activities.* Retrieved may 10, 2015, from http://escmarzano.wikispaces.com/10.+Kinesthetic+Activites

McDonough, J. (2000). Engaged learning. Retrieved may 18, 2015, from http://asumag.com/furniture-amp-furnishings/engaged-learning

National Center for Biotechnology Information,. (2015). Attention span statistics. Retrieved may18, 2015, from http://www.statisticbrain.com/attention-span-statistics/

Odabaşi, B., & Kolburan, G. (2013). Employment Of Active Learning In Classroom Management And It's Effect On Students' Academic Success The International Journal of Research in Teacher Education, (4), 23-29.

Pinterest. Retrieved may 21, 2015, from https://www.pinterest.com/pin/575897871076909482/

Polar. (2015). Polar loop activity tracker. Retrieved may 18, 2015, from http://www.polarloop.com

Proovel, T. (2015). Prepuberteedielaliste laste kerelihaste ja rühi seisundi hindamine ja harjutuskava väljatöötamine kerelihaste tugevdamiseks eesmärgiga vältida rühihäireid ja selja vaevusi. . Unpublished manuscript.

Raised Square, L. (2015). Stand up! Retrieved may 18, 2015, from https://itunes.apple.com/us/app/stand-up!-the-work-break-timer/id828244687?mt=8

Reynolds, G. (2012). The first 20 minutes: Surprising science reveals how we can: Exercise better, train smarter, live longer

Rietveld Architecture-Art Affordances. (2014). The end of sitting. Retrieved may 16, 2015, from http://www.raaaf.nl/en/projects/927_the_end_of_sitting

Rodeochair. (2015). *Rodeo.* Retrieved may 24, 2015, from http://rodeochair.no

Rosanbosch. (2011). Vittra school telefonplan. Retrieved may 21, 2015, from http://www.rosanbosch.com/en/project/vittra-school-telefonplan

Scholastic. Retrieved may 10, 2015, from http://www.scholastic.com/teachers/sites/default/files/imagecache/300x234_huge/asset/image/az_laptopclassroom.jpg

Scott-Webber, L., Strickland, A., & Kapitula, L. R. (2013). Built environments impact behaviors results of an active learning post-occupancy evaluation. *Planning for Higher Education, 42*(1), 28-39.

Special-ism.com. Long summer vacation? top 10 ways to maintain your student's attention!. Retrieved may 21, 2015, from http://special-ism.com/wp-content/uploads/2012/09/ball-in-a-box-picture.jpg

Tervise Arengu Instituut. (2014). Tervist edendavate koolide võrgustik. Retrieved 07.05, 2015, from http://www.terviseinfo.ee/et/tervise-edendamine/koolis/tervist-edendavate-koolide-vorgustik

Tervise Arengu Instituut. (2015). Tervisestatistika ja terviseuuringute andmebaas. Retrieved february 22, 2015, from http://pxweb.tai.ee/esf/pxweb2008/Database/Uuringud/databasetree.asp

The Guardian. (2008). Rock-steady chair means an end to classroom tipping. Retrieved may 8, 2015, from http://www.theguardian.com/education/2008/feb/17/schools.uk

Van Cauwenberghe, E., De Bourdeaudhuij, I., Maes, L., & Cardon, G. (2012). Efficacy and feasibility of lowering playground density to promote physical activity and to discourage sedentary time during recess at preschool: A pilot study. Preventive Medicine, 55(4), 319-321.

Wilkhahn. (2015). Stand-up. Retrieved may 24, 2015, from http://www.wilkhahn.com/en/orgatec/

Appendixes

Appendix I

USER 1:
Child age 7-12, elementary school student

USER 2:
Teacher of elementary school

POSTURE

PURPOSE OF CLASSROOM

- required study programs
- collaboration
- active learning
- building relationships
- transmition of knowledge
- basic skills
- preparation for labour market
- child storaging (for parent)

Teaching methods has changed, classroom is same

New teaching requires alternative teaching methods

Need of skills has changed

Labour market needs has changed

CORE MUSCLES ARE WEAK

- training
- raising activity rate
- informing
- trends
- reminders
- passive training objects
- furniture
- traditions
- playing

SCHOOL ENVIRONMENT

- sitting
- furniture
- physical activity

lifestyle
habits
traditions
curriculum
activity time in school

standards
ergonomic
sizes
passive training
price

do they need to sit?
the perfect seating?
perfect work posture?
how long?

BEHAVIOUR

- habits
- overweightness
- sedentary lifestile
- schedule
- classroom routine
- health trends
- fun+ play
- activities

trend for overweightness

term of play has changed

childs doesnt read activity rates

communication is more tech based

ENVIRONMENT

PHYSICAL ENVIRONMENT

- furniture
- aesthetic
- technology
- light
- air
- temperature
- accoustic
- scent
- ergonomic
- multifunctional use
- storage
- displaying materials
- regulations, standards
- placement/desk arrangement
- displays
- safety
- data collection

Too heavy desks for rearrangement
childs height and build has changed

need for access to materials

group works needs furniture arrangement

chairs are not adjusted according to heights

childs backward are distanced from teacher in front

independent works needs isolation

need for access to materials

need of storaging

INTELLECTUAL ENVIRONMENT

- open minded
- privacy
- possibility to show initiative
- friendly
- rules of classroom
- guidance
- cooperation
- feedback
- child-teacher relationship
- child-child relationship
- motivation

effective discussion distance

placement for discussion possibility

cooperation possibility
creative space and diciplipe

Apendix II