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Sleep Hygiene – Health Promotion within Primary Schools using Mod- ern Mobile Technology

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Abstract <p>Healthy sleep promotion is a significant challenge that has nowadays become a strategic priority in the health care system, by the reason of severe outcomes for children's development and risk of chronic diseases. Behavioral sleep hygiene recommendations for children are alternative interventions intended to promote healthy sleep.</p> <p>When taking into account health promotion from a modern prospect, it is relevant to consider the impact of the rapid, global digital development that is forming nowadays' society. Technological developments have led to the growth of the mobile health, and particularly health applications, that offer wide opportunities for promoting sleep. Mobile application OnniWay is a digital tool for teachers, facilitating children's health promotion by establishing lifelong holistic, healthy habits, through fulfilment of the daily micro-actions. Creating healthy habits in children lead to the positive behavioral change, that can improve health and well-being of children and significantly prevent the risk of chronic conditions.</p> <p>This study was aimed to promote sleep health within primary school children by utilizing modern mobile application OnniWay. Accordingly, this thesis was based on the practice-based methodology, supported by the latest theoretical knowledge regarding sleep hygiene, health promotion and mobile health. The practical section of the thesis was implemented through the development of the sleep promotion product. This product comprised three mini lessons teaching children different relaxation exercise techniques to calm the body and mind at bedtime and establish long-lasting healthy sleep habits. The product was designed to apply modern resources and technology, to contribute distribution to multiple demographics.</p> <p>In conclusion, sleep promotion in schools is an essential topic to address. The sleep promotion product was successfully released by the OnniHabit company and is ready to utilize in schools. Further research regarding evaluation of the product effectiveness in children's sleep promotion might be needed.</p>		
Key words: sleep hygiene , health promotion , mobile health , children , OnniWay		

CONTENTS

1	INTRODUCTION.....	4
2	AIM AND OBJECTIVES.....	5
3	THE BASICS OF SLEEP HYGIENE	6
3.1	The Health Impact of Poor Sleep.....	6
3.2	Consequences of Insufficient Sleep in Children.....	7
3.3	Definition of Sleep Hygiene	8
3.4	Sleep Hygiene: Basic Guidelines for School Aged Children (6-12 years)....	9
4	HEALTH PROMOTION	10
4.1	Ottawa Charter for Health Promotion, WHO	11
4.2	The Fogg Behavior Model (FBM) and Tiny Habits in Health Promotion ...	12
4.3	Health Promoting Schools	14
4.4	The Role of Schools in Children’s Sleep Promotion.....	16
5	THE ROLE OF MOBILE APPLICATIONS IN HEALTH AND SLEEP PROMOTION	17
5.1	Why Use Mobile Phones for Health Interventions?	17
5.2	Mobile Application-Based Health Promotion Programs and their Benefits from a Customer Perspective	18
5.3	Mobile Applications for Healthy Sleep Promotion	21
6	MOBILE APPLICATION ONNIWAY.....	22
6.1	OnniWay – Overview and Objectives	22
6.2	OnniWay – Micro-Action Categories.....	23
6.3	OnniWay Benefits from Pupils and Teachers Perspective	25
6.4	OnniWay – Practical Implementation and Achievements.....	26
7	SLEEP WELL – HEALTH PROMOTION PRODUCT FOR ONNIWAY	28
7.1	Sleep Promotion Product – Inspiration.....	28
7.2	Sleep Promotion Product – Planning.....	29
7.3	Sleep Promotion Product – Implementation.....	30
7.3.1	Overview and Objectives	30
7.3.2	Micro-actions.....	31
7.3.3	Realization and Feedback.....	34
8	THESIS PROCESS AND METHODS.....	35
9	DISCUSSION	37
	REFERENCES	40

1 INTRODUCTION

Sleep is crucial for the health, well-being and development of children, becoming a significant call for action in the nowadays society (Gruber et. al. ... 2016, 88-89). Sleep health can be defined as “multidimensional pattern of sleep-wakefulness that promote physical and mental well-being”, and it incorporates the following potential domains that are recognized as predictors of health outcomes: duration (the amount of sleep received in 24 h), timing (the time of sleep within he 24h), continuity (an ability to fall asleep and come back to sleep when awoken without need), sleepiness/ alertness (an ability to preserve thoughtful wakefulness), regularity (constancy of sleep and wake times), quality (personal assessment of “good” or “poor” sleep) and rhythmicity (general circadian rhythm pattern) (Buysse 2014, 9; Wallace et. al. ... 2018, 1-15).

This concept can be applied for children based on the scientific studies concerning negative outcomes of children having poor sleep quality and/or not enough sleep due to the irregularity of the sleep mode. According to statistics, more than 33% of primary school children have significant sleep problems (Mindell & Owens 2015, 2). Literature data indicate that poor sleep in 6-12 years old children can result in the increased risks of chronic diseases, obesity and emotional dysregulation, including signs of anxiety and depression. Likewise, it can lead to behavioral problems such as impaired social functioning, hyperactivity and irritability, cognitive issues, including memory deficit and learning problems, and disrupted family functioning (Kopasz et al. ... 2010, 167; Bub, Buckhalt & El-Sheikh 2011, 1505; O’Brien et al. ... 2011, 652–658; Volsko & Barnhart 2018, 260).

Irregular and insufficient sleep in children can be partially influenced by poor sleep hygiene (Mindell, Li, Sadeh, Kwon & Goh 2015, 717-722; Brambilla et al. ... 2017, 1-7). Sleep hygiene comprises a set of behavioral practices and environmental recommendations, daytime activities and sleep routine, aiming in healthy sleep promotion (Irish, Kline, Gunn, Buysse, & Hall 2015, 23). Promotion of sleep hygiene is consid-

erably essential as it helps children to maintain regular sleep routine during the weekdays and the weekends, and to avoid sleep loss. Accordingly, a bedtime routine comprises calm and relaxing activities aimed to prepare children to fall asleep (Allen, Howlett, Coulombe & Corkum 2016, 1-2).

Mobile health and particularly health applications offer wide possibilities in healthy sleep promotion and have a growing population demand due to their modern approach (Lee-Tobin, Ogeil, Savic & Lubman 2017, 1349–1351). Mobile application OnniWay is a digital tool for the primary school teachers, intended to promote children's health and well-being through the performance of the daily micro-actions, leading to the positive behavioral change.

This thesis presents the review of the latest literature associated with the sleep hygiene, health promotion and mobile health, and describes the process of developing sleep promotion product for the OnniHabit company. The product consists of three practical micro-actions on healthy sleep, for use by the teachers in educating children about sleep hygiene. The sleep promotion product is emphasizing on the relaxation exercise techniques aiming to calm children's bodies and minds at bedtime for better sleep.

2 AIM AND OBJECTIVES

The aim of the thesis is to promote sleep health within primary school children using modern mobile application OnniWay.

The objectives of the thesis are the following:

To review the latest theoretical knowledge regarding sleep hygiene, health promotion and mobile health. This shall also comprise the discussion concerning promotion of sleep hygiene in schools.

To create a sleep hygiene product for OnniWay Application. The product consists of three progressive mini lessons, that include contact teaching and home performance of the daily micro-actions.

3 THE BASICS OF SLEEP HYGIENE

Sleep can be defined as natural, periodic state of immobility, when the person is rather unaware of the environment and not reacting to external stimuli. It is known that sleep is an active psychological process inside the brain, which is strongly regulated and controlled. During the sleep, almost all voluntary muscles become inactive and metabolic rate is diminished (Westcombe & Green 2012, 18). People spend approximately one third part of their life asleep. Babies and children need more sleep time, and as they grow up, the sleeping pattern becomes 7-8 hours per night. Even though subjective sleeping time persists rather constant with aging, it has been studied that sleep efficiency and total duration of night sleep is becoming less with the age (Bixler 2009, 3-6). Proper sleep is needed for people's optimal everyday performance, general health and well-being (Cappuccio, Miller & Lockley 2018, 5).

3.1 The Health Impact of Poor Sleep

Sleep loss leads to a large variety of consequences, including cognitive impairment, mood swings and inadequate hormone rhythms. After the loss of sleep, there is a rebound process, which assumes that sleep loss leads to the growth of homeostatic compensatory. Therefore, sleep is necessary for the brain function. Diseases such as fatal insomnia, which is almost complete absence of sleep leads to an early death. Scientific research has demonstrated, that decrease of sleep leads to worsening of memory and learning processes, and consequently sleep can be decisive to neuronal plasticity (Wilson & Nutt 2013, 1). Insufficient sleep is a risk factor and an important correlate of the leading non-communicable diseases (Liu et al. ... 2013, 84). Short duration of sleep is a significant risk factor for developing hypertension and for cardiovascular related

mortality, while longer duration sleep is associated with non-cardiovascular related mortality (Ferrie et al. ... 2007, 1662–1666).

Different studies have found the connection between the poor sleep and asthma, high blood pressure, arthritis, diabetes, stroke as well as obesity (Grandner, et al. ... 2011, 463; Vishnu, Shankar & Kalidindi 2011, 1). For example, poor sleep contributes to hormonal changes and leads to insulin resistance, which is a risk factor for type II diabetes (Lou et al. ... 2015, 178). Poor sleep is also commonly reported by people with cancer. There is a strong connection between cancer-related fatigue, such as loss of concentration and poor efficiency and quality of sleep (Roscoe et al. ... 2007, 35). It has been studied that people with lung diseases are more likely to have poor sleep by reason of breathing difficulties during the sleeping (Choudhary & Choudhary 2009, 118).

Therefore, sleep has a great impact on human's health and well-being. Poor sleep is a significant risk factor for development of non communicable diseases. Moreover, sleep problems are prevalent in people with the chronic diseases, which greatly deteriorate their life quality and contributes to further progression of the disease (Basnet et al. ... 2016, 249–254).

3.2 Consequences of Insufficient Sleep in Children

Sleep influences on all the aspects of children's health, well-being, and daily functioning. Therefore, insufficient, interrupted and low-quality sleep is one of the most frequent parents complain to medical care specialists. Statistically, about 25% of all children suffer from some type of sleeping issues, including difficulty falling asleep, night awakenings and more severe primary sleep disorders such as narcolepsy and apnea. More than 33% of primary school children have significant sleep complains (Mindell & Owens 2015, 1).

Poor sleep in children results in behavioral problems such as impaired social functioning, hyperactivity and irritability. According to O'Brien et al. (2011) research, children

with inadequate sleep are more likely to have maladaptive behavior at school. Insufficient sleep also affects the development of children's brain, which influences on many areas of cognitive functioning and can lead to memory deficit, learning problems and decrease in executive functions. Learning difficulties may include attention, verbal understanding and processing speed (Kopasz et al. ... 2010, 167; Bub, Buckhalt & El-Sheikh 2011, 1504). Likewise, insufficient sleep in children is associated with obesity and emotional regulation, including signs of anxiety and depression. Moreover, poor sleep in children has a major effect on the parents, which leads to disrupted family functioning (Volsko & Barnhart 2018, 260).

3.3 Definition of Sleep Hygiene

Sleep hygiene can be defined as various habits and practices that are needed in order to have a good quality sleep during the night and full alertness during the day (Website of the National Sleep Foundation, 2019). Sleep hygiene education is aimed to provide knowledge about lifestyle factors (exercise, diet, substance use) and environmental factors (such as noise, light, temperature), that might either disturb or promote sleep. Sleep hygiene also comprises general sleep advices, such as maintaining of sleeping schedule, having enough relaxing time before sleep, avoiding of clock watching (Kryger, Roth & William 2011, 869).

Significant research has been performed in order to develop the guidelines intended to promote good sleeping habits. The evidence has proven that sleep hygiene strategies can provide long-term solutions for sleep problems. There are many medications intended to treat sleep difficulties such as insomnia. However, sleep medications provide mostly short-term effect, and the continues consumption of them may lead to dependence. It is recommended to apply sleep hygiene in order to develop good sleep habits and become independent from sleep medication. Nevertheless, individuals using sleep medication shall consult with health professionals to find the right solution of their sleep problem, which could be the use of sleep hygiene either alone or with other treatments such as medication or cognitive therapy (Website of the Centre for Clinical Interventions 2019).

3.4 Sleep Hygiene: Basic Guidelines for School Aged Children (6-12 years)

6-12 years old age children need 10-11 hours of sleep (Mindell & Owens 2015, 22). At this age there is a growing demand on their time from school, hobbies, sports and social activities. Moreover, they become more interested in computers, Internet and social media, TV as well as caffeine products, which contributes to potential sleep difficulties (Website of the Sleep for Kids 2019). Table 1 provides the following sleep hygiene recommendations for primary school children:

Table 1. Sleep hygiene recommendations for children (Mindell & Owens 2015, 43-47)

Recommendation number	Description
1	Keep a regular sleep schedule, with the same bedtimes and wake times every day including weekends.
2	Use bed for sleeping and avoid spending non-sleep time in bed, thus the brain will associate bed with sleep.
3	Keep child's bedroom quiet, cool and comfortable.
4	Avoid caffeine consumes (coffee, tea, sodas, chocolate) in the afternoon and evening.
5	Avoid high stimulation activities prior to bedtime, such as exercise, watching TV or playing video games. If possible, TV, computer and phone should be excluded from the child's bedroom.
6	Children should go to bed when they are sleepy, but still awake. Avoid falling asleep in other places than a bed.
7	Have a predictable sequence of actions before falling asleep, such as teeth brushing and reading.
8	Use of security object in bed such as a toy is beneficial for children to feel safe alone.
9	Avoid clock watching before falling asleep. If children look at the clock, it should be turned away from them.

10	If cannot fall asleep for more than 20 minutes, come out of the bed and do a low stimulation activity such as reading, then return to bed.
11	If the child is not sleepy at the bedtime, temporarily postpone the bedtime for 30 minutes until he/she feels drowsy and experiences faster falling asleep. Then gradually adjust the bedtime till desired.
12	Do physical exercise in a daily basis.
13	Worry time is not a bedtime. Children should have earlier “worry time” to discuss their problems with the parents.
14	If the child experiences poor sleep, keep a sleep diary in order to keep track of sleep times, naps and activities and detect the target issue.

6-12 years’ age is a crucial time for the development of overall health habits and particularly sleeping habits. Primary care providers have a good possibility to introduce the concept of sleep promotion and sleep disorders prevention for children at this age, since they are more susceptible to sleep recommendations compared to other age children (Mindell & Owens 2015, 22).

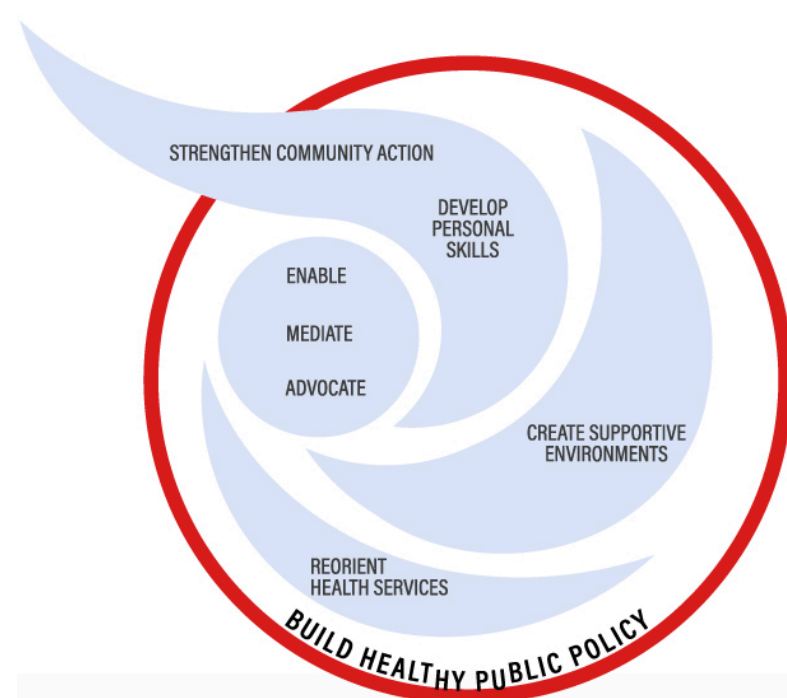
4 HEALTH PROMOTION

In 1948, the WHO defined health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (World Health Organization 1948). Thought, this definition has been criticized (Seedhouse 1986) by the reason that it proposes the ideal state of health, which it likely unachievable. Therefore, the WHO in the Ottawa Charter for Health Promotion (1986) added to the original definition the following concept to make it more realistic and achievable: health is “a resource for everyday life, not an object of living; it is a positive concept emphasizing physical capacities as well as personal and social resources” (World Health Organization 1986).

4.1 Ottawa Charter for Health Promotion, WHO

The WHO's Ottawa Charter for Health Promotion determines health promotion as the process that allows people to increase control over, and to improve, their health. In order to achieve a state of physical, social and mental well-being, a person or group should be able to identify and to realize aspirations, environmental change and safety needs. Therefore, health is considered as a resource for daily life, and not the purpose of living. Health is a positive concept that emphasizes physical capacities as well as social and personal resources (World Health Organization 1986; World Health Organization 2009, 1).

As a result of the Ottawa Charter, a health promotion emblem was created. Overall, the concept of logo demonstrates that health promotion is a multi-strategy, comprehensive approach (Picture 1) (World Health Organization 1986; World Health Organization 2009, 33-34).



Picture 1. WHO Health Promotion Emblem (World Health Organization 2009, 33)

The interior circle of the logo introduces the fundamental background that contributes to health promotion. This comprises “enabling” people to reach their complete health

potential; “mediating” among different interests in society to achieve health; and “advocating” health through different means involving economic, political, social, environmental, cultural, biological and behavioral factors (World Health Organization 1986; World Health Organization 2009, 33-34).

The three wings introduce the five main action areas required for health promotion. The upper wing introduces actions aimed: to “strengthen community action” through the development of society, social support and self-help; and to “develop personal skills” through providing the knowledge, health education and improving life skills. “Healthy public policy” is required in order to achieve those. The middle and bottom wings introduce actions required: to “create supportive environments” for health; and to “reorient health services” towards health promotion and prevention of the diseases (World Health Organization 1986; World Health Organization 2009, 33-34). Since 1986, the WHO continuing using the health promotion emblem and its concepts in health promotion (World Health Organization 2009, 33-34).

4.2 The Fogg Behavior Model (FBM) and Tiny Habits in Health Promotion

Health promotion can be defined as helping people to develop or modify lifestyle habits that maintain long-term optimum health outcomes, which can relate to physical, emotional, spiritual or intellectual well-being. This comprises three components: providing information and raising awareness (health education); providing supportive environments that contribute to positive practices and choices; behavioral change support (Groghan 2007, 29).

The Fogg Behavior model (FBM) is a theory of behavior change introduced by Stanford Professor B. J. Fogg. It interprets behavior as a function of the constructs of Ability, Motivation and Triggers as shown in Figure 1. Fogg model has the following formula: “ $B = MAP$ (Behavior = Motivation X Ability X Prompts), where motivation should be adequate in order to undertake an action; ability demonstrates, whether an individual is ready to implement the behavior, or behavior requires extra education and learning; prompts are signs and signals that trigger the behavior. According to

Fogg's formula, behavior happens only above the green "action" line, which introduces the activation threshold. Under this line the behavior does not occur, despite the prompts exists, since ability and/or motivation is insufficient (Fogg 2009, 1-3).

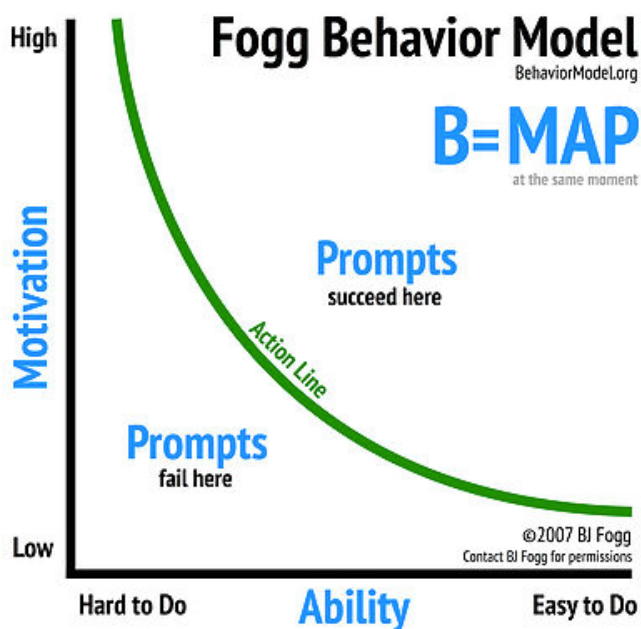


Figure 1. Fogg Behavior Model (Website of the Behavior Model)

The practical utility of the FBM is demonstrated with the concomitant method, named "Tiny Habits", which was developed by Fogg in 2011. The concept of the tiny habits is a change in health behavior through developing very small habits. The main aim of the tiny habits' method is the achievement of automatism for the practiced behavior. When the behavior becomes a habit, it can be enlarged and expanded (Dotzauer 2017, 78). The tiny habits method has been tested in multiple studies in 2013 and 2016 and has proved its effectiveness (Mayer & Jacobs 2013, 11–16; Lieber 2016, 3; Militello, Melnyk, Hekler, Small & Jacobson 2016, 2). Nowadays this method is implemented in an online program by Fogg. The online intervention includes free five-day session intended to build habits, and which has been used by thousands of participants. It can be found on TinyHabits.com (Website of the Tiny Habits).

The tiny habits method can be widely applied in the field of health promotion for different individuals, as the behaviors are small and demand very little time, skill or resources. The tiny habits method allows clients with different physical limitations (e.g., neurological diseases), skill level (e.g., exercise technique) or number of unhealthy

habits (e.g., inactive lifestyle, obese and smoking) to take part in the same intervention. However, the progression speed of individuals varies, as more advanced clients (e.g., that have a lot of time, resources and healthier habits) very likely can have faster results (Dotzauer 2017, 77-85).

4.3 Health Promoting Schools

The health promoting school (HPS) is an international approach to consider the health of children and teachers in a strategic and comprehensive basis. If health education of pupils' emphasis on the individual behavior and health promoting, HPS considers the impact of the school itself as a health promoting environment and a part of the larger community (Naidoo & Will 2016, 224). The World Health Organization (WHO) determines a health promoting school as 'one which fosters health and learning, strives to provide a healthy environment; implements policies and practices that respect well-being and dignity' (Website of the WHO, 2019). The whole-school approach, introduced in the Figure 2, comprises all the components of HPS, that intended to interact, support and reinforce each other.



Figure 2. The whole-school approach to health promotion (Naidoo & Will 2016, 225)

The HPS approach begins as an initiative from the health care sector. However, nowadays the initiative is readily taken on and advanced by the educational sector. The evidence indicates that healthy pupils learn better and enhancing health education and promotion in school improves learning outcomes of the children. Moreover, health promoting schools create a good learning climate, which contributes to the achievement of the school aims (Rowling & Jeffreys 2000, 117-122; Tjomsland, Iversen & Wold 2009, 89-102; Samdal, Viig & Wold 2010, 44-45).

The implementation of the HPS is performed through the national and international networks. Thus, the Schools of Health in Europe and Australian Health Promoting Schools Association (AHPSA) were founded in 1992. The HPS networks in Latin America and Western Pacific were established by the WHO in the 1990s. Schools of Health in Europe network incorporate 43 countries and has an international coordinator from each nation, nominated by the Ministry of Health and Ministry of Education (Samdal & Rowling 2013, 3-8).

However, HPS is still a very young field, that does not have the uniform implementation. The main issue is unclear operationalization of what and how is to be implemented. While the overall guidelines introducing the principles of HPS were provided, their comprehension and practical implementation have mainly been left to the schools. The deficiency of definite implementation guidelines leads to difficulty for the schools to recognize specific actions to fulfill the whole school health promotion approach and follows by a broad variety of practices across schools and countries. Therefore, further research and guidelines concerning HPS are needed (Samdal & Rowling 2013, 4-10).

4.4 The Role of Schools in Children's Sleep Promotion

The main mission of schools is to improve academic achievement and to promote behavioral correction of children and teenagers. Many studies have shown that insufficient sleep such as poor sleep quality, short sleep duration and daytime sleepiness, leads to disturbances in emotional control and cognitive functioning of the child, which negatively affects school achievement in both academic and behavioral assessment (Dewald, Meijer, Oort, Kerkhof & Bogels 2010, 179–182; Wolfson & Montgomery-Downs 2013, 292).

In response to mentioned above studies, Wolfson & Montgomery-Downs (2013, 292-298) provided different actions that school professionals can undertake in order to prevent sleep problems, identify them and promote good sleep in children. For example, paying attention to children's sleepiness may facilitate to recognize the early stages of sleep disorders; education about sleep and its effect on health and performance can be added to the school curriculum; consulting with the parents about children's sleep and good sleep hygiene can be included in the parent-teacher interaction. Moreover, Wolfson & Montgomery-Downs are indicating that it is important to consider system-wide policies that promote sleep health, such as discontinuing very early start time of the school and late time sports after school.

Nowadays the public awareness about the importance of sleep, proper sleep hygiene and sleep diseases is still insufficient in both adults and children. There is a significant

gap between the sleep scientific researches and their practical implementation. For example, in the U.K. education system, school professionals are educating children about the importance of proper diet and exercise, but promotion sleep health is seen very seldom. However, poor sleep habits in childhood may lead to long lasting health problems (Cappuccio, Miller & Lockley 2018, 7).

5 THE ROLE OF MOBILE APPLICATIONS IN HEALTH AND SLEEP PROMOTION

The development of mobile technologies has a great potential for improving health management strategies. The incremental availability and simplicity to apply of mobile applications has allowed for substantial growth of applications, utilized for health behavior change (McKay, Cheng, Wright, Shill, Stephens & Uccellini 2018, 22). Health promotion institutions are progressively embracing smartphone technologies to involve end users in a more interactive approach and to broadly distribute their messages with the goal of improving health outcomes (Brusse, Gardner, McAullay & Dowden 2014).

5.1 Why Use Mobile Phones for Health Interventions?

Mobile phones are especially attractive tool for delivering health interactions for the following reasons: the worldwide prevalence of technically powerful phones is growing; people tend to carry mobile phones with them all the time; people are attached to their phones; content recognition features can be activated through phone-based personal information and sensing. Those reasons are briefly described below (Klasnja & Pratt 2012, 184).

First, the number of smartphone users is growing every year. According to the data from Statista, the expected number of smartphone users will reach 3,8 billion in 2021 (Figure 3). This indicates not only that the adoption of mobile phones has become almost global, but also that the market is changing towards phones with high technical

capacities that make phone-based health interventions largely relevant (Klasnja & Pratt 2012, 184-185).

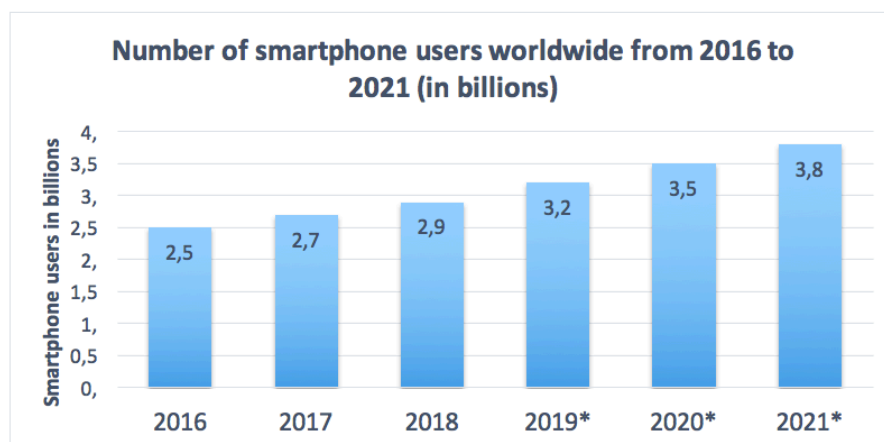


Figure 3. Number of smartphone users worldwide from 2016 to 2021 (in billions) (Website of the Statista 2019)

Second, in contrast to computers and laptops, mobile phones are almost constantly together with the person. According to Fogg, people spend more time with the mobile phones than with their partners or at work (Fogg 2007, 5–11). Therefore, mobile phones can potentially provide care in the clinics, patient homes and at any other place and time, when needed. Third, mobile phones contain personal information and are highly customized by the notification sounds, call melodies, images, cases and decorations. As a result, the personalized nature of mobile phones can decrease acceptance barriers and increase adoption of mobile phone-based health interventions. Finally, due to their technical capacities and proximity to the users, smartphones can be aware about the current situation of their holders. This information creates the opportunity to produce just-in-time interventions to supply users with assistance at times when it is the most needed (Klasnja & Pratt 2012, 185).

5.2 Mobile Application-Based Health Promotion Programs and their Benefits from a Customer Perspective

Progress of mobile technologies led to the development of mobile health (mHealth), determined as “medical and public health practice supported by mobile devices, such

as mobile phones, personal digital assistants (PDAs), patient monitoring devices, and other wireless devices” (World Health Organization 2011, 6). The mobile health field is developing rapidly: in 2017, the global app store market included over 318,000 health applications, almost double the number of applications available in 2015 – with more than 200 health apps being added every day (Website of the IQVIA Institute for Human Data Science 2017). MHealth has a potential to play a role in the transformation of the healthcare system and enhance its efficiency and quality (Website of the European Commission 2017).

The worldwide utilization of Mobile app-based health promotion programs is growing every year. In accordance with the International Telecommunication Union (ITU), in 2015 the amount of global mobile phone subscriptions was over 7 billion, with more than 70% of them coming from low- and middle- income countries. In many of those countries, individuals are more likely to have access to a mobile phone than to electricity, drinkable water or bank account (World Health Organization 2018b, 1-2).

Most of the mobile applications for health promotion concentrate on the monitoring of behavior change and health status, as well as providing the health-related information and feedback. The behavioral change may include, for example, physical activity, diet and sleep interventions for generally healthy individuals. The use of such applications may be more effective, when applied together with social support and when comprises entertainment functions and visualization characteristics (Lee, et al. ... 2018, 3-11).

Health and lifestyle promoting applications were shown to develop the coverage and quality of health care, enhance access to health data, skills and services, as well as to promote positive changes in health behaviors in order to prevent the chronic and acute diseases (Free, et al. ... 2013, 18-22). The evidence showed that young individuals apply technology as a reliable alternative to face-to-face mental health support, which increases the significance of developing quality products (Antezana, et al. ... 2018). Mobile app-based health promotion programs are notably relevant, by virtue of their simplicity to use, wide acceptance and broad reach. From the customer perspective, the usage of health mobile applications has multiple benefits, as demonstrated below in the Table 2.

Table 2. Health applications benefits from a consumer perspective (Corcoran 2013, 103-104; Klasnja & Pratt 2012, 184-192)

Customer benefit	Description
Time saving	Health mobile applications potentially propose a time effective solution to health promotion (Corcoran 2013, 103-104).
Cost effective	Numerous health mobile applications, available in iOS and Android store, are provided free of charge or with a cost of US\$ 0.99.
Ease to access	Due to the increase in the number of mobile phone users and related development of the health applications market, mobile applications are highly accessible and fast to download.
Social support or competition	Health applications can provide social support or competition among users by various ways, including promoting family and friends support; obtaining support from users with the same health goal (e.g. peer-to-peer influence); and engaging users who have achieved similar health goal (e.g. peer modelling) (Klasnja & Pratt 2012, 184-191).
Allows feedback to targeted person	Health applications allow the real-time personalized feedback by considering both user's health profile and the information that the user is tracking as well as other relevant information depending on the application.
Can be user friendly	Health application design may include e. g. touch screen activation, voice commands, barcode scanning.

Can be empowering	Health applications offer opportunities to create a social network, share experiences and provide emotional support (Corcoran 2013, 103-104).
Information resource	Sleep applications contain a great amount of information: from different meditation techniques, sounds and stories for falling asleep to sleep trackers and sleep hygiene tips. Moreover, applications potentially increase the general people's engagement in health care by enhancing the flow of information (Klasnja & Pratt 2012, 192).

Regardless of the increasing amount of mHealth applications, the level of awareness and usability of them is still relatively low. However, most people who have used such applications have found them useful for improving their lifestyle and health. Therefore, in order to increase the use of health applications, they should be promoted both in the public and to healthcare professionals (Kayyali, Peletidi, Ismail, Hashim, Bandeira & Bonnah 2017, 33).

5.3 Mobile Applications for Healthy Sleep Promotion

Mobile applications that promote sleep are becoming more and more popular, which is demonstrated by the great number of downloads: the 10 most known sleep applications were downloaded from 1 to 5 million times. Most sleep applications are directed at identifying, monitoring, and providing support for sleep issues. Likewise, most of the sleep applications contain sleep tips (Lee-Tobin, Ogeil, Savic & Lubman 2017, 1349–1351).

In a systematic literature review published in 2017, evidence was presented that in 88% of the cases, sleep applications can attenuate sleep disorders and enhance sleep quality. The same research stated that mobile interventions may provide better sleep solutions versus other acknowledged treatments such as cognitive-behavioral therapy

for insomnia (Shin, Kim & Grigsby-Toussaint 2017, 446-447). Likewise, mobile applications have a potential to form behavior change related to healthy sleep habits and to promote sustainable sleep hygiene practices (Grigsby-Toussaint, Shin, Reeves, Beattie, Auguste & Jean-Louisc 2017, 126).

In a randomized controlled trial study published in 2018, the mobile phone sleep-management system was applied among students in order to improve their sleeping habits. The results demonstrated that after two-week intervention, most of the students reduced their sleep problems and developed healthier sleeping habits by self-regulation. Thus, the intervention helped students to enhance their learning effectiveness (Chu, Liu & Kuo 2018).

6 MOBILE APPLICATION ONNIWAY

The subsequent section provides an overview of the OnniWay application. The idea and the main features of the OnniWay are described, as several micro-action categories are incorporated into the application. Furthermore, this section shall outline the benefits of utilizing OnniWay from teachers and pupil's perspective, the practical implementation of the application on the market, and the development plan of the OnniHabit company.

6.1 OnniWay – Overview and Objectives

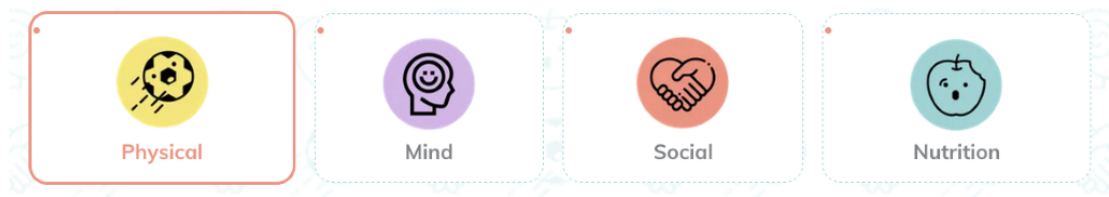
Nowadays children and adolescents face several crucial challenges influencing physical, social and psychological health. Globally, over 80% of children aged 11-17 are insufficiently physically active (World Health Organization 2018a, 1). Around 50% of children experience bullying (Website of the National Voices for Equality, Education and Enlightenment 2019). 10-20% of children and adolescents face mental health disorders (Website of the WHO 2019). The number of obese children and adolescents aged 5-19 has increased from 11 million in 1975 to 124 million in 2016 (World Health Organization 2017, 1).

Early intervention key to addressing these challenges. Based on the evidence, health interventions intended to promote holistic well-being of children may have a great preventive effect. The main inspiration for the OnniHabit Oy company to develop OnniWay application has become Healthy Kids of Seinäjoki model, which was developed in Finland and has proven success with reducing obesity in children. Healthy Kids of Seinäjoki model is based on micro actions leading to behavioral changes (Website of the OnniWay 2019).

OnniWay is an easy, efficient and time saving digital tool for teachers, facilitating children to establish healthy habits, by performing daily micro-actions. OnniWay proposes high-quality digital interventions for promoting holistic education in the classroom. OnniWay's goal is to assist children to create lifelong holistic healthy habits, through fulfilment of the daily micro-actions. OnniWay's objective is to build a tool that can be easily integrated into the school day, without the need for extra preparation or work. OnniWay believes, that small acts, when multiply, can change the world. Creating healthy habits in children and adolescents can lead to positive behavioral change, that may have a significant preventative impact on children's obesity and can help to improve the physical condition of the children as well as their mental health and social interactions (Mulholland 2019).

6.2 OnniWay – Micro-Action Categories

OnniWay differentiate from other digital health solutions available on the market, through use of its holistic approach. OnniWay promotes overall well-being by covering several important areas associated with healthy lifestyle: physical activity, mental health, social and relationships, and nutrition, as demonstrated in the Picture 2. Each category of micro-action is described below:



Picture 2. Micro-Action Categories (Website of the OnniWay 2019)

Physical activity: promoting motion for health and concentration in the classroom. Fighting against the obesity epidemic facing children and adolescents today. Physical activity in the classroom focuses on improving attention, integrating learning and movement and avoiding long static positions.

Mental health: opening the tools within oneself, to reduce mental fatigue, over-stimulation and anxiety, to improve mental health and well-being, promote mindfulness and the capability to cope with environmental stress, cognitive loading etc.

Social and relationships: reconnecting with peers to promote feelings of empathy and thankfulness, and decrease loneliness, bullying and disconnect. Social and relationships micro-actions focus on developing social awareness and social communication skills, promoting a safe environment in the classroom, building community and understanding emotions.

Nutrition: raising awareness about what fuels us, to facilitate development of children's bodies and brains. Nutrition in the classroom promotes understanding on the role of nutrition on health and development, the importance of fluids and healthy snacks (Website of the OnniWay 2019).

Repeatable, simple and easy to perform micro-actions can lead to positive and lasting behavioral change. For example, a micro-action aimed to sit less during the class, can be to imagine that children are in a sporting event, and must stand up and raise their hands every 20 minutes as the teacher raises hands. Another example of a micro-action aimed to promote social interaction, may be to say something nice to a peer. Use of positive words can lead to positive behaviors and empower children to support each other (Ensimmäinen healthy kids-teemasta... 2018).

6.3 OnniWay Benefits from Pupils and Teachers Perspective

The OnniWay mobile application is designed for education professionals, such as teachers, kindergarten teachers and tutors around the world (Ensimmäinen healthy kids-teemasta... 2018). Table 3 describes the following benefits of OnniWay application from both educational specialists and pupil's perspective.

Table 3. OnniWay Benefits from Pupil's and Educational Professionals Perspective (Website of the OnniWay 2019)

OnniWay Benefit	Description
Promoting holistic healthy habits	Focusing on key challenges affecting nowadays children and adolescents.
Time efficient	The program is created with the understanding that the classroom often has limited time and resources. Therefore, simple micro-actions take only 1-5 minutes to perform.
Community focused	Within the application, teachers can share their successes with other professionals worldwide. Moreover, they can share their own studies or findings, as well as communicate with each other.
Teaching practical life skills	The program focuses on empowering children through knowledge combined with practical application of knowledge learnt.
Research based	All micro-actions are created by the group of healthcare professionals, to guarantee evidence-based strategies.

Besides the advantages mentioned above, OnniWay is easy to use; it can be applied as an information source for teachers, as every micro-action comprises theoretical background; an application allows feedback and support. Thus, OnniWay has numerous benefits from both teachers' and students' perspectives, and therefore has great potential for growth and development.

6.4 OnniWay – Practical Implementation and Achievements

OnniWay has been developed as a first commercial product of OnniHabit company in the collaboration with the healthcare professionals. The OnniHabit company is established in Seinäjoki, Finland, with Into Seinäjoki involved as a shareholder in the startup phase. In addition to Into Seinäjoki, OnniHabit's partners include entrepreneurs Kyle Mulholland, Emmi Kangas and Suvi Talvitie. OnniWay's initial target market is the Nordic and English-speaking countries, due to the language of the application. However, the company has already received the first requests from Asia. At the beginning, the application has been tested in schools in Finland (Seinäjoki), Sweden, USA, Namibia and Malaysia. The pilot study incorporated 15 teachers and about 250 children (Ensimmäinen healthy kids-teemasta... 2018).

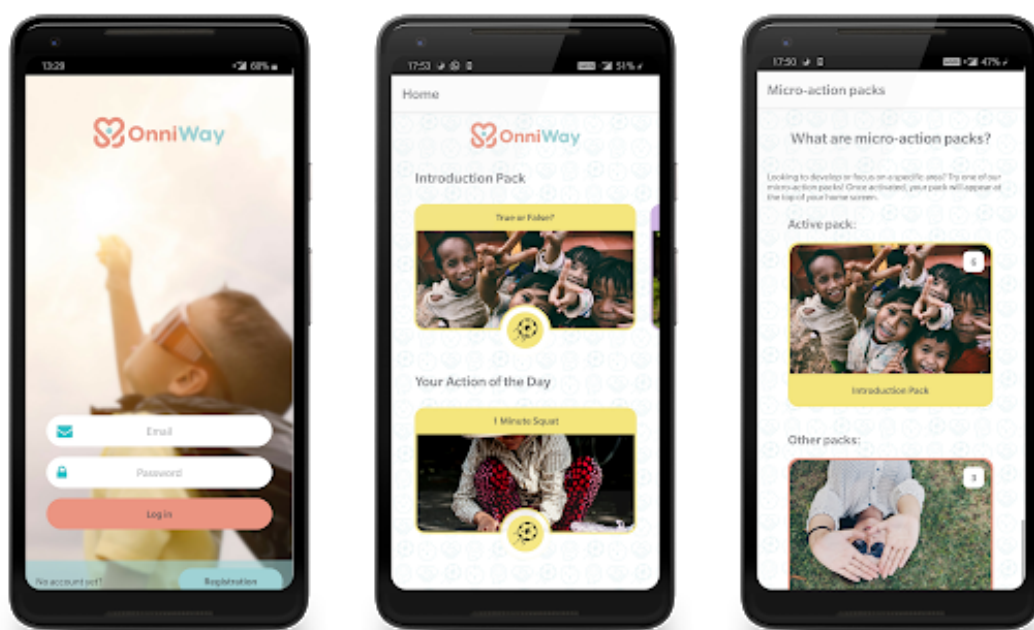
Nowadays, OnniWay is in the development stage, based on the feedback received from the pilot study. The full version of the product will be launched during the year 2020. However, the demo version of OnniWay is already available for download in both Google Play and App Store. Picture 3 demonstrates OnniWay in the App Store, which is compatible with iPhone, iPad and iPod touch.



Picture 3. OnniWay application in App Store (Website of the App Store 2019)

The OnniWay demo version is free of charge. The provider of OnniWay is OnniHabit Oy, the size of the application is 70.2 MB, and the category is education. The application requires iOS 10.0 or later for Apple and 4.4 or up for Android. OnniWay language is English, and the age rating of the users is 4+. The application offers family sharing support, which allows to share one application with up to six family members (Website of the App Store 2019).

Picture 4 presents the home page of OnniWay, which includes the registration and login page, the introduction pack and the action of the day. The introduction package comprises six micro-actions, introducing the basic concept of OnniWay, and is available for all users. In order to access the action of the day, as well as to activate other packages, teachers need to enter their assigned School Identification code, which can be purchased from OnniHabit Oy for a monthly/annual fee (Website of the Google Play 2019).



Picture 4. OnniWay Home Page (Website of the Google Play 2019)

Besides the introduction pack, the OnniWay demo version includes the following packages: Understanding Emotions, Let's Get Moving, Introducing Moments of Mindfulness, D-Licious and A- welcome Vitamins, Creative and Insightful Thinking. Each package contains a short description and the learning outcomes, the focus area of the micro-actions, an average time per task as well as a feedback from other teachers, who have already activated the package (Website of the Google Play 2019).

Nowadays OnniHabit Oy is planning to attract investors and future partners, who are interested in solving global health issues, facing children and adolescents, and willing to invest in a new and scalable digital solution that enhances people's health and well-being. Investors will help to expand the digital service to the larger international market, in order to sell the product as widely as possible around the world. To achieve this,

the product must be translated into the local languages. In the future, the company has an ambition to become a leading provider of the digital services for children's well-being (Helinko 2018).

7 SLEEP WELL – HEALTH PROMOTION PRODUCT FOR ONNIWAY

This section shall outline the process of creating health promotion product, from the inspiration and planning to the practical implementation. The development of the product was based on the theoretical knowledge, latest evidence and needs of the OnniHabit company. The product is called “Sleep Well” and its main intention is to promote sleep hygiene in children.

7.1 Sleep Promotion Product – Inspiration

Today, more than 33% of primary school children have sleep difficulties. Sleep is crucial to children's health and well-being, brain functioning, memory, and learning. Thus, sleep problems in children are the risk factor for developing future health issues, including chronic diseases (Mindell & Owens 2015, 1). Recent studies regarding sleep and primary school aged children have found a connection between sleep problems and children's academic performance, as well as proved the positive effects of the sleep promotion interventions in children's health and well-being (Åslund, Arnberg, Kanstrup & Lekander 2018, 1937; Stormark, Fosse, Pallesen & Hysing 2019, 1). However, there is a lack of practical implementation of the sleep interventions in the primary schools, and public awareness about sleep hygiene is yet insufficient in both adults and children (Cappuccio, Miller & Lockley 2018, 7).

Early intervention is crucial to addressing sleep problems and forming lifelong sleep hygiene habits. The main inspiration for the author to create Sleep Well Pack has become the OnniWay model, which is based on the micro-actions resulting in behavioral change. The pilot version of OnniWay proved positive results in the promoting holistic

wellbeing of children. Likewise, the author is interested in the topic of sleep and health promotion. The product idea to promote sleep within primary schools was supported by the OnniWay, since sleep area was not covered yet by the application and the product aimed to develop practical implementation of the children's sleep promotion.

7.2 Sleep Promotion Product – Planning

The planning process of the Sleep Well Pack was based on the product's aim. The practical implementation of the sleep promotion product was to develop a package, consisting of the product overview and three short micro-actions. The selection of the micro-actions was evidence and experiment based. The steps of the product planning process are described below in the Table 4.

Table 4. Product Planning Process

Stage of the planning process	Description
1.	Getting familiar with the existing similar type of products in the market.
2.	Researching latest evidence associated with the sleep promotion activities for the primary school aged children, including cognitive and behavioral interventions, peaceful mind exercises and relaxation techniques.
3.	Selecting three best bedtime routines for the micro-actions, based on the founded evidence and preference to utilize different types of interventions for better sleep.
4.	Testing the selected micro-actions by the author and four members of her family, in order to convince that they are simple to understand; easy to remember; fast to perform; and efficient in relaxing the mind and body at bedtime.

The final decision-making concerning the micro-actions were made considering the target group of the product: 6-12 years old primary school children. The micro-actions

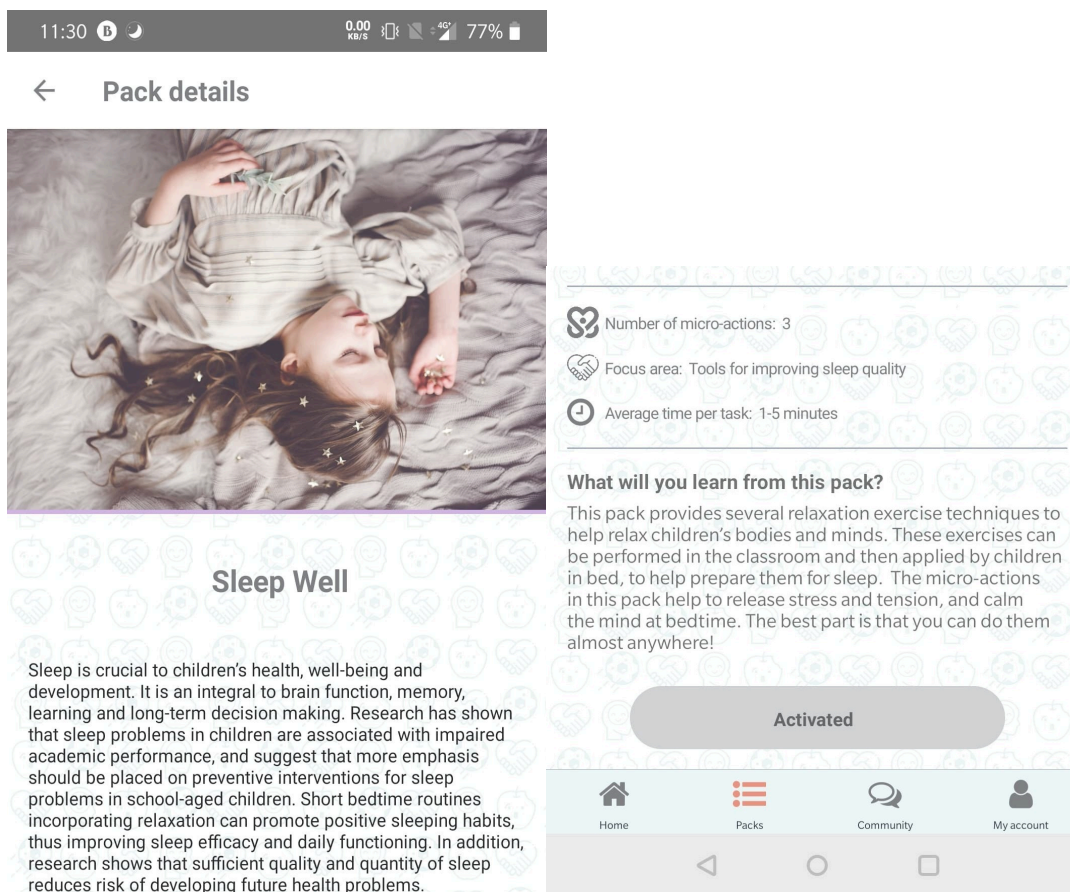
were developed in order to suit the children's learning skills and performing capacities. Likewise, the micro-actions were chosen to easily integrate to the lesson: they are fast to perform and do not require an additional preparation or equipment.

7.3 Sleep Promotion Product – Implementation

The practical implementation of the health promotion product incorporates an overview and main characteristics of the Sleep Well, including illustrations that are aimed to demonstrate product design. This section shall also outline the product feedback received from the OnniWay, and the process of launching the product into the market.

7.3.1 Overview and Objectives

The Sleep Well package provides several exercise techniques to help relax children's bodies and minds at bedtime. The aim of the product is to provide short bedtime routines, that can promote positive sleeping habits, thus improving sleep efficacy and daily functioning of the primary school children. The product includes three micro-actions, and an average time per task is 1-5 minutes. The learning outcomes of the product are to utilize bedtime exercise techniques to release stress and tension and calm the mind at bedtime. These exercises can be performed in the classroom and then applied by children in bed, to help prepare them for sleep. The front page of the Sleep Well package shall provide the primary features and details of the product, and assist teachers make decisions, whether they want to utilize the package in the lessons. When the Sleep Well is activated, the three micro-actions shall be seen. The design of the front page is presented below in the Picture 5.



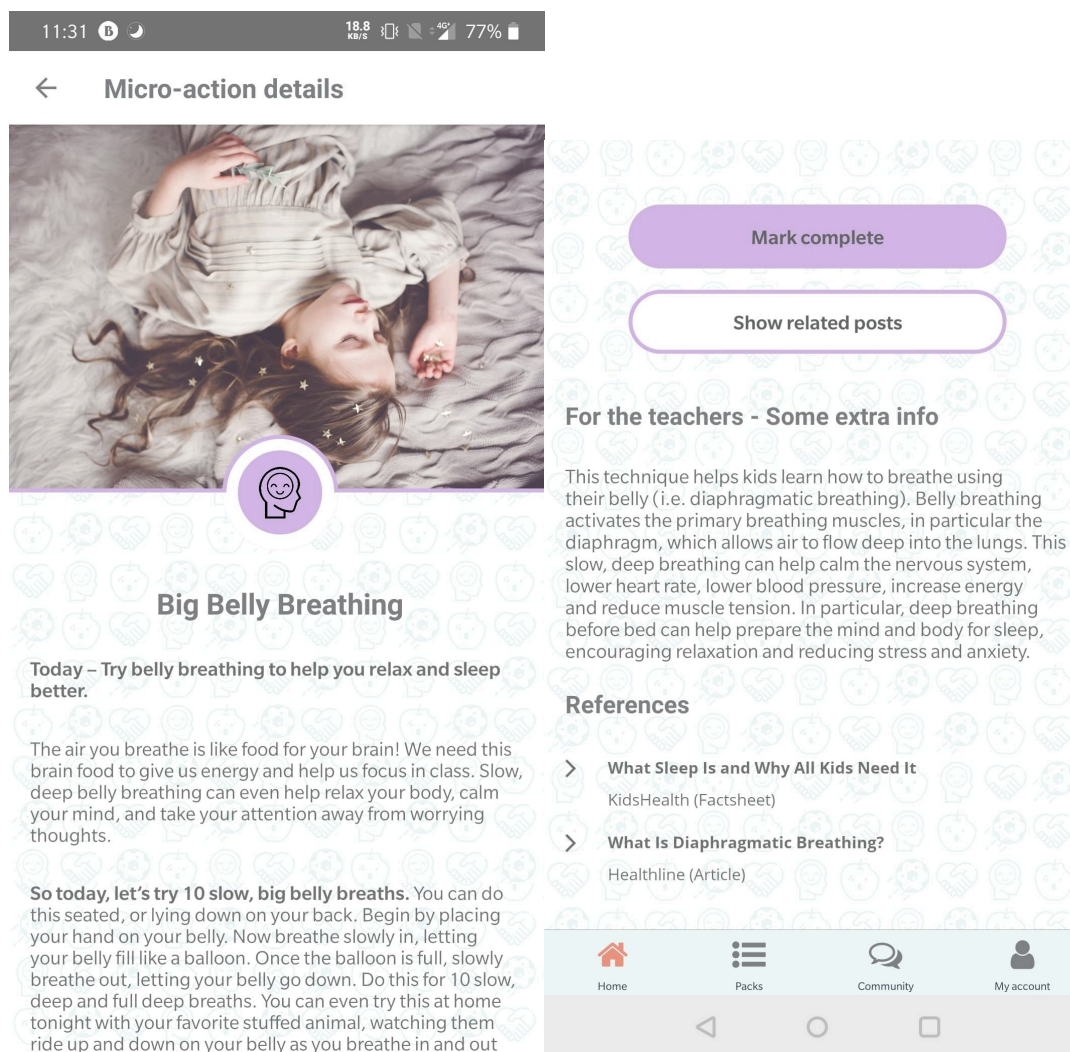
Picture 5. Sleep Well Front Page

7.3.2 Micro-actions

The three micro-actions of the Sleep Well product can be performed in classroom and then applied by children in bed to prepare them for sleep. Every exercise includes a simple explanation regarding the effect of the technique on the body and mind, and how it can help children to sleep better. Micro-actions also contain short instructions on how to perform the exercise. Likewise, they comprise an additional information for the teachers concerning the theoretical background behind the micro-action, and the references. Micro-actions comprise illustrations, intended to assist the performance of the exercise technique.

Micro-action 1: Big Belly Breathing. This exercise helps children learn how to breathe fully using belly, or diaphragmatic, breathing. An exercise is performed by placing a hand on the belly, breathing calmly in and out and feeling how the belly rises and goes down. Belly breathing activates the diaphragm muscle which allows air to flow deep

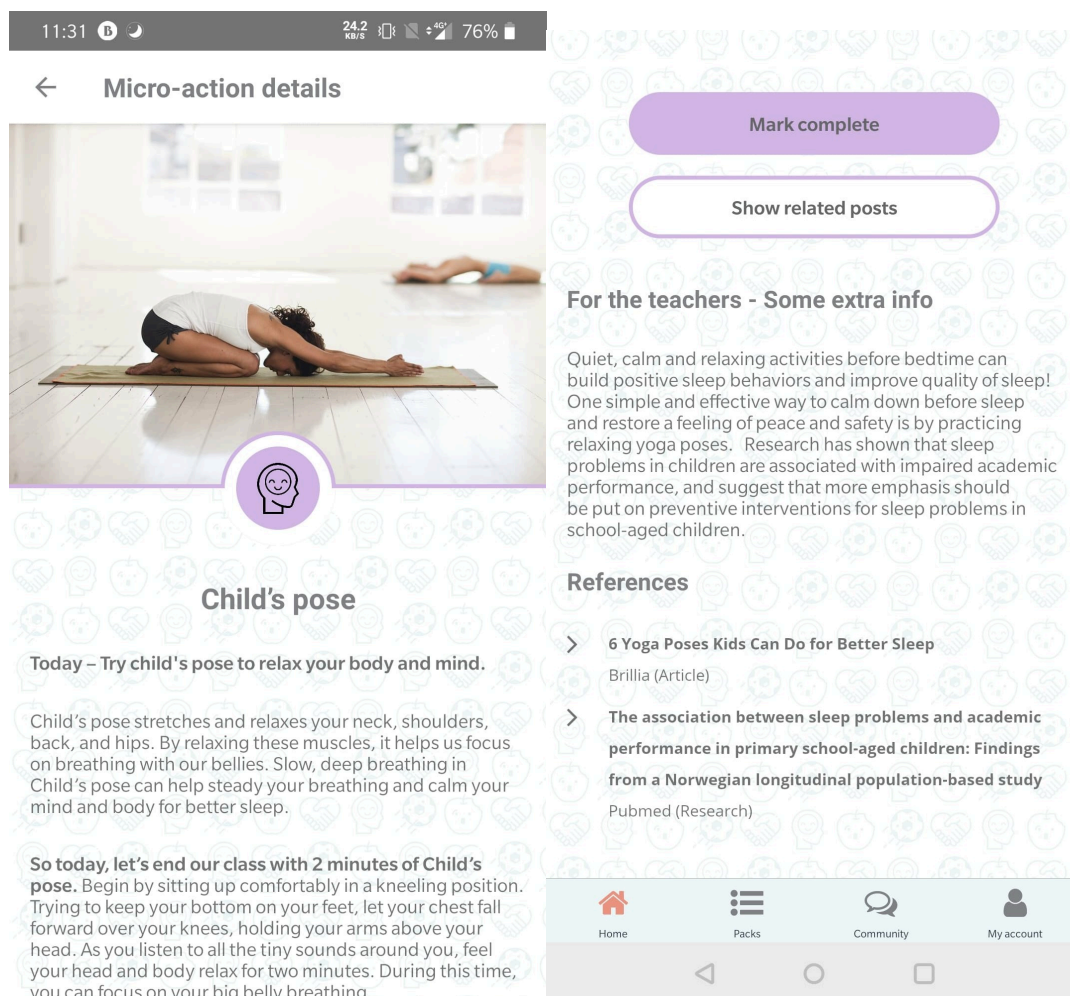
down into the lungs. Deep breathing increases the supply of oxygen to the brain, which promotes brain function and relieves stress and anxiety. Slow, deep belly breathing can help calm the nervous system, lower heart rate, lower blood pressure, increase energy and reduce muscle tension (Jewell 2018, 1-3). Belly breathing before bed can help prepare the mind and body for sleep and encouraging relaxation. Picture 6 demonstrates the first micro-action of the Sleep Well.



Picture 6. Micro-action 1: Big Belly Breathing

Micro-action 2: Child's pose. Quiet, calm and relaxing activities before bedtime can build positive sleep behaviors and improve quality of sleep. Child pose comes from yoga, and the performance of exercise begins from sitting in the kneeling position. The chest is moving forward as close to the knees as possible, and the arms are extended in front. Child's pose stretches and relaxes neck, shoulders, back and hip muscles.

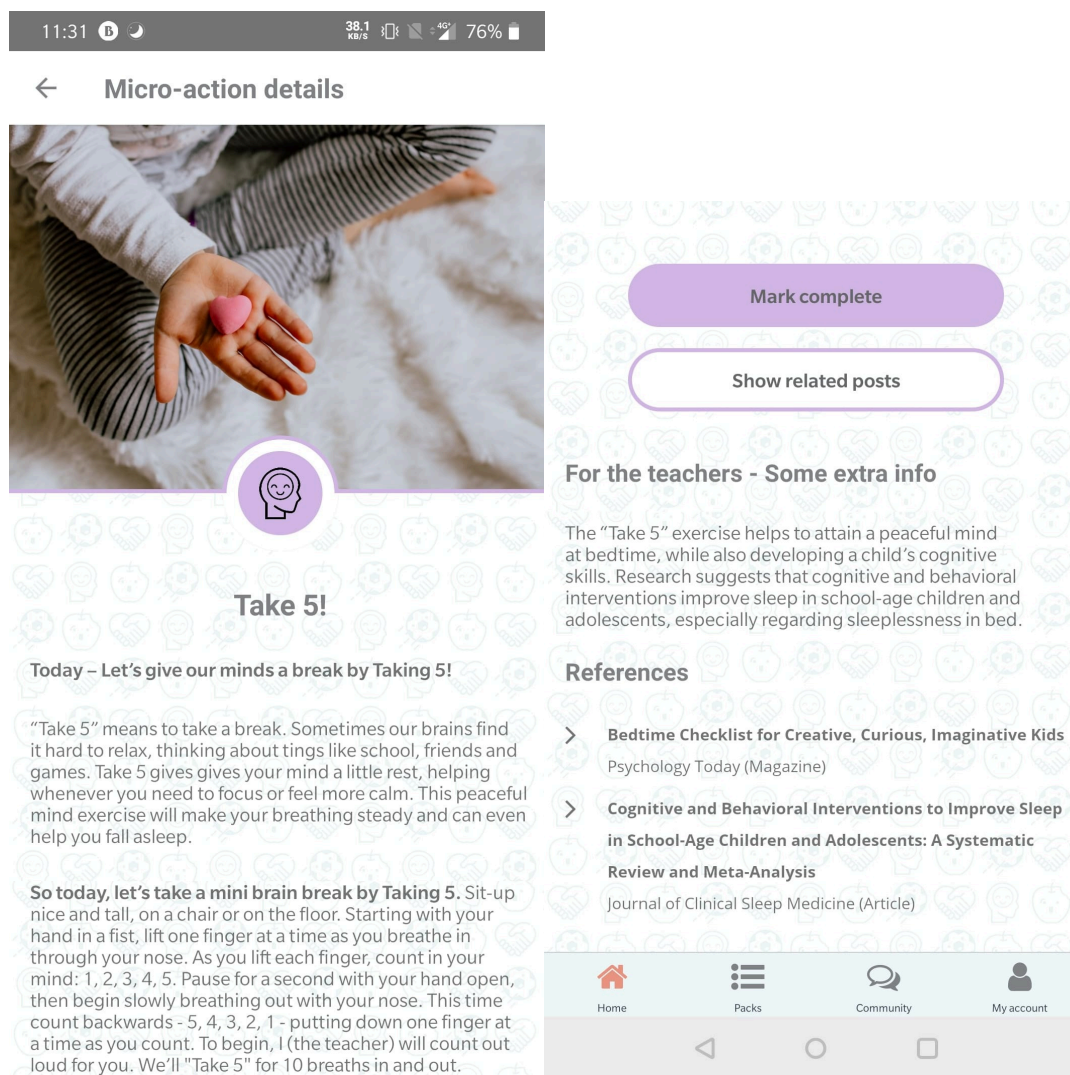
Slow, deep breathing in Child's pose can help calm mind and body for better sleep. Research suggests that practicing relaxing yoga poses at bedtime helps to calm down and restore a feeling of peace and safety before sleep (Ashforth 2018, 1-7; Nelson 2019, 5). Picture 7 presents the design of the second micro-action in OnniWay.



Picture 7. Micro-action 2: Child's pose

Micro-action 3: Take 5! "Take 5" means to take a break. This technique helps to attain a peaceful mind at bedtime, while also developing cognitive skills of the child. The idea of the exercise is to start with the hand in the fist and lift one finger at a time while slowly breathing in through the nose and counting from 1 to 5. After a little pause, the fingers are put down one after another while slowly breathing out through the nose and counting backwards. "Take 5" technique takes attention away from worrying thoughts, steadies the breathing and helps to relax the mind. Based on the research, cognitive

and behavioral interventions improve sleep in school-age children, particularly regarding sleeplessness in bed (Åslund, Arnberg, Kanstrup & Lekander 2018, 1937; Matthews 2016, 1-5). The third micro-action of the Sleep Well can be found on the Picture 8.



Picture 8. Micro-action 3: Take 5!

7.3.3 Realization and Feedback

Sleep Well package was initially created by the author as a Word document and sent to the OnniHabit company for evaluation. Little text adjustments were performed based on the feedback received from OnniWay. The choice of illustrations was modified to meet the criteria to be officially used in the commercial product. When the final

version of the product was ready, it was launched into the market as a package inside the OnniWay application. At the moment Sleep Well product can be activated by users free of charge. OnniWay is planning to enlarge Sleep Well in the future by adding more micro-actions in order to keep the users engaged.

The product feedback was provided by Kyle Mulholland on behalf of the OnniHabit company through the verbal form. An overall feedback was very positive. It was commented that *“the name of the product sounds really good. The three actions look really great. The language is good”*. It was mentioned that some words might be a little difficult for children to understand. The author agreed with this as English is not her native language and she does not have enough experience communicating in English with the children. The needed wording adjustments were performed to satisfy this comment. Likewise, it was noted that *“the teacher’s part is really good”*.

8 THESIS PROCESS AND METHODS

The thesis process of this study has been one year long, starting from the thesis idea and ending by the final work presentation. Figure 4 demonstrates the main schedule of the process, and the detailed description of each step is presented below.

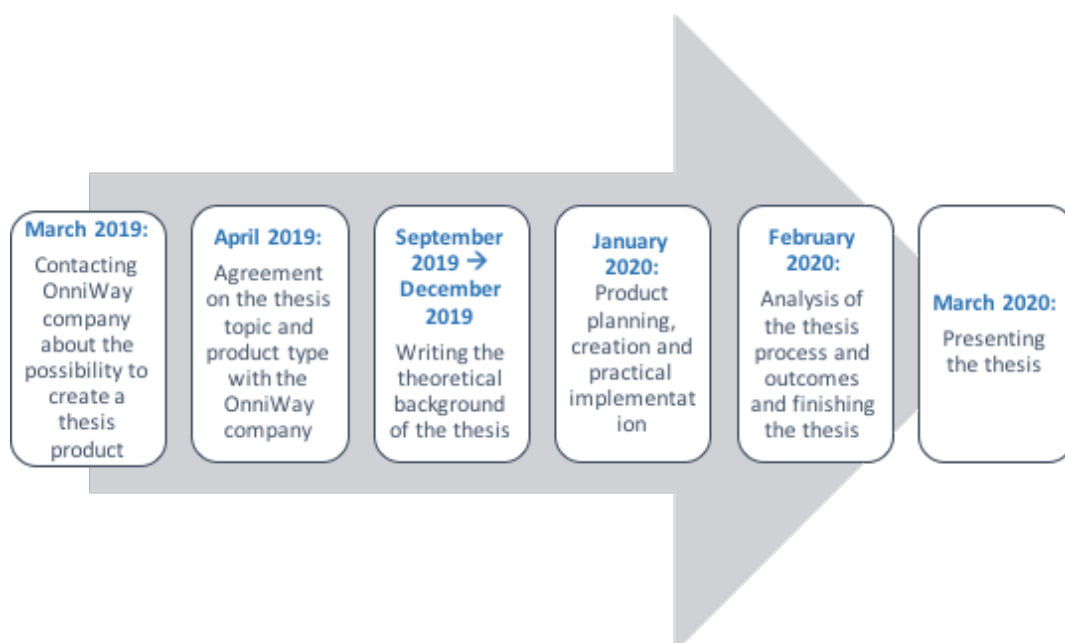


Figure 4. Thesis process

The thesis idea appeared in March 2019, when Kyle Mulholland has presented OnniWay at SAMK. The concept of the application attracted the author's attention, since the author is interested to work in the pediatric physiotherapy area, perhaps as a physiotherapist at school. Moreover, healthy lifestyle promotion has always been important for the author. The discussion with Kyle Mulholland lead to the first meeting, where Kyle Mulholland has introduced more deeply the OnniWay concept, current condition and developmental plan.

Thesis idea of promoting sleep was inspired by author's personal experience of how much sleep influences on overall well-being and particularly learning skills and supported by OnniWay as an important area that has not yet been covered by the application. The company and the author of the thesis saw a valuable opportunity for the cooperation. OnniWay believed physiotherapy student could implement sleep hygiene promotion within primary schools by creating a product, and in the middle of April 2019 thesis topic and the product type were agreed.

During the summer 2019, author familiarized with the topic-related knowledge and collecting literature for the theoretical frame of the thesis. From September to December 2019, most of the theoretical section of the thesis was written. Thesis plan was made and presented to the mentoring teachers and classmates on the 5th of November 2019. Thereupon, from the middle of December 2019 till the middle January 2020, the practical section of the thesis was planned and implemented, including the collection of the data and illustrations for the product and creation of the product design. The product was delivered to the company on the 17th of January for evaluation. On the 21st of February the final version of the product has been released to the market.

This study is considered as a practice-based thesis. This method is applied to the studies searching new knowledge through practice and its outcomes. Practice-based thesis is a recognized methodology in medicine, engineering and design (Skains 2018, 82-86). A practice-based thesis comprises the definition of the research question or problem and the selection of the corresponding research methods. The decision-making during the thesis process is based on the experimental and development-oriented approach. A practice-based thesis is created for the needs of the company or workplace,

and aims to develop practical activities, such as modernization, improvement of effectiveness, providing the instructions.

A practice-based thesis comprises both theoretical and practical parts. The theoretical part emphasis on the theoretical background of the research question or problem, and the outcomes of the practical part and their evaluation. The practical part is concentrating on the practical implementation of the thesis, which can be e.g. an electronic material, a guide, development plan or planning and implementation of the project, event, exhibition or specific product (Häme University of Applied Sciences 2018, 7-9).

Guidelines for the practice-based thesis include instructions concerning the introduction, the goal and purpose of the thesis, the evidence-based foundation, planning and realization of the project, product or an output, conclusion and reflection. The practical implementation of the thesis such as a finished project or product is often more important for the client than the entire thesis. However, the report always includes the documentation of the whole thesis process leading to the output, comprising the text body of the thesis and the appendices (Website of the Satakunta University of Applied Sciences 2019).

9 DISCUSSION

The whole process of creating sleep promotion product has been a highly valuable learning experience. During this process, the author gained an essential theoretical and practical knowledge related to sleep hygiene and relaxation techniques for improving children's sleep. The aim of the thesis to promote sleep health within primary school children in the collaboration with the OnniWay has been successfully achieved. The author appreciates that the thesis product is already available for the users and ready to be tested. The fact that the OnniWay is planning to continue developing Sleep Well indicates that the company believes in the relevance and demand for the product.

The timeline of the thesis was successfully completed, as there were no significant deviations in the working process. The interaction between the author and the OnniHabit company was smooth and respectful. The OnniHabit company provided all the needed information for the thesis author. The author has created the thesis product in the agreed time, and the company has managed to release it in the application before the thesis was completed.

The product of the thesis comprises three different bedtime routines to improve sleep by establishing long-lasting healthy sleep habits, and is implemented as a package within the OnniWay application. However, the topic of sleep hygiene is broader and contains other sleep recommendations, which cannot be included into three 1-5 minutes long micro-actions. Those guidelines were incorporated into the product in the teacher's additional information section. The author believes that teachers could educate children about other aspects of sleep hygiene, if there is a demand and enough human and time resources. Moreover, as it was mentioned above, OnniWay is planning to expand Sleep Well product by supplementing new micro-actions, that will disclose the promotion of other features of sleep hygiene.

Another limitation of the thesis is related to the product testing. As it was mentioned above, nowadays the application is in the development stage. The demo version of the OnniWay is accessible on the market, however, the application is not widely applied in schools until the full version is released. Therefore, it was not possible to evaluate the effects of the interventions on children's sleep and assess, whether children developed the long-lasting healthy sleep habits. This research could be a development idea for the further bachelor's thesis topic.

Moreover, the author would recommend next students to continue implementing a practice-based research in the area of sleep promotion within children, in order to apply existing theoretical knowledge concerning sleep into practice, as today there is a substantial gap between scientific studies in this field and their practical fulfillment. As an idea for the practical implementation of the future study or bachelor's thesis, the lesson material about different aspects of sleep hygiene could be created for the teachers. Alternatively, next writer could emphasize the thesis on educating parents about the importance of proper sleep of their child. As a practical part, educational workshop

or information brochure could be created, since today's awareness about this topic is still insufficient in adults, which has a great influence on children.

Overall, author believes that the whole thesis process gave her a beneficial foundation for further professional development, as she is planning to work in the pediatric field of physiotherapy, and sleep has a great impact on the health and well-being of the children. Thus, the author believes to continue implementing the promotion of sleep hygiene in her future career by utilizing the gained knowledge and skills into practice.

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