University of South-Eastern Norway
Faculty of Humanities, Sports, and Educational Science

Doctoral dissertation no. 149
2023

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Classroom-based physical activity as a means to promote health, well-being and learning in school

A study on health changes and students' and teachers' perspectives in secondary school

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A PhD dissertation in
Person-Centered Health Care

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Faculty of Humanities, Sports, and Educational Science
University of South-Eastern Norway
Bø, 2023

Doctoral dissertations at the University of South-Eastern Norway no. 149

ISSN: 2535-5244 (print)
ISSN: 2535-5252 (online)

ISBN: 978-82-7206-739-6 (print)
ISBN: 978-82-7206-740-2 (online)

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Print: University of South-Eastern Norway
Cover photo: Kristine Mellefoss, Vestfold and Telemark County Municipality

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Preface and acknowledgements

This thesis builds on research from 2017-2021 with its base in the research unit Health & Exercise - a Life-course Perspective (HELP), at the Department of Sports, Physical Education and Outdoor Studies, University of South-Eastern Norway.

The research was made possible through collaboration with Jorunn, Kjersti and Guro of the Vestfold and Telemark County Council Health Department, and the financial support from Sparebankstiftelsen Sparebanken Sør. Thank you for your support and collaboration. Importantly, a special thanks to all the schools, principals, teachers, students and parents that have been part of the project.

I would like to thank all the colleagues and master's students who contributed to the research project and especially my supervisors Solfrid Bratland-Sanda and Rob Bongaardt. Although I did not choose you myself, I do not believe I could have had a better supervisory team. I feel truly fortunate.

Finally, thank you Anders Steen for all your support and encouragement in the process.

Sabrina Krogh Schmidt

Bø i Telemark, September 2022

List of articles

Article 1

Schmidt, S. K., Reinboth, M. S., Resaland, G. K., Bratland-Sanda, S. (2020). Changes in physical activity, physical fitness and well-being following a school-based health promotion program in a Norwegian region with poor public health profile: A non-randomized controlled study in early adolescents. *International Journal of Environmental Research and Public Health, 17*(3), 896. https://doi.org/10.3390/ijerph17030896 (Published 31 January, 2020)

Article 2

Schmidt, S. K., Bratland-Sanda, S., Bongaardt, R. (2022). Young adolescents' lived experience with teacher-led classroom-based physical activity: A phenomenological study. *Teaching and Teacher Education*, *116*, 103777. https://doi.org/10.1016/j.tate.2022.103777 (Published 19 May 2022)

Article 3

Schmidt, S. K., Bratland-Sanda, S., Bongaardt, R. (2022). Secondary school teachers' experiences with classroom-based physically active learning: "I'm excited, but it's really hard". *Teaching and Teacher Education*, *116*, 103753. https://doi.org/10.1016/j.tate.2022.103753 (Published 17 May 2022)

List of appendices

Abstract

Background: Schools have been identified as a key setting for promoting physical activity. The relation of physical activity to cognitive function and academic achievement in primary school has received considerable attention. Less focus has been given to the secondary school setting and students' psychosocial well-being. The aim of this Ph.D. study was to explore how students' health and well-being are influenced when classroom-based physical activity is implemented into curriculum teaching. The thesis examines how this affects physical activity levels, physical fitness and well-being, and explores students' and teachers' experiences of classroom-based physical activity with a focus on psychosocial well-being.

Method: The study was conducted in two phases. 1) Changes in student levels were assessed using a quasi-experimental design with pre/post-tests of physical activity levels, BMI and questionnaires on health-related quality of life and vitality (well-being) on 644 students in 8th grade. 2) Student and teacher lived experiences of the classroom-based physical activity were explored through a descriptive phenomenological study using in-depth individual interviews with nine students and six teachers.

Results: Nine months after implementing classroom-based physical activity, students at intervention schools had improved their physical fitness and were more physically active in school time than students at control schools. Further, in female students, there was a greater positive difference in health-related quality of life outcomes. The students' shared experiences were that classroom-based physical activity was a valued and meaningful movement activity that improved their psychosocial well-being at school. The teachers' shared experiences were that classroom-based physical activity was relevant, yet more complex than expected, in secondary school settings. This experience resulted in the loss of motivation and resorting to simpler solutions with a potential loss of the coherence of the approach.

Conclusion: Classroom-based physical activity can benefit students' health and well-being mostly by counteracting an expected reduction. Especially female students seemed to benefit from the initiative by reporting more stable levels of psychosocial health and well-being. While students in general support and welcome classroom-based physical activity, some found the competitive focus demanding. Teachers seem to struggle to implement and apply the approach in a regular and meaningful way that supports the implementation of more physical activity and academic learning objectives. Support and focus on teachers' professional development are critical for physically active learning to become a regular part of subject teaching in secondary school.

Keywords: school-based physical activity, classroom-based physical activity, physically active learning, physical activity breaks, secondary school, physical activity, psychosocial well-being, students' perspective, teachers' perspective.

Abbreviations

These abbreviations are used in the manuscript.

PAL	Physically active learning
PA breaks	Physical activity breaks
BMI	Body mass index
MVPA	Moderate to vigorous physical activity
CRF	Cardiorespiratory fitness
WHO	World Health Organization
USN	University of South-Eastern Norway
NSD	Norwegian Centre for Research Data

1 Introduction and presentation of the thesis

This document presents my PhD work. The thesis is based on three articles utilizing empirical data collected in three separate studies to gain specific knowledge about classroom-based physical activity in secondary school.

The vast amount of research on classroom-based physical activity has focused on the relation between physical activity, cognitive functioning and academic performance (Erwin et al., 2012; Mavilidi et al., 2021; Norris et al., 2019; Rollo et al., 2019; Watson et al., 2017) and overall mostly focused on primary school settings, leaving a knowledge gap for secondary schools (Norris et al., 2019; Watson et al., 2017). Specific reviews of classroom-based physical activity with academic content have shown it to be effective in improving students' physical activity levels (Martin & Murtagh, 2017b; Norris et al., 2019; Vetter et al., 2020), improving time-on-task (Daly-Smith et al., 2018), slightly improving educational outcomes (Bedard et al., 2019; Norris et al., 2019) and showing a positive effect on student enjoyment (Bedard et al., 2019). A recent review shows that physical activity breaks performed during a lesson without academic content may have a facilitating effect on students' physical activity levels and enhance time-on-task (Masini et al., 2020).

However, classroom-based physical activity and other activities with the body in focus also hold the potential to benefit students' psychosocial well-being (Biddle et al., 2019; Mavilidi et al., 2021; Pedersen et al., 2016). There has been less research focus on the improvement of psychosocial health and well-being. It is argued that the experience of physical activity is important for well-being, and that positive experiences of physical activity can create a virtuous cycle and improve self-concept and especially well-being (Bailey et al., 2013). At the same time, negative experiences can also transform the relationship into a vicious cycle in which the person becomes more and more disaffected with physical activity (Bailey et al., 2013). The way physical activity is experienced is therefore a key factor. Student experiences of classroom-based physical activity are thus of importance for both their health and well-being.

There are several examples of research on primary school students' experience of classroom-based physical activity (Dyrstad et al., 2018; Holt et al., 2019; Ingulfsvann, 2018; Marchant et al., 2019; Martin & Murtagh, 2015; Martin & Murtagh, 2017a; McMullen et al., 2019; Van den Berg et al., 2018). Young adolescents in secondary school have been less researched and are almost non-existent in the available literature, there are also important knowledge gaps concerning the secondary school teachers' experiences and perspectives. This, together with the vast amount of researcher-driven studies in contrast to user-driven studies that might have a better external validity, calls for studies that cover these aspects.

This PhD research was linked to a school-based health promotion research project called the Active and Healthy Kids Program. The program was developed and implemented by the former Telemark County Council Health Department (now Vestfold and Telemark County Council), where the University of South-Eastern Norway (USN) has been a partner by researching and evaluating the implementation of the program. A key driver for my entire thesis has been to conduct research on people, students and teachers, in context and the school as setting, with a health promotion perspective. I evaluate the health promotion initiative by focusing on the people involved, i.e. students and teachers, in the context of their daily studies and work at the school.

By exploring possible changes in student health and well-being following more school-based physical activity and how students and teachers experience classroom-based physical activity, the thesis will make a substantial contributes to the field of classroom-based physical activity in secondary school.

Figure 1 below provides an illustrated overview of my research process on a timeline. Articles are placed at the month they were finished and submitted to a research journal.

Figure 1

An overview of my research process, data collection and time of submission for peer review.

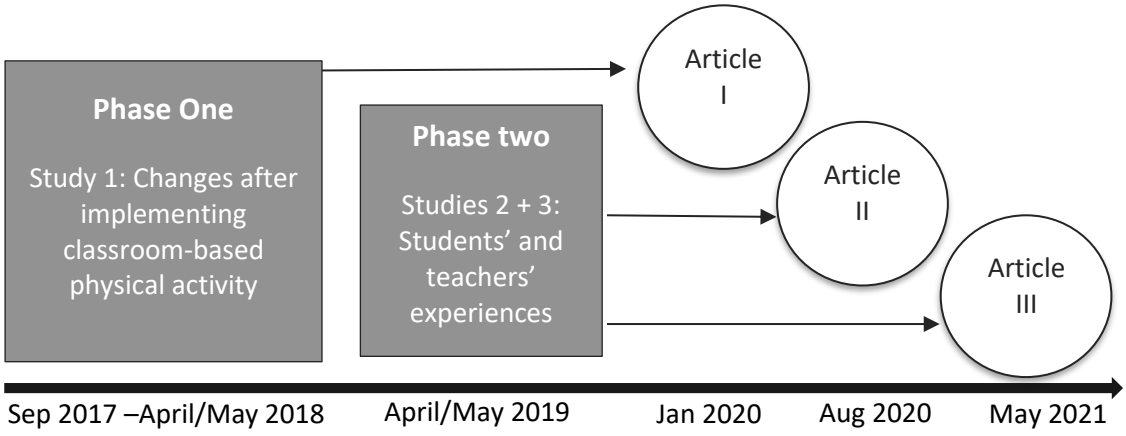


Table 1 provides an overview of the three empirical studies included in this thesis. As the first author of all the articles, I had the primary responsibility for all the data collection and analysis. I joined the research project and started in my position as a PhD candidate in February 2018. Pre-tests for Study 1 had then already been performed by the research group evaluating the Active and Healthy Kids Program on behalf of Telemark County Council. For the post-test I was responsible for data collection and selected data analyzed and included in Study 1.

Table 1

An overview of the three studies included in the thesis

	Phase one	Phase two	
Studies	Study 1: Changes after implementing classroom-based physical activity	Study 2: Student experiences of teacher-led classroom-based physical activity	Study 3: Teacher experiences of classroom-based physical activity with focus on physically active learning
Setting	15 schools in Telemark County, Norway	Two schools enrolled in the Active and Healthy Kids Program	Two schools enrolled in Active and Healthy Kids Program
Period	Sep 2017-April 2018	March 2019	April 2019
Methods and volume	Quasi-experimental design with pre/post testing of 644 students. Six intervention and nine control schools	Observations of physically active learning activities Nine in-depth interviews with students	Observations of physically active learning activities Six qualitative in-depth interviews with teachers
Target group	Students in 8th grade in school year 2017/2018	Students in intervention schools who took part in Study 1	Teachers in intervention schools from Study 1 with experience of teaching physically active learning
Focus	Changes in physical activity, physical fitness and well-being	Students' lived experience of classroom-based physical activity	Teachers' lived experience of adopting and teaching physically active learning
Article	I	II	III

1.1 Outline of the thesis

This thesis starts with a short introduction and then moves on to the theoretical framework and previous research, which set the scene for the research questions. A method section follows, outlining the methods used and some methodological considerations. The results section presents results from the three articles individually. The discussion section presents methodological reflections and highlights strengths and limitations of the research. Further, a synthesis of the main findings is discussed in relation to findings from previous studies structured around a socio-ecological model, followed by practice implications and recommendation for future research. In the conclusion, the main findings of the thesis are summed up.

2 Theoretical background and previous research

2.1 Health and physical activity

Besides the pandemic of the COVID-19 infectious disease, one of the biggest threats to general public health in the Western Hemisphere is the consequences of an unhealthy lifestyle (World Health Organization, 2009). Lifestyle-related health risk factors such as overweight, poor dietary habits and physical inactivity are among our greatest health challenges (Blair, 2009; Candari et al., 2017; Lee et al., 2012; Wing et al., 2001). In Norway 90% of the disease burden is dominated by non-communicable diseases (Norwegian Institute of Public Health, 2018b). Modern lifestyle has unintentionally created a mismatch between human evolutionary history and the current environment we have adapted with serious consequences (Gluckman & Hanson, 2008).

Health can be a complex concept and has had different definitions through time. Health today, as defined by the World Health Organization (WHO), is closely linked to the idea of a "healthy mind in a healthy body", and is described as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". According to the Ottawa Charter, health promotion is the process of enabling individuals and communities to increase control over the determinants of health, thereby improving their health to live an active and a productive life. Health is viewed as a positive concept emphasizing social and personal resources, as well as physical capabilities (World Health Organization, 1984). There is a close relation between health and well-being, as stated in the WHO definition of health. Well-being is a broad and complex term (Dodge et al., 2012). Common to ways of defining, understanding and measuring well-being is that it covers aspects of positive emotions and moods, the absence of negative emotions, satisfaction with life, fulfillment and positive functioning (CDC, 2021; Pedersen et al., 2016). Ultimately, what is good for a person, meaning the degree of functioning and degree of thriving in everyday life, covers physical, social and emotional aspects (Pressman et al., 2013). These definitions and aspects have formed the basis for the understanding of health and well-being in this thesis.

Insufficient physical activity is a leading risk factor for non-communicable diseases, and has a negative effect on mental health and quality of life (Guthold et al., 2018; World Health Organization, 2020). It is increasing worldwide, particularly prevalent and rising in high-income countries where women are less active than men (Guthold et al., 2018). General physical activity to promote public health is on the agenda on a world basis. The WHO states that failure to act to increase levels of physical activity will see related costs continue to rise, with negative impacts on health care systems, the environment, economic development, community well-being and quality of life (World Health Organization, 2018). Low physical activity levels are a threat to public health in Norway and internationally (Blair, 2009; Bull et al., 2020).

2.2 Adolescents and physical activity

For adolescents, physical activity is associated with a multitude of health benefits (such as physical fitness, cardiometabolic health, bone health and reduced adiposity (World Health Organization, 2020) and is further widely recognized as an important determinant of their psychosocial health and well-being (Biddle & Asare, 2011; Lubans et al., 2010; Penedo & Dahn, 2005). Adolescent well-being has been defined as adolescents who thrive and are able to achieve their full potential (Ross et al., 2020). Psychosocial health and well-being have been described as a wider term for mental, emotional and social well-being connected to experience and quality of life (Burns, 2017). Psychosocial health and well-being are important because it affects young people's ability and motivation to learn throughout life and to utilize cognitive, social and emotional skills in a positive way in the right settings.

Despite the health benefits related to physical activity, a significant number of adolescents in Norway and other Western countries do not reach the recommended minimum level of 60 minutes of daily moderate-to-vigorous physical activity (MVPA) (Bull et al., 2020; Steene-Johannessen et al., 2019). In 2020, this recommendation was updated, stating that adolescents should do at least an average of 60 min/day of MVPA across the week (Bull et al., 2020). Physical activity levels decline significantly in the transition from childhood to adolescence (Dumith et al., 2011; Guthold et al., 2020). This

trend is also seen in Norway, where only around half of Norwegian 15-year-olds adhere to the global guidelines (Steene-Johannessen et al., 2019). Research also shows that adolescence boys are more active than girls, which is a trend seen both internationally and in Norway (Riddoch et al., 2003; Steene-Johannessen et al., 2019).

Physical activity and other healthful behaviors are learned and developed in childhood and adolescence, tracking into adulthood (Hinkley & Salmon, 2011; Telama et al., 2005). This phase of life is therefore especially important in terms of policy measures to develop long-term public health benefits, and efforts towards effective policies, research and health promotion programs to increase young people's physical activity levels.

2.3 An ecological perspective on health promotion

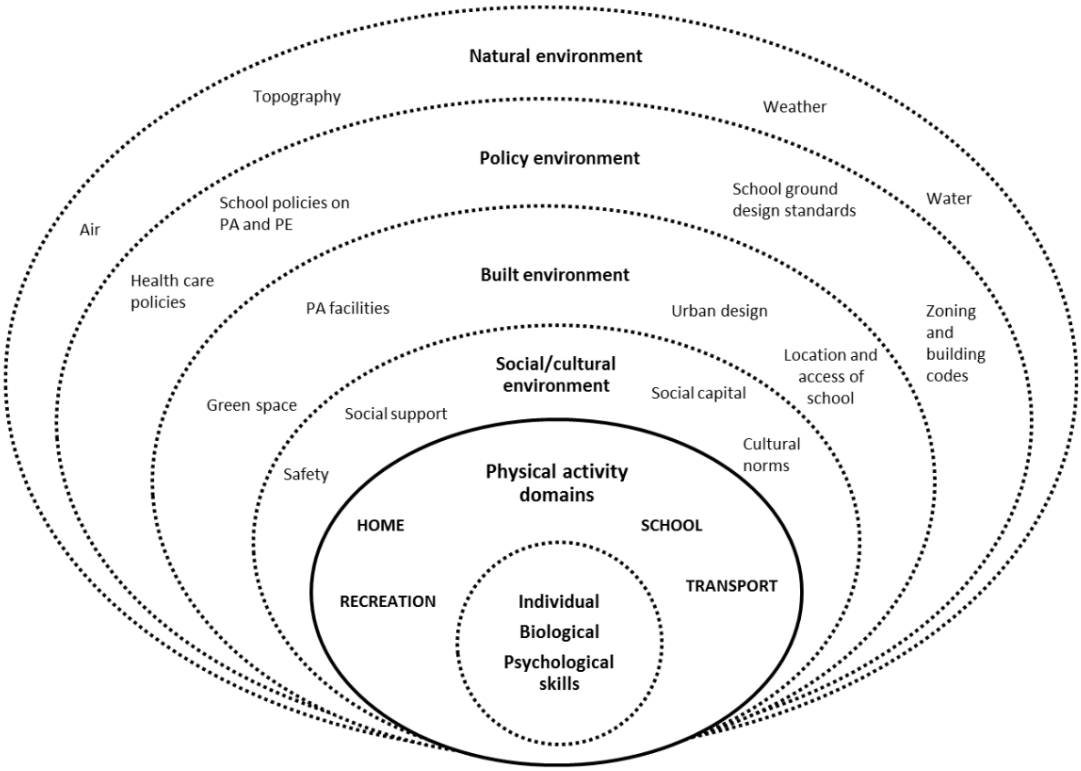
Social-ecological health promotion for adolescents has become more prominent (Wold & Mittelmark, 2018). Research has shifted from focusing on the individual's responsibility to make healthy lifestyle choices to also focus on the environment and community, reflecting an ecological perspective that individuals are affected by several layers of influencing factors (Okan et al., 2019; Stokols, 1996). Macro systems, such as policies, have moved up on the health promotion agenda. Experts explicitly recommend that interventions on social and behavioral factors related to health should focus on the lifespan perspective and link multiple levels of influence, including the individual, interpersonal, institutional, community and policy levels (Okan et al., 2019; Smedley & Syme, 2001). In accordance with the system-based approach to health promotion, the WHO is advocating for policy actions to increase physical activity at all levels (World Health Organization, 2018).

The socio-ecological model of Bronfenbrenner (1977), developed and adapted to the health perspective by Sallis et al. (2006), underscores that the whole ecological system needs to be taken into account for effective health promotion (Sallis et al., 2006). The purposes of the social-ecological model are both to understand the broad range of agency and contextual factors contributing to a person's health behavior, and to take

these into account when designing interventions. The model particularly address the complex interconnections of behavioral change between people and their environment. The socio-ecological model by Sallis et al. (2006) provides a framework to help identify multiple layers and factors that can influence physical activity/active living, shown in Figure 2.

Figure 2

The socio-ecological model with four domains of physical activity. Adapted from Sallis et al. (2006), reprinted with permission from Pawlowski (2016).



The model shown operates with four different domains of physical activity: Home, School, Recreation and Transport. It emphasizes that behavior is influenced by a range of determinants: intrapersonal (individual factors), interpersonal (social/cultural environment), built environment, and policy. These influence each other and physical activity in each of the four physical activity domains. Thus, the environment can affect our experience, motivation, and our opportunities to move, and thus hinder physical activity (Sallis et al., 2006; Stokols, 1996). The policy levels are described as a higher-

level process that has strong influence on lower levels of the model, where school health policies can “trickle down” into schools (Langille & Rodgers, 2010; Wold & Mittelmark, 2018).

The socio-ecological model is an oversimplification of the system it is meant to represent (Wold & Mittelmark, 2018). However, it is recognized as an effective way to organize empirical findings for a problem-driven approach to change behavior (Eldredge et al., 2016). It has been applied in several school-based physical activity studies as a tool in the development of programs/interventions or as a framework for the analysis or discussion and to organize the results (McMullen et al., 2019; Jørgensen & Troelsen, 2017; Koch, Troelsen et al., 2021; Langille & Rodgers, 2010; Pawlowski, 2016; Webster et al., 2020).

2.4 School-based solutions to increase physical activity

As shown in the socio-ecological model, the school represents an important domain for physical activity. In general, schools have been identified and recognized as a key setting for promoting physical activity among adolescents internationally and in Norway (Norwegian Directorate of Health, 2019; World Health Organization, 2018) and there is a growing political interest in developing and implementing more opportunities for physical activity in schools to increase physical activity levels among youth across the world. Adolescents spend a substantial amount of their waking hours at school, mainly in sedentary behavior. Targeting schools has the potential to reach all students irrespective of social and cultural background, which can reduce social inequality in health (Dobbins et al., 2013; Reis et al., 2016). Overall, schools are an ideal environment for population-based health interventions involving physical activity, as no other institution has as much influence on children and adolescents in the early part of their lives (Naylor & McKay, 2009; Story et al., 2009).

In order to apply such a system-based approach to increase physical activity levels among school-aged children and youth, various strategies and models have been sought, tested, researched and implemented. Examples of these are to encourage and

facilitate active transportation to and from school (Schönbach et al., 2020), to increase recess physical activity (Ridgers et al., 2012), to increase the number of physical education lessons (Lonsdale et al., 2013) and to integrate physical activity into subject lessons (Watson et al., 2017).

School-based physical activity is often accompanied by arguments for its positive relationship with students' learning, well-being and health. These can each be seen as a positive outcome of school-based physical activity, although they are often interconnected, one building on the other. The positive relationship between physical activity and health is well established (Hallal et al., 2006; Warburton et al., 2006). As mentioned above, a person's health is closely linked to well-being. An association has been found between physical activity and mental health and well-being, reflecting well-being as both the absence of problems and the degree of functioning in everyday life (Bailey et al., 2013; Pedersen et al., 2016). Also, an important domain for adolescents' well-being is learning, competence, education and skills (Ross et al., 2020), and physical activity environments that provide positive experiences of the adolescents' own competence, relations to others, and a sense of autonomy, increase well-being and motivation (Hagger et al., 2005; Hagger et al., 2003; Pelletier et al., 2001; Standage et al., 2003; Standage & Treasure, 2002). Health is also related to learning, where physical fitness is strongly correlated with cognition (Åberg et al., 2009). Learning is a wide concept and complex phenomenon; in the context of school-based physical activity the focus on learning is often related to cognitive functioning and learning processes and how these relate to academic performance. A clear consensus exists about a connection between physical activity and learning, with both an acute and lasting positive effect on cognitive functioning (Erickson et al., 2011; Kashihara et al., 2009). The greatest effect in school-based physical activity is seen in executive functioning (work memory, self-control, and cognitive flexibility) but an effect is also seen in educational outcomes and facilitators of learning, further described as student enjoyment, teacher approval, and on-task behavior (Fedewa & Ahn, 2011; Kramer & Erickson, 2007; Sibley & Etnier, 2003). Learning and feeling competent can increase well-being and motivation (Gutman & Vorhaus, 2012; Ryan & Deci, 2017). Overall, psychosocial health and well-being are

building blocks in adolescents' learning and development outcomes in school (Ommundsen, 2018).

2.4.1 Classroom-based physical activity

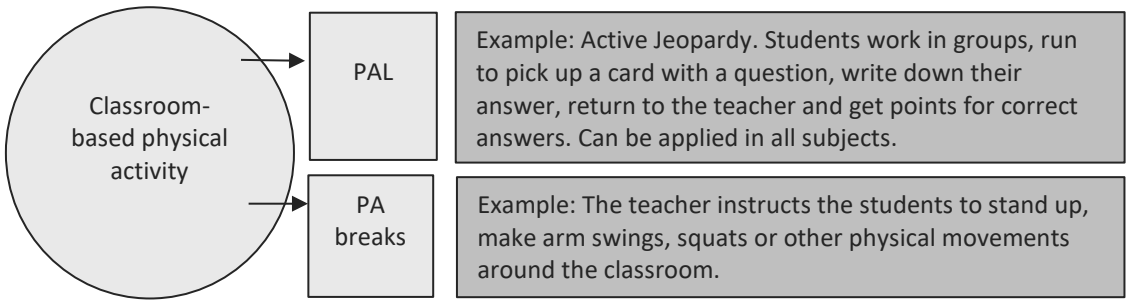
The strategy of integrating physical activity into academic classroom lessons, defined as *classroom-based physical activity* is an increasingly popular strategy (Daly-Smith et al., 2020; Watson et al., 2017). It is a broad term for all physical activity performed in regular lessons and includes integrating physical activity into educational activities as well as providing physical activity breaks (CDC, 2018). It can take place at any time during the lesson, occur in one or several brief periods, at all school levels, and is offered in addition to physical education classes and recesses. Numerous terms exist to describe physical activity in classrooms, or aspects of such activities, yet the goal is often the same. It is to provide periods of physical activity and bodily movement to improve students' health (physical activity and reduce sedentary time), which can help improve academic achievement, well-being and student enjoyment and motivation (CDC, 2018; Pedersen et al., 2016). Classroom-based physical activity is particularly being promoted because of its potential benefits mentioned above, and because it is integrated into the lesson and does not take time away from subject teaching or prolong the school day. The main argument is its relation to the three pillars that promote student learning, health, and well-being, and this rests on the empirical evidence explained in Section 2.3.

The term classroom-based physical activity covers two main approaches: 1) Physical activity during classes in other subjects, often implemented as physical activity breaks (PA breaks), also called e.g. brain breaks, energizers or classroom movement breaks. PA breaks are short breaks during a classroom lesson that interrupt students' sedentary behavior, with or without educational content or focus. 2) Physical activity that is combined or integrated with the curriculum in other subjects and planned as part of lessons. This approach is referred to as physically active learning (PAL) in this thesis.

Classroom-based physical activity as a broad term including PA breaks and PAL is visualized in Figure 3. Classroom-based physical activity can take place both indoors and outdoors.

Figure 3

Classroom-based physical activity. PAL = physically active learning, PA breaks = physical activity breaks



In this thesis, emphasis is placed on the PAL approach, as this is the main intervention component to increase physical activity in the school-based health intervention under study. PAL is growing and expanding internationally as it is recognized as a valid strategy to increase physical activity across the school day (Daly-Smith et al., 2020). There are examples of interventions and policies at local and national levels across the world, but most are in Western countries, such as Canada, the US, Australia, the UK, Ireland, Finland, Denmark and Norway (Bartholomew & Jowers, 2011; Gammon et al., 2019; Resaland et al., 2016; Smedegaard et al., 2016; Webster et al., 2013).

2.5 Previous research

This overview of available and relevant literature was continuously updated while I was working on this thesis to represent the body of research in this field. The literature included here has been sampled through a comprehensive search, using the databases and search engines PubMed, Oria, and Google scholar. The keywords I used for the literature search included “classroom-based physical activity”, “movement integration”, “physically active learning”, “physically active academic lessons”, “in-class activity”,

"physical active break", "school-based physical activity", "secondary school", "school" "physical activity", "adolescents", "student", and "teacher". In addition, "cited reference searching", meaning assessing the reference lists in relevant publications, was used. I have only included articles published in international, peer-reviewed, scientific journals.

2.5.1 Systematic reviews

Following is an overview of the available relevant systematic reviews. As mentioned previously, most research on classroom-based physical activity has been conducted in primary school settings. Several systematic reviews highlight the lack of studies on adolescents (Masini et al., 2019; Norris et al., 2019; Bedard et al., 2019). Therefore, few reviews cover classroom-based physical activity in secondary school and adolescents exclusively, and the reviews mentioned below contain research on either both children and young adolescents (5-13 years) (Norris et al., 2019; Watson et al., 2017) or secondary/middle/high school adolescents (11-15 years) (McMichan et al., 2018).

The current evidence on the concept of classroom-based physical activity for adolescents shows some inconsistent findings. Two reviews did not find classroom-based physical activity to significantly affect students' physical activity levels (Watson et al., 2017; McMichan et al., 2018). However, the relatively recent review by Norris et al. (2019) found PAL to have a positive impact on students' physical activity levels, both during the actual lessons and throughout the school day. These reviews should be interpreted with caution for the secondary school settings, partly because few studies on secondary schools are included, and partly due to the use of self-reported physical activity.

Further, results on educational outcomes are inconsistent. Watson et al. (2017) concluded that classroom-based physical activity may have a positive impact on academic outcomes, highlighting that the inconsistent findings might be related to the variability in the quality of measures used. The review by Norris et al. (2019) found a

positive impact on educational outcomes; classroom-based physical activity improved on-task behavior and reduced off-task behavior (Norris et al., 2019; Watson et al., 2017).

2.5.2 Original studies

The following section presents previous research on classroom-based physical activity among adolescents in secondary school in three different categories: 1) quantitative studies measuring reported effects on students, 2) studies on students' perspectives, and 3) studies on teachers' perspectives (Table 2). Table 2 presents a list of the identified empirical studies of classroom-based physical activity in secondary school.

Implementation of classroom-based physical activity in secondary school is a relatively new practice, hence also a relatively new research field. There are two large projects with several publications, these are referred to by the name of the trial: School in Motion and "Burn 2 Learn". Research on the effect of classroom-based physical activity on adolescents' educational outcomes such as cognition, academic performance and time on task have received the most attention (Valle et al., 2015; Kubesch et al., 2009; Helgeson, 2013; Lubans et al., 2021; Gammon et al., 2019; Solberg et al., 2021; Mavilidi et al., 2021). Although there are some inconsistent findings, the School in Motion Study reported robust positive results from a nine-month PAL intervention (30 min PAL and 60 min of an additional PE lesson per week) (Solberg et al., 2021). Several studies have tested the effect of accelerometer-measured physical activity levels and physical fitness (Christiansen et al., 2021; Lubans et al., 2021; Kolle et al., 2020; Gammon et al., 2019). Only the School in Motion Study (Kolle et al., 2020), found positive results for adolescents' physical activity levels, while both the School in Motion Study and the "Burn 2 Learn" found positive results for physical fitness (Kolle et al., 2020; Lubans et al., 2021). Both the School in Motion Study and the "Burn 2 Learn" are randomized controlled trials (RCTs) developed, initiated, and controlled by researchers.

Students' mental health and/or well-being has been examined by a handful of studies through self-reported questionnaires (Gammon et al., 2019; Mavilidi et al., 2021; Lubans

et al., 2021; Åvitsland et al., 2020). The PAL intervention by Gammon et al. (2019) did not show effects on students' mental health or well-being, nor did the PAL intervention reported by Åvitsland et al. (2020), exploring mental health. However, the "Burn 2 Learn" study found that high-intensity interval PA breaks improved students' well-being (vitality). The evidence for the effect of classroom-based physical activity on physical activity levels, physical fitness and well-being in adolescents is sparse and inconsistent. Further, the studies mentioned, researching the effects of classroom-based physical activity were researcher developed, initiated, and controlled. No study has so far explored the effects of classroom-based physical activity in secondary school in a natural setting.

Adolescents' own perspectives on classroom-based physical activity have barely been researched. Three studies were identified and are listed in Table 2. One explored students' perspectives of PAL as part of a larger implementation evaluation and students' perspectives are only briefly mentioned (Gammon et al., 2019), while another explored only classroom-based PA breaks, where students' perspectives are reported and analyzed together with teachers' perspectives (Stoepker & Dauenhauer, 2020). A further study included both children and adolescents, but was conducted before the implementation of PAL in order to explore future opportunities for movement (Uibu et al., 2021). These studies found that 1) on the one hand, the students found PAL to be an enjoyable and preferred teaching method, but on the other hand, it made some students more lazy, unfocused and less productive (Gammon et al., 2019), 2) students preferred yoga as a PA break and wanted the activities to last longer than five minutes (Stoepker & Dauenhauer, 2020), and 3) students did not naturally associate physical activity with an academic lesson, although they displayed creativity and a positive attitude when asked to suggest future movement activities (Uibu et al., 2021). These three studies all used focus group interviews to explore students' perspectives and experiences. Gammon et al. (2019) had students and teachers in the same focus group (a total of 12 students included). Stoepker and Dauenhauer (2020) conducted very short focus group interviews, lasting for 12-17 minutes (a total of 20 students) where the students' perspectives were merged with teacher interview data to find similarities and

differences between the perspectives and preferences of the two groups. Reviewing the currently available literature, no study has been entirely devoted to the student perspective, and no study has provided an in-depth description of how students in secondary schools experience classroom-based physical activity.

Teachers' perspectives on classroom-based physical activity, on the other hand, have been explored more. A large proportion of these studies include teachers from both primary and secondary school settings and are listed in Table 2 (Knudsen, Bredahl et al., 2021; Knudsen, Skovgaard et al., 2021; Benes et al., 2016; Larsen et al., 2012; McMullen et al., 2014; Cothran et al., 2010; Koch, Troelsen et al., 202; Koch, Pawlowski et al., 2021), where more recently, studies have been published focusing exclusively on secondary school teachers (Lerum et al., 2021; Jørgensen et al., 2020; Gammon et al., 2019; Warehime et al., 2019; Stoepker & Dauenhauer, 2020). These six studies all used a qualitative approach with individual and/or focus group interviews. Gammon et al. (2019) and Ottesen and von Seelen (2019) explored teachers' perspectives as part of evaluating time-limited controlled PAL trials. Jørgensen et al. (2020) explored teachers' perspectives on classroom-based physical activity as part of a new state school reform. Lerum et al. (2022) explored why secondary teachers adopt PAL, and Warehime et al. (2019) and Stoepker and Dauenhauger (2020) explored the perspectives of teachers at schools that have classroom-based physical activity as part of the school policy based on national recommendations. However, in the two latter studies, classroom-based physical activity was mainly used and understood as PA breaks. Several studies have reported that teachers' motivation to use classroom-based physical activity to enhance learning and teaching by providing a variation that "wakes up" and stimulates the students, increasing both student motivation and focus on the task at hand (Lerum et al., 2022; Warehime et al., 2019; Gammon et al., 2019; Ottesen & von Seelen, 2019). However, the teachers' perceived difficulty in adhering to the concept of PAL was evident in all studies. Lerum et al. (2022) found that teachers' adoption is related to the personality of the teacher and describes different teacher personas. Jørgensen et al. (2020) describe a reported need among teachers for more support and necessary resources. Gammon et al. (2019) report that teachers experienced disruptive behavior

in class and challenges in refocusing students after a PAL. Teachers may also feel time pressure (Ottesen & von Seelen, 2019; Warehime et al., 2019), and several studies address the concern about classroom-based physical activity conflicting with increased academic focus and testing at secondary school level (Gammon et al., 2019; Ottesen & von Seelen, 2019; Jørgensen et al., 2020). The available literature clearly shows that classroom-based physical activity is not a straightforward approach for many secondary school teachers. There is a need to explore further, especially in natural contexts from a teacher perspective, how classroom-based physical activity with a focus on PAL is experienced in order to better understand this complex task.

Specifying the knowledge gap

The majority of available studies focus on students' physical activity level, cognitive function, and/or academic performance. Most studies are also researcher-driven, i.e., the intervention is planned, developed, and led by academic institutions without involvement/co-creation of end-users such as teachers and/or students. Although a randomized controlled trial is regarded as the optimal research design in the evidence-based hierarchy, such studies can be flawed by limited external validity (Berg & Latin, 2008). There are thus important knowledge gaps with regards to classroom-based physical activity in the secondary school setting, and on how classroom-based physical activity can influence students' physical activity levels, psychosocial health and well-being. There is a lack of research in the field on classroom-based physical activity in natural settings that are practice-driven or community-driven and thus implemented by school authorities at county and municipal levels. Further, little attention has been given to students' and teachers' perspectives and experiences from classroom-based physical activity programs. There is also a lack of methods and analysis in previous studies on students' and teachers' experiences that enables these experiences to be more fully explored and described.

Table 2. *Empirical studies of school-based research exploring classroom-based physical activity with adolescents*

Author, country	Sample	Design	Method	Assessment/topic	Findings
Quantitative studies on classroom-based physical activity measuring effects on students					
Valle et al. (2015) USA	N= 40 12-13 years (junior high school)	Split-plot factorial design, data measured in one lesson.	PAL intervention: walking around tables learning words in the classroom	Cognition, Immediate word recall	No significant difference between intervention and control group Mobility-preferenced students performed significantly better in the active environment than in the passive environment. Passive-preferenced students performed significantly better in the passive environment than in the active one.
Kubesch et al. (2009) Germany	N=36 13-14 years	RCT within-subject cross-over, 1-week intervention	PA break intervention: 5-min movement break, jogging virtual marathon	Cognition	No improvements in students' executive attention
Gammon et al. (2019) UK	N=296 students between 11-14 years n=69 teachers n=2 head teachers	RCT 12-week intervention	PAL intervention Teachers were trained and supported to adopt active pedagogical approaches	Physical activity: Accelerometer assessed physical activity during lesson and during school day Self-reported well-being Observations of cognition, time-on-task	Effectiveness in reducing students' sedentary time was not found. Teachers reported good acceptability of PAL training and mixed experiences of delivering PAL. Teachers' acceptability of training was lower and teachers identified aspects of the training in need of review, including the outdoor PAL training and learning challenge of PAL strategies. Students and assistant head teachers reported good acceptability of the intervention. Effectiveness on students' activity behaviors and well-being indicators was not observed.
Helgeson (2013) USA	N=130 12-14 years (junior high school)	Quasi-experimental trial, 4-week intervention	PAL intervention: active English lessons 10-15 minutes a day	Cognition: reading comprehension	No significant effects on reading comprehension as a result of participating in PAL activities
Christiansen et al., (2021) Sweden	N = X, 16-17 years (upper secondary school)	Non-randomized trial, 12-month intervention	PA break intervention and classroom adjustments (standing tables, balance pads) in English and math and walks with podcast in PE. Multicomponent intervention	Physical activity levels measured with accelerometers	No between-group differences in physical activity were statistically significant, the within-group changes may suggest a preventive impact on the decline in physical activity during adolescence.

"Burn 2 Learn" trial Australia		RCT 12-month intervention	PA break intervention 2x10 minutes per week with high-intensity interval training during curricular time.		
Mavilidi et al. (2021)	N = 221, grades 11 and 12, 16-18 years (a sub-study of Burn 2 Learn)			On-task behavior through classroom observations Subjective vitality through a questionnaire	Short high-intensity physical activity breaks improved students' on-task behavior and their subjective vitality.
Lubans et al. (2021)	N = 670 students between 16-17			Primary outcome: CRF Secondary outcomes: muscular fitness, physical activity, stress, mental health (psychological difficulties and mental well-being) and cognitive function, self-efficacy and motivation for HIIT.	The intervention improved CRF and muscular fitness in a sample of older adolescents. The intervention had a positive effect on stress, internalizing problems and working memory in a pre-specified subsample of students. Participants who were overweight or obese at baseline had the largest improvements in a range of secondary outcomes. 12-month findings suggest that the majority of benefits are not sustained once the intervention is no longer delivered by teachers.
School in motion study - Norway	N=2084 students, 9th graders, 14-15 years	RCT 9-month intervention	Additional physical activity: 30 min PAL and 60 min additional PE lesson weekly		
Solberg et al. (2021)				Academic performance Accelerometer assessed physical activity	Improved numeracy and reading performance in 14-year-old students compared with controls.
Åvitsland et al. (2020)				Effects on mental health, through questionnaire on strength and difficulties.	The physical activity intervention showed favorable results in the subgroup with the highest levels of psychological difficulties at baseline and in the immigrant subgroup
Kolle et al. (2020)				Accelerometer assessed physical activity Physical fitness	Daily physical activity and time spent in MVPA decreased throughout the intervention. It decreased less in intervention group than control group. Intervention group increased CFR more than control group.

Students' perspectives, studies with only adolescents					
Gammon et al. (2019) UK	N = 296 students between 11-14 years N = 69 teachers N = 2 head teachers	RCT and mixed-method 12-month intervention	Evaluation of a PAL intervention. Questionnaires Focus group interviews (Three focus group interviews with five teachers, twelve students)	Teacher and student perspectives on feasibility and acceptability of the PAL intervention	Most preferred PAL to desk-based lessons and wanted the teachers to continue delivering them. Students reported enjoying going outside and moving around, that PAL were less boring/more fun than desk-based lessons and that they could concentrate better. Negative comments about PAL included lethargy (12%), more disruptive behavior (9%) and less work achieved.
Stoepker & Dauenhauer (2020) US	N = 17 students, grades 9-12. N = 13 teachers	Qualitative	Focus group and individual interviews	Examine how high school students and teachers feel about the implementation, feasibility, and application of integrating PA breaks into the classroom.	Students and teachers value the integration of classroom PA but have conflicting viewpoints on various components that go into providing movement opportunities. Students prefer PA breaks to be 5-10 minutes. Teachers prefer PA breaks to be min ≥ 5 minutes. Many students prefer yoga as a PA break.
Uibu et al., (2021) Estonia	N = 92 children, 8-15 years	Qualitative pilot study	Focus group interviews	Exploring students' perspectives of physical activity opportunities in the classroom before the implementation of classroom-based physical activity.	Students do not associate physical activity with academic lessons. However, they are eager and motivated for classroom-based physical activity to be implemented. Activity preferences vary among genders and age groups. No teacher asked students for their opinions.
Teachers' perspectives, studies only including secondary school					
Lerum et al. (2021) Norway	N=13 teachers at secondary school	Qualitative	PAL and PA break intervention. Go-along and individual interviews	Explores why teachers adopt PAL	Results indicated that, in addition to enhancing their teaching and pupils' learning, teachers adopt PAL to adhere to school policy (The Conforming Teacher), to be an innovative educator (The Innovating Teacher), and because it matches past positive personal experiences (The Connecting Teacher).
Jørgensen et al. (2020) Denmark	N=14 teachers at secondary school	Qualitative	PAL and PA breaks have been implemented. Semi-structured interviews, focus group interviews, go-along observations and informal interviews	Exploring lower secondary teachers' interpretations and perceptions of classroom-based physical activity	Substantial diversity among teachers' interpretations and perceptions of movement integration, and consequently a lack of definitional clarity regarding movement integration and a possible misalignment between policy and practice. Perceptions were influenced by other and more prioritized policies and discourses regarding academic achievement, as well as by intrapersonal, interpersonal and institutional factors. The findings also suggested a lack of support and collaboration.
Gammon et al. (2019) UK	N=296 students between 11-14 years	RCT and mixed-method	Evaluation of a PAL intervention	Teachers' and students' perspectives on feasibility and	Teachers reported concerns about students not learning as much in PAL. Barriers included disruptive behavior, lethargy and off-topic chatting, challenges refocusing students after a PAL and limited

	n=69 teachers n=2 head teachers		Focus group interviews (five teachers and twelve students)	acceptability of the PAL intervention	classroom space. Positive for delivery were teachers' and students' enjoyment of PAL, good weather allowing them to go outside, more classroom space and a more diligent group of students. Teachers reported that ≤15 extra minutes were required to plan PAL, and a few extra minutes were needed to prepare the classroom and students for PAL.
Ottesen and von Seelen (2019) Denmark	Secondary teachers	Mixed-methods	Quasi-experimental controlled design Semi-structured group interviews	Quantitative: Assessed math and reading performance Qualitative: Teachers' experience of barriers and opportunities for implementing PAL	PAL engages and motivates more students, and it increases the students' on-task behavior. Integrating PA in the lessons is a challenge, because of the time pressure and strong curriculum demands in secondary school.
Warehime et al. (2019) US	N = 11 secondary science teachers	Qualitative	Exploring classroom-based physical activity (focus on PA breaks) in a natural school setting Individual interviews with science teachers	Explored the use of classroom physical activity in secondary science classrooms.	Teachers used classroom PA to improve academic and behavioral outcomes of students. They had varied perceptions regarding collegial support of classroom PA, but mostly felt supported by administrators. Overall, factors that negatively influenced classroom PA use tended to be within the interpersonal, organization, and policy levels of the social-ecological model, while factors that positively influenced classroom PA use tended to be within the individual level.
Stoepker & Dauenhauer (2020) US	N= 13 teachers N = 17 students, grade 9-12.	Qualitative	Focus and individual interviews	Examine how high school students and teachers feel about the implementation, feasibility, and application of integrating movement into the classroom, PA breaks.	Students and teachers value the integration of classroom PA but that they have conflicting viewpoints on various components that go into providing movement opportunities. Students prefer PA breaks to be 5- 10 minutes. Teachers preferred PA breaks to min ≥ 5 minutes. Many students prefer yoga as a PA break.
Teachers' perspectives, studies including both primary and secondary school					
Knudsen, Skovgaard et al. (2021) Denmark	Teachers of 0-10th grade	Mixed method	Questionnaires (206 responses) Semi-structured in-depth interviews (nine teachers)	Exploring what motivates and challenges teachers to integrate classroom-based physical activity into their daily teaching practice	The study reveals a number of key motivational drivers such as supporting teachers' autonomy, competence and collaboration. Conversely, the study also reveals barriers for integrating physical activity, such as a lack of time, lack of support and lack of appropriate training.
Knudsen, Bredahl et al. (2021) Denmark	N=9 teachers of 1st-9th grade	Qualitative	Semi-structured in-depth interviews	Identifying factors associated with teachers' sustained use of classroom-based physical activity and pointing out usable ways to support teachers in their professional practice.	Didactical skills, teacher collaboration (including sharing and co-creation of activities), and resources focusing on suitable physical activities influenced sustained use of classroom-based physical activity. Classroom-based physical activity should make sense for the content of subjects, the students, and the teachers.

Benes et al. (2016) USA	N=17 teachers of 1st-12th grade	Mixed-method	Survey and semi-structured interviews	Exploring teachers' interpretations and perceptions of a classroom-based physical activity policy	Teachers reported a lack of knowledge but were willing to learn more and add movement to their "teaching toolbox" with support and training. Younger teachers were more willing to implement. Classroom-based physical activity increased student enjoyment and concentration afterwards. Physical activity is difficult to integrate with academic content. Schools should have a role in increasing physical activity opportunities.
Larsen et al. (2012) Norge	N=38 teachers of 1st-10th grade	Qualitative	Focus group interviews	Teachers' perspectives on implementation of one hour of physical activity per school day. No specific strategy is emphasized, classroom-based physical activity is addressed.	Teachers experience that school-based physical activity is important for student health, learning and behavior. Barriers are academic pressure, especially in secondary school. Lack of time, competence, facilities and skills in how to organize are addressed. They request activities that can be integrated with academic content. Teachers did not incorporate physical activity on a regular basis.
McMullen et al. (2014) USA	N=12 teachers of 1st-12th grade	Qualitative	Semi-structured interviews	Exploring teachers' experience of using classroom-based physical activity, identifying factors important for teacher willingness	Teachers have a positive experience of classroom-based physical activities when they are easy to start and organize, short (5-10 minutes), when physical activity is integrated with academic content and when the students have fun. Barriers for using classroom-based physical activity are fear of losing control, concerns about student safety, concerns about student ability to calm down and focus after activity. Teachers report lack of time and space to implement classroom-based physical activity.
Cothran et al. (2010) USA	N=23 primary and secondary teachers	Longitudinal qualitative study	Interviews	Exploring teachers' involvement in integrating classroom-based physical activity	Teachers' willingness to engage was influenced positively by caring about students and their own personal wellness history. Their engagement was impeded by institutional factors of scheduling and assessment pressures.
Koch, Troelsen et al. (2021) Denmark	N = 392 primary and secondary teachers N = 31 school management members	Mixed methods	Questionnaire and interviews	School staffs perceived barriers to implementing a national physical activity policy involving classroom-based physical activity	Key barriers were identified: lack of facilities, motivation and time

Koch, Pawlowski et al. (2021) Denmark	N = 846 Students in grades 5-9 N = 191 teachers N = 11 school management teachers	Mixed methods	Evaluating a school-based physical activity implementation, including classroom-based physical activity	Questionnaire to the teachers assessed how often teachers' employed physical activity within the curriculum and their attitudes towards the requirement.	Teachers' interest seemed crucial for commitment. Managerial support was important. For some teachers it was perceived as a threat to the academic standard of teaching.

Abbreviations: N = number, RCT = randomized controlled trial, PAL = physically active learning, CRF = cardio-respiratory fitness, PE = physical education

2.6 Aim and research objective

The overall aim of this PhD is to gain knowledge of classroom-based physical activity in secondary school, its influence on the target groups health and well-being (the students), and how this new way of teaching is experienced by the individuals performing and living it (students and teachers).

The overall research question is: How does classroom-based physical activity influence student health and well-being?

Each of the three articles in the PhD has its own specific perspective and research objective to contribute to the overall aim. The objectives are:

- *Article I:* To examine if the Active and Healthy Kids Program led to changes in physical activity, sedentary time, physical fitness and well-being in early adolescents.

- *Article II:* To identify and describe the general meaning structure of students' experience of classroom-based physical activity and its influences on their psychosocial well-being.

- *Article III:* To explore subject teachers lived experience of classroom-based physical activity with an emphasis on PAL, to identify and describe secondary school teachers' general perception of this phenomenon.

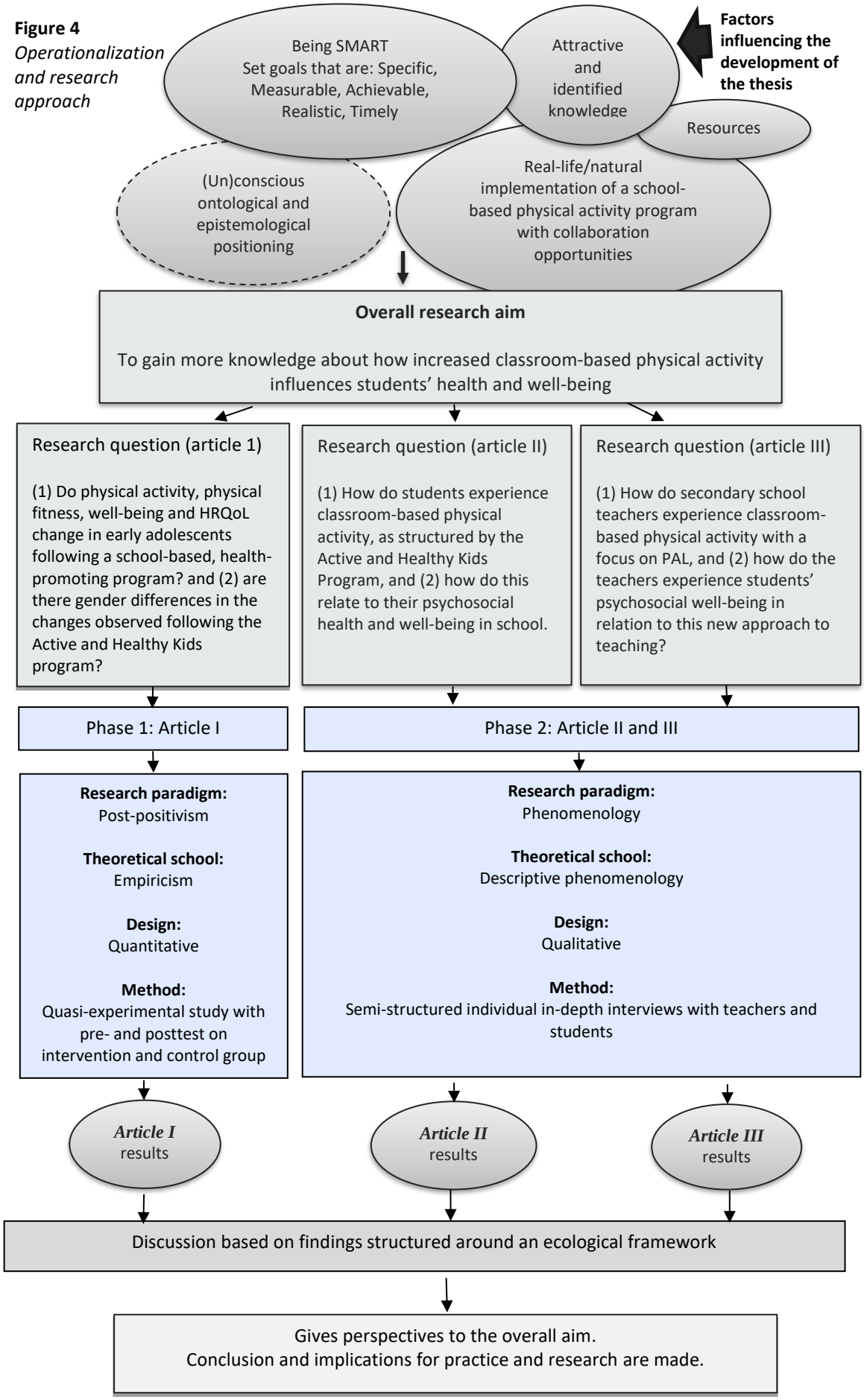
3 Method

3.1 Research position and approach

How we conduct research is connected to and embedded in what we think we can know (ontology) and how we think we can know it (epistemology), forming a research paradigm, a basic belief system (Guba & Lincoln, 1998). There are different ways of grouping and naming paradigms. For this thesis the research questions guided the methodology and both quantitative and qualitative methods were applied. My aim was to gain more knowledge about how increased classroom-based physical activity influences students' health and well-being. This issue can be approached from different perspectives and with several research questions. For this thesis I developed and limited the research to the three presented sub-studies with their respective research questions. Figure 4 below is a visual depiction of the overall research approach of the thesis.

Overall, the thesis is designed as a two-phase study that uses both quantitative and qualitative approaches to explore classroom-based physical activity in a natural setting. The point of departure is the Active and Healthy Kids Program, which can be described as a natural experiment in which the intervention is not undertaken for the purpose of research, yet the variations in exposure and outcome can be analyzed with the aim of making causal inferences (Craig et al., 2012) and important stakeholders' experiences can be explored and described (Giorgi, 2009).

Figure 4
Operationalization and research approach



Phase 1: Seeking to explore, measure and test if students' health changed after implementation of classroom-based physical activity. This phase has a quantitative design as this allows for the measurement of associations between measurable quantities. This methodology is grounded in a post-positivist research paradigm. Post-positivism has evolved from and is closely aligned to positivism, considering reality to be objective, patterned, and knowable (Leavy, 2017). It is about testing claims or causal relationships. This worldview values scientific objectivity, researcher neutrality and replication (Hesse-Biber & Leavy, 2011). The post-positivism approach acknowledges that it is not possible to gain a truly objective understanding through measurements and observations. A post-positivistic approach is also characterized by a much greater openness to different methodological approaches with a greater emphasis on multiple methods to examine a single phenomenon (Jones, 2015).

In phase 1, in order to find out how the students' health and well-being was affected by the implementation of more school-based physical activity, a quasi-experimental non-randomized pre-post control group design was applied.

Phase 2: Seeking to gain more knowledge about students' and teachers' experiences with classroom-based physical activity. This phase has a qualitative design grounded in descriptive phenomenology (Giorgi, 2009). This method is rooted in Husserlian phenomenological philosophy, focusing on human beings and their life worlds, believing that gaining knowledge about the world can take place through people's experiences with it (Giorgi, 2009). Husserl argued that anything that had to be dealt with in the world had to come through consciousness (Giorgi, 2005, p. 76). This research tradition is concerned with the study of phenomena from the perspective of persons, "bracketing" as far as possible taken-for-granted assumptions and usual ways of perceiving. Descriptive phenomenology seeks to describe aspects of our world rather than explain them, and to start free from hypotheses or preconceptions. It is however not limited to the description of experiences, it is designed to reveal the implicit meaning structure of the explored phenomenon as a unique experience that also possesses more general and

essential properties. These essences are not understood as universal, but as contingent essences that pertain to their cultural and causal context.

In phase 2, in order to explore qualitative dimensions of the overall aim and describe students' and teachers' lived experience with classroom-based physical activity, this descriptive phenomenological approach was applied. Individual in-depth interviews were conducted with students and teachers who had experience with the phenomenon.

3.1.1 Applying two different approaches

The quantitative phase 1 allows for an "from-the-outside" third-person perspective that allows for associations between measurable quantities, while the qualitative phase 2 allows for an "from-the-inside" first-person view. Although the two approaches are placed in different research traditions in Figure 4 and may seem very different, there are similarities in beliefs of how we can gain knowledge about the world. They are similar in the sense that we can gain knowledge about actions and experiences, but from different perspectives, a first- or third-person position, respectively. These different perspectives or positions have given rise to different methodological approaches. However, they are still related to the same matter, the person, taking the view that science is in part subjective (Depraz et al., 2000). Phenomenology is not in principle opposed to a quantitative research approach; Husserl was a strong believer in both. In fact, Husserlian phenomenology considers itself to be positivistic and was preceded by the tradition of empiricism and positivism (Sinha, 1963). *Positivism* comes from the French word *positivisme* and in its philosophical sense means "imposed on the mind by experience" (Wikipedia, 2022). One basic affirmation of positivism is that all knowledge regarding factual matters is based on "positive" data of experience, that is, what can be available to the eye, senses or measurement instruments. The sense-given is the primary source of knowledge in positivism (Sinha, 1963). Husserlian phenomenology is concerned with what is available to the mind through conscious reflection. Both approaches take seriously how phenomena present themselves to us, through our body and mind, while theoretical and folk-psychological common-sense understandings are bracketed out. Giorgi (2009), who developed the descriptive phenomenological method in psychology

based on the work of Husserl, points out that the phenomenological approach is more comprehensive than empiricism insofar as it allows for irreal objects as well as real or empirical ones (p. 67). Where the post-positivistic approach works with measurements and numbers, the descriptive phenomenological method works with experiences and words as descriptions of experiences. These approaches may go hand in hand as "every phenomenon in the world has a quantitative aspect and a qualitative aspect" (Giorgi, 2009, p. 74) and "if quantitative dimensions of the phenomenon are to be explored, then a method yielding numbers as basic data is required, and the assumptions upon which the statistical procedures are based would have to be clarified and met. If the qualitative dimension of a phenomenon is to be explored, then one has to be sure that the data obtained express the qualitative dimension of the phenomenon" (p. 64). Surely research is not black and white and restricted to certain boxed beliefs and traditions; there is a pragmatic side to it which is generally acknowledged: "It would be difficult to argue that one and only one method can be used in research. Thus, the selection of method is a choice, sometimes of necessity, but far more frequently it is a preference that, in either case, has to be related to the basic research question and the purpose of the research" (Giorgi, 2009, p. 62). As shown in Figure 4, the research questions determined my methodology and I think Giorgi puts it quite well, stating that as a researcher one should think about: "What is the best access to the phenomenon I am interested in researching, given the question I am seeking to answer" (Giorgi, 2009, p. 63).

3.2 Research setting and population

The student population for this thesis comes from Norwegian secondary schools, which comprises grades 8-10 (13-16 year-olds). The particular target group of this thesis is 8th-9th graders (13-15 years), in order to enhance understanding of young adolescents' health in a school-based health promotion intervention setting, in an age group known to significantly decrease their physical activity levels, but which has been the subject of little classroom-based physical activity research.

3.2.1 The Active and Healthy Kids Program

Classroom-based physical activity was explored through access to the Active and Healthy Kids Program, implemented in public schools in South-Eastern Norway, in the former Telemark County. This county has a poor public health profile compared to the national average, with a higher prevalence of mental health challenges, shorter life expectancy and lower physical activity levels (Norwegian Institute of Public Health, 2018a, 2019, 2020, 2021). The Active and Healthy Kids program was developed and implemented by the Department of Health of Telemark County Council (now Vestfold and Telemark County Council) as a means to improve health in the county. The program is a health promoting multi-component program aiming to improve the lives of children and adolescents through the school system. The program consists of three main components to reach its overall goal: 1) a healthy diet, 2) awareness of important lifestyle factors, and 3) increased physical activity (see also *Article I* for a description of the overall program). Component 3 consists of classroom-based physical activity, which is most relevant to the main focus in this thesis of gaining access to a setting where classroom-based physical activity is implemented in secondary school. The intervention program for secondary school is outlined in Table 3. The physical activity component is based on the Active Smarter Kids (ASK) study (Resaland et al., 2015).

Table 3

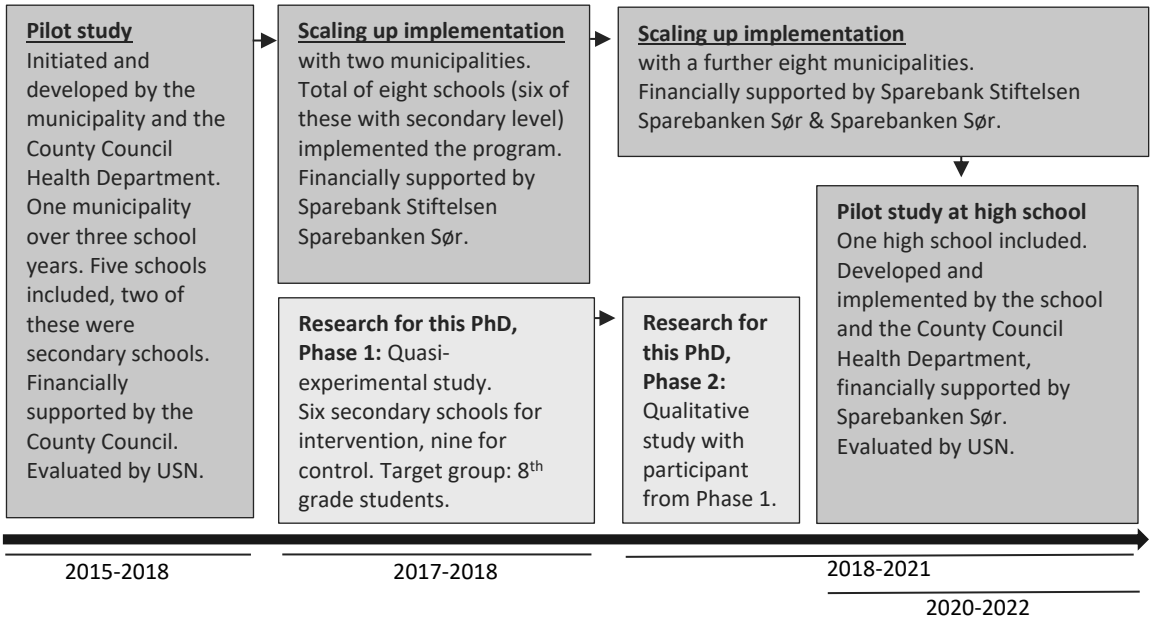
The Active and Healthy Kids Program for secondary school

Intervention program	Section	Content
Competence development program	Courses for teachers	Teachers were offered a one-day generic course focusing on PAL before implementation. During the intervention period there were a status meeting, a half-day follow-up course, and a session for the assigned resource teachers each semester.
	Courses for the school cafeteria staff	Mandatory course program: Active courses in the kitchen, inspiration folder, webinar.
Diet (not a focus in this thesis)	Packed lunch	Talks by the school nurse to parents and students on the importance of a healthy packed lunch.
	Healthy meals in the school cafeteria	Reduction of food and drink with a high sugar content. Food in line with the Department of Health recommendations for school meals. Varied weekly menus in school cafeteria. Facilitation of social lunch.
Physical activity settings	PAL lessons/activities	3 x 30 min in Norwegian, English and Math. 30 min/month in six other subjects. Total per week = 90 min physical activity
	PA break	5 min break with physical activity x 5 per week Total per week = 25 min physical activity
	Physical Education	Physical Education as usual 45 min x 3 per week. Total per week = 135 min physical activity **All physical activity combined gives an average of 59 minutes, or almost one hour of physical activity per school day**

The program was pilot tested in 2015-2018 in one municipality with five schools (two of which were secondary schools). In 2017 the program was expanded and up-scaled to two municipalities and from 2018 up-scaled further, now (year 2021) implemented in eleven municipalities in Vestfold and Telemark County. Figure 5 below presents the time line for the overall implementation of the Active and Healthy Kids Program, highlighting the development and implementation of the natural context and how this thesis studied a small part of the whole.

Figure 5

Timeline for the implementation of the Active and Healthy Kids Program



The implementation and evaluation of the pilot study was based on a three-year process evaluation, where data were collected on school staff and student experiences of the implementation process. The report concluded that the program's physical activity component was sufficiently implemented. Positive aspects were the provision of resources, such as time, equipment and financing, and positive employees. Barriers were a lack of incorporation and delegation of responsibility among the leadership and staff, a lack of courses for competence development and a poor culture of sharing.

All schools, students and teachers included in the thesis were recruited from the Active and Healthy Kids Program. I gained access to the program and schools through the County Council Health Department and the research project at the University of South-Eastern Norway (USN), which was a partner of the Active and Healthy Kids Program by providing evaluation. In phase 1, all municipalities in the county who planned implementation of the program in fall 2018 were recruited as the intervention group (six secondary schools). Municipalities planning to implement the program the following

year (in 2018/2019) were recruited as the control group (nine secondary schools). The selection of schools and ratio between the intervention and control groups was therefore based on a pragmatic approach due to the naturalistic setting of the implementation. Recruitment and sample size are shown in Figure 6. For phase 2, I recruited students and teachers at the intervention schools from phase 1. Recruitment and sample size are shown in Table 5.

3.3 Data collection

In this thesis both qualitative and quantitative methods were used. In this section I will describe these methods in general terms and explain why they were used. A more detailed description of the methods used to collect and analyze data can be found in the three articles.

3.3.1 Measurements of students in a pre-post control group design

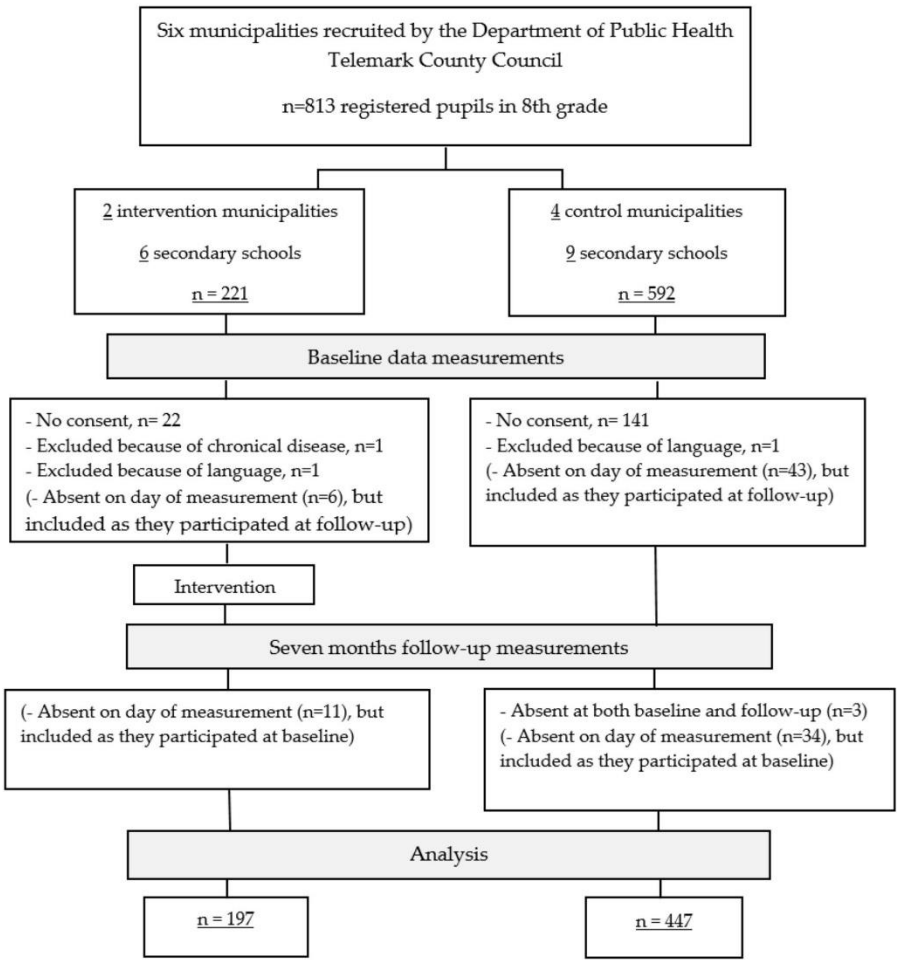
A natural experimental approach was used to evaluate student health and well-being outcomes after the implementation of the Active and Health Kids Program covered in *Article I* in a quasi-experimental pre-post control group design. In this design measures of both groups are taken over time, where one is the experimental intervention group, described as a multiple time-series experiment (Leavy, 2017). A quasi-experimental design allows the researcher to take advantage of natural settings or groups, as when researchers have access to specific areas (Leavy, 2017), in this study educational institutions. This approach is suitable for exploring a complex population health intervention when randomized controlled trials are challenging to conduct (Craig et al., 2008; 2012), as in this case where the USN research partners had no role in selection, or developing or implementing the program, only in evaluating it.

The intervention period was adjusted to fit the natural setting of the schools, covering one school year. This means that the student baseline test was carried out at the very beginning of the school year (Aug/Sep 2017), before the program was implemented, while the post-test was conducted near the end of the school year (April/May 2018),

before exams and tests would dominate the school day. A flow chart of recruitment is presented in Figure 6.

Figure 6

Flow chart of Study 1 from Schmidt et al. (2020)



The outcomes were measured using a variety of tools as shown in Table 4. The tools are well-known and much used in school-based research, and thus have the advantage that it is relatively easy to compare with other research. The primary outcome was physical activity (counts per minute). Secondary outcomes were sedentary time, MVPA, physical fitness (cardiorespiratory fitness and strength) and well-being (HRQoL and vitality).

Both researchers and master's degree students were involved in data collection and at least one researcher was present as test leader. Master's students helped with data collection, partly to gather data for their theses. All received detailed instructions on how to test and collect data in the part in which they were involved.

Table 4

Pre and post measurements in Article I

Participants	Measurements	Benefits	Limitations	
	Physical activity, sedentary time and time spent in moderate to vigorous physical activity measured objectively with Actigraph accelerometer, GT3X+. Worn on the hip for 4 days. Cut-off points: Evenson et al. (2008). Details of specific analysis is described in *Article I*	Easy to use. Valid objective measurements that are not too expensive. Fits well with large scale studies in a natural setting (Ainsworth et al., 2014).	Cannot distinguish between sitting and standing still. Misses upper body movement. Cannot take into account extra weight being carried (Lee & Shiroma, 2014).	
	Cardiorespiratory fitness using a field running test (Andersen test) (Andersen et al., 2008) in the school gym.	Easy to test groups in the field. Found valid and reliable to estimate cardiorespiratory fitness (Aadland et al., 2014). Low cost.	Indirect measurements. Difficult to check participants' efforts. Participants can get better at the test as they become more familiar with it.	
	Estimates of plyometric strength through the Standing Long Jump test (Castro-Piñero et al., 2010) in the school gym.	Practical, time efficient, low in cost and equipment requirements (Castro-Piñero et al., 2010).	A general index of muscular fitness (Castro-Piñero et al., 2010). Requires motor coordination (Zhou et al., 2020).	
	Body mass index, by measuring height and body weight, in a quiet room at the school or the school nurse's office.	Easy to collect from a large group. Can screen for potential weight problems and other health risks.	Only an indicator. Does not distinguish between muscles and fat.	
	Self-reported questionnaires: Health related quality of life using the Kidsscreeen-27 questionnaire (Ravens-Sieberer et al., 2006). Vitality using the Subjective Vitality Scale (Ryan & Frederick, 1997), in the classroom via a link to our online questionnaire.	Easy to distribute and collect data. Good for collecting data on large numbers of participants. Validated questionnaires.	Participants can only respond to predesigned questions.	

Since many constructs of well-being exist and are used interchangeably, it is important to clarify what constructs have been used when reporting on well-being research. Well-being is overall assessed through the two concepts, vitality and HRQoL. Vitality emerges as one component under the umbrella of well-being in evaluated subjectively by the person and functions as a closely related construct of well-being (Guérin, 2012). The concept of vitality refers to the state of feeling alive and alert and to having energy available to the self as vital and energetic, which is part of what it means to be fully functioning and psychologically well (Ryan & Deci, 2001). Quality of life can be viewed as part of a person's well-being and life satisfaction, thus an aspect and indicator of general well-being (Guérin, 2012). HRQoL is a health-focused quality of life concept inclusive of mental, physical and social well-being.

3.3.2 Individual in-depth interviews

Aiming to provide a close perspective on students' and teachers' experiences of the changed way of teaching, I applied a descriptive phenomenological approach (Giorgi, 2009) using individual in-depth interviews as the method for *Articles I and II.* This qualitative method was chosen as suitable for conducting a descriptive phenomenological study. The individual in-depth interview method is an effective way to encourage people to talk about their personal feelings, opinions and experience, which helps us to understand their world. This is important when conducting an interview for a phenomenological study, as the researcher in such a study is interested in describing a person's experience in the way he or she perceives it, not from a theoretical standpoint (Bevan, 2014; Giorgi, 2009). The advantage of conducting interviews individually instead of collectively is that informants describe their own experiences, meanings and context without being influenced by others' opinions or experiences. This may also explain why individual interviews are the dominant data collection method for a phenomenological study where information is sought about a phenomenon through people's life worlds.

Before recruiting informants and interviewing them, I spent some time becoming more familiar with the research setting. I visited all intervention schools from Study 1 and

observed a PAL lesson/activity (a total of six PAL activities). I entered the observations with an open mind. The observations provided a space where I as a researcher obtained a sense of the whole, the practical setting where classroom-based physical activity was being performed and lived. This helped to give me a sense of how the teachers and students spoke and behaved in these settings, which proved valuable when preparing the interviews as well as in understanding what the informants were referring to during the interviews.

Informants were recruited from intervention schools from *Article I* that had adopted the Active and Healthy Kids Program, one school from each municipality. One of the municipalities had only one secondary school. A school from the other municipality equal in size in terms of staff and students was selected, resulting in one rural and one urban secondary school. All schools included in the intervention group had continuously implemented the program since September 2017, and at the time of data collection we had no indication that some schools were more successful in implementation than others. Informants shared their experiences in interviews conducted in April and May 2019, about 18 months after the start of implementation of classroom-based physical activity at their school. Recruitment is outlined in Table 5.

Table 5

Recruitment of informants

Selection	Inclusion criteria	Data collection sites and informants	
Two secondary schools	Secondary school from Study 1 intervention group. Equal in size regarding staff and students.	 One rural school	 One urban school
Nine student informants for *Article II*	Students who wished to participate. Students with varied physical activity habits. Recruited through their teacher.	 Four girls One boy	 Two girls Two boys
Six teacher informants for *Article III*	Teachers with experience of teaching PAL who were teaching students in Study 1.	 Two females Two males	 Two females

The informants were interviewed at an available meeting room in their school with only me and the informant present. Student interviews lasted from 40 to 50 minutes and teacher interviews from 50 to 80 minutes. Before the interviews we had an informal talk, where the informants were told about the study and given an introduction to me as a researcher, my role and the planned interview. Through the questions in the interview I sought clarification or requested elaboration of specific experiences that were pertinent to the phenomenon under study, namely classroom-based physical activity. It is difficult to predict how an interview may play out or how "good" the informants are at describing their experiences. The most important aspect of a phenomenological interview is to have the informant describe experiences of the phenomenon under study. However, Englander (2012) points out that research related to more specific research projects may require a more semi-structured interview. For the two studies I had prepared a semi-structured interview guide, where I experimented with possible questions that could be asked depending on how the interview developed. Thus, the prepared semi-structured interview guide was only used to a limited extent in the interview situation but was important for preparing for the interviews. Presence of the interviewer is important in an interview situation (Englander, 2012). Putting the interview guide aside allowed me as a researcher to be more present, and to listen more carefully, allowing the interview situation to be based on the informants' descriptions. If a natural pause in the conversation occurred, I went back to the semi-structured interview guide to find questions that helped to direct the informant to talk and describe more about experiences of classroom-based physical activity. As a result of this, my questions were not the same in all interviews. However, all questions aimed to track the phenomenon as described by the informant and I focused on listening and asking follow-up questions for clarification and probing. I tried helping the informants to describe their experiences by asking questions such as: "Think back about a PAL that you remember well – could you tell me about that?" or: "Think of a PAL activity you facilitated that you think went well – what happened?".

The interview as a method has potential pitfalls, one of which involves the researcher's ability to create a secure environment. The researcher may quite naturally ask questions

based on her/his own experiences and preunderstandings while missing out on the informants' lived meanings with the phenomenon. It is important not to ask leading questions; however, as Giorgi states: "Leading and directing the participant in an interview, one must direct to have the participant speak to the researcher's phenomena of interest" (2009, p. 123). I had this in the back of my mind during the interviews to help myself to be unafraid of asking questions or becoming unnaturally aware of all the words that emerged to prevent a natural conversation.

When conducting the interviews I tried to be aware of not being influenced by my own preunderstanding of classroom-based physical activity. An important part of a phenomenological study is to bracket one's prior knowledge about the phenomenon, meaning that the researcher adopts the so-called phenomenological attitude (Giorgi, 2009). This will be further explained when describing the descriptive phenomenological method of analysis.

For both studies, I judged the descriptions of the informants to be large enough to provide rich and diverse data of their experiences of classroom-based physical activity and small enough to conduct a detailed and sophisticated analysis. Giorgi (2009) states that descriptions are adequate if they contain sufficient depth and details to reveal new psychological knowledge about the phenomenon under study. I considered nine detailed and rich interviews with students and six detailed and rich interviews with teachers sufficient for the two descriptive phenomenological studies.

3.4 Analysis

3.4.1 Statistical analysis

The data for *Article I* were managed and analyzed using the IBM SPSS 26.0 program (Chicago, IL, USA), with a significance level of 0.05. All participants were included even though some did not have a complete data set or only participated at the pre- or post-test. This could be a source of bias, although an analysis can be considered valid as long as the data are missing at random, thus the data set will still be representative. A Little's

MCAR test (Little, 1988) showed that the data were not missing completely at random ($p<0.001$). There is no truly effective way to deal with missing data; the choice lies between imputation of data and removal of data. Since the data set for Study 1 was not missing completely at random, removing data could have produced a bias in subsequent analyses. Therefore, we chose the other undesirable option, to impute data for the missing values. It should be noted that missing outcomes may still result in a bias. Analysis of the missing values showed that the data set was non-monotonic, hence we used multiple imputation to complete the data set, using the Markov chain Monte Carlo Method (Jakobsen et al., 2017; Wilson & Lueck, 2014). Multiple imputation is a simulation-based statistical technique for handling missing data.

Analyses conducted leading to the results presented in *Article 1* were:

1) A descriptive analysis of baseline data presented as means (± standard deviation) followed an independent sample t-test and a chi-square test to analyze differences between the intervention and control groups at baseline (results presented in Table 2 in *Article I*).

2) A comparison of intervention and control groups from baseline to follow-up for primary and secondary outcomes was analyzed with independent sample t-tests (presented in Table 3 in *Article I*).

3) A linear mixed model was used for all dependent variables in order to consider cluster random effects. The model accounts for correlations among observations in the same cluster. Random effects was students nested in schools. Fixed effects were time, group and the between time and group effects (group x time). First the variables were standardized before analysis by subtracting the mean and dividing by the standard deviation (i.e. Mean = 0; Standard deviation = 1). The standardized variables thus had a mean of zero and a standard deviation of one. The Bonferroni correction was used for estimated means (results presented in Table 4 in *Article I*). The same analysis was performed across genders (presented in Tables 5 and 6 in *Article I*).

4) In the results section of this thesis, "4.1 Article I" is a revised version of Table 4-6 from *Article I* to show associations and estimated effect sizes between the groups over time based on the mixed model analysis. In the revised tables, standardized regression coefficients (β) and unstandardized regression coefficients (B) are reported with 95% confidence interval for all variables along p-values for the whole group in Table 7, for boys in Table 8 and for girls in Table 8.

When variables are measured using different scales, effect size can be reported with the standardized beta coefficients (β) with 95% confidence intervals, standardizing each variable before analysis (Lorah, 2018). Standardized β can inform about the magnitude/impact of the effect and these figures are comparable amongst themselves and across studies with similar populations.

Unstandardized B is also reported for the variables' original values as this is useful for interpretation and to show an effect size. It shows how much the measured value increased/decreased between the two groups over time. P-values are reported to show whether the effect was significant.

3.4.2 Descriptive phenomenological analysis

A descriptive phenomenological method was used to analyze interviews with students (*Article II*) and interviews with teachers (*Article III*), in order to elicit their experiences of classroom-based physical activity. The descriptive phenomenological method was developed by Giorgi (2009) based on principles of Husserl rooted in phenomenological philosophy. It is one of several analysis methods based on phenomenology (Packer & Addison, 1989; Smith, 1996; van Manen, 1997). The descriptive phenomenological approach and analysis place the individual's experience of a certain phenomenon in the center, aiming to rigorously analyze the experience without invoking theoretical or general folk psychological assumptions to describe the phenomenon being explored. An important part of the analysis is to adopt the so-called phenomenological attitude, meaning the use of the epoché and the phenomenological psychological reduction. Epoché means bracketing one's assumptions regarding the phenomenon under study,

allowing the researcher to see the data in a new light with the informant's descriptions and meanings in focus. The phenomenological psychological reduction does not imply that we forget everything about the natural world and knowledge about the phenomenon, it merely means that we should not let our past knowledge be engaged while determining the mode and content of the present experience (Giorgi, 2009, p. 92).

While adopting the phenomenological attitude, four steps of the descriptive phenomenological psychological method were followed: 1) all transcripts were read closely to gain a sense of the whole, 2) the text was re-read in depth and divided into psychological meaning units, and 3) the meaning units were re-written into psychologically sensitive expressions that highlighted the psychological meanings lived by the informants. In this step the first author also transformed the meaning units into the third person perspective, and 4) based on the transformed meaning units, a general psychological meaning structure of the experience was written. Imaginative variation was used to bring forward and describe the invariant meanings in a general structure. This implied asking oneself: "What is general about the experience of having PAL and PA breaks? What is essential about that experience? If I remove this aspect from the structure, how does that change the description of the phenomenon?". Giorgi points out that one should be aware that the general meaning structure of the phenomenon can never grasp the totality of the original experience of the individual participant (Giorgi, 2009).

Steps 1 to 3 were conducted in two Nordic languages, Norwegian and Danish, for all transcripts of students and teachers respectively. Instead of writing a general meaning structure for every single interview, I wrote what can be called a "situated structure", an essential summation of the psychologically relevant aspects of the particular individual's experience of the phenomenon. I decided to add this extra step after participating in a course by professor James Morley, a colleague of Amadeo Giorgi, the creator of the method used. Morley's experience after teaching this method for many years was that this step was helpful for novices. My experience in the analysis process was that this extra step enhanced my understanding of the individual informant and the

many psychological meanings generated during the analysis. Based on all the situated structures, the fourth step of writing a general meaning structure took place, eliciting a new whole representing all informants' experiences of the phenomenon of classroom-based physical activity. Step 4 was written in English from its first draft onwards.

3.5 Ethical considerations

Ethical considerations should be given high priority when conducting research with human subjects and especially children and youth, as minors are considered to be a vulnerable population for which special protection must be provided (Santelli et al., 2003; World Medical Association, 2013). Several ethical considerations and initiatives were applied during the research of this thesis. For *Articles I and II*, all students at the intervention and control schools received oral and written information about the study. As the students were minors, a parent or guardian gave written permission for participation (see Appendix I). Adolescents may be fully capable of making sound decisions about research involvement (Santelli et al., 2003), and to show more respect for the students' autonomy, today I would have asked for written consent from both student and parent in the consent form shown in Appendix I . Students participating in interviews were asked for oral consent in addition to their parents' permission. They received information before the interview and at the beginning were informed about the purpose, that it was voluntary and that they could withdraw at any time without any consequences. For *Article III*, all teachers teaching students from Study 1 at the two selected schools were invited to participate. Participating teachers received written and oral information, gave written consent and at the start of the interview were reminded about voluntary participation and the possibility to withdraw at any time without any consequences (for the information and consent form, see Appendix II). Although voluntary participation for the interview studies was emphasized to the informants, there will always be a certain power dynamics that can make it more difficult for informants to withdraw if they wish to (Miller et al., 2012). Therefore, one of the main criteria for recruiting students was that they themselves wished to participate. For both students and teachers, I set aside time at the beginning of the interview to explain the

purpose, how the data were being managed and the use of the research. I also told them that I was available following the interview for questions or reflections they had made after the interview.

In all research, the potential contribution of the study must be evaluated against potential risks for the participants, in order to carefully assess the risk and benefits of including them (Santelli et al., 2003). In this study the potential risks were considered low based on the definition of minimal risk: "The probability and magnitude of harm or discomfort anticipated. . . are not greater...than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests" (Santelli et al., 2003, p. 403). An ethical issue in studies with a control group concerns the control group not receiving the benefits of the intervention (Nardini, 2014). This disadvantage was eliminated as the control schools implemented the program after the intervention study ended. These schools received the same support from the program owners, the County Council.

Some ethical issues arose during the data collection for *Article I*. We, the test leaders, found that students were very interested in talking about and asking for each other's weight. We reminded the students that weight was personal information and encouraged them not to ask about and comment on their classmates' weight. People in general may feel uncomfortable about having their weight measured, and height and weight were therefore measured in a closed room, with only the test personnel and student present. Other test results were not shared with the students.

Another consideration was to ensure anonymity and prevent the possibility of identifying students or schools. Every student was paired with a unique identification number (*Article I*) or a pseudonym for students and teachers in interview studies (*Articles II* and *III*).

Finally, according to the Norwegian Regional Committee for Medical and Health Research Ethics (REK), the project did not fall under Sections 2 and 4 of the Health Research Act, and could thus be conducted without REK approval (Reference No.

2017/387). The data management procedures for the articles presented in this thesis (*Articles I, II and III*) were approved by the Norwegian Centre for Research Data (NSD) (Reference No. 54327) and registered in Clinical Trials.gov (Reference No. NCT03906851).

4 Results

This section presents the title, aim and results of each of the three articles.

4.1 Article I

Changes in physical activity, physical fitness and well-being following a school-based health promotion program in a Norwegian region with poor public health profile: A non-randomized controlled study in early adolescents.

The aim was to examine whether the Active and Healthy Kids Program led to changes in physical activity, sedentary time, physical fitness, well-being and health-related quality of life in adolescents.

A total of 644 pupils provided written consent to participate: 197 students at the intervention schools and 447 students at the control schools, with an even proportion of male and female participants across intervention and control schools ($p > 0.05$). The intervention and control groups did not statistically differ with respect to demographic data (gender, age and socio-economic status), but the intervention group had a more positive attitude to the school environment, reporting a significantly greater baseline level in the relevant HRQoL domain ($p = 0.018$).

The Actigraph measurements of time spent per day on MVPA showed that 36% of the adolescents adhered to the physical activity recommendations of a minimum of 60 min/day of MVPA. This adherence rate did not change between baseline and follow-up.

Characteristics of study participants and changes between the groups are shown in Table 6. School-based physical activity level, physical fitness, HRQoL, and vitality changed from pretest to posttest. None of the groups changed their full day physical activity. However, the control group increased full day sedentary time, and there was also a tendency towards a similar increase in the intervention group. For school-time physical activity, the control group reduced total physical activity ($p = 0.012$) and MVPA ($p < 0.001$). The control group reduced sedentary time during school hours ($p < 0.001$).

The control group had reduced scores on HRQoL psychological well-being (p = 0.023), peers and social support (p = 0.031) and school environment (p = 0.016), along with vitality (p = 0.000). Both the intervention group and control group improved their scores on HRQoL autonomy and parent support, with greater improvement in the intervention group (intervention group p = 0.001, control group p = 0.026).

Table 6

Mean (SE) baseline, follow-up and group (intervention-control) differences (SE) with p-values for changes

	Intervention			Control			Group diff (SE)	p-value
	Baseline (SE)	Follow-up (SE)	p-value	Baseline (SE)	Follow-up (SE)	p-value		
n	197			447				
BMI (kg/m^2)	19.8 (0.2)	20.2 (0.2)	0.000**	20.0 (0.2)	20.4 (0.2)	0.007*	-0.01 (0.1)	0.934
PA full day								
n	197			447				
Total PA (cpm)	492 (13.1)	505 (20.1)	0.512	466 (9.8)	470 (15.6)	0.762	6,6 (9.1)	0.467
SED (min/day)	543 (5.7)	557 (6)	0.057	536 (3.8)	553 (0.9)	0.012*	-2.68 (3.7)	0.466
MVPA (min/day)	56 (1.7)	55.9 (1.9)	0.916	52 (1.1)	51 (1.4)	0.485	0.76 (1)	0.446
PA school time								
n	197			447				
Total PA (cpm)	441 (16.3)	449 (17.3)	0.668	404 (12.1)	359 (10.7)	0.012*	54.7 (9.7)	0.000**
SED (min/day)	182 (2.6)	175 (3.2)	0.098	190 (2.2)	177 (2.4)	0.000**	6.5 (2)	0.001**
MVPA (min/day)	17 (0.8)	17 (10.8)	0.585	16 (0.6)	13 (0.5)	0.000**	2.8 (0.4)	0.000**
n	197			447				
CRF (m)	1005 (8.1)	1021 (7.3)	0.076	990 (6.6)	999 (5.3)	0.164	8.7 (4.1)	0.035*
Strength (cm)	163 (1.8)	171 (1.8)	0.000**	161 (1.3)	167 (1.4)	0.000**	2 (0.5)	0.000**
HRQL								
n	197			447				
Physical	46 (0.6)	47 (0.7)	0.366	46.3 (0.5)	46.1 (0.5)	0.648	0.9 (0.4)	0.012*
Psychological	51 (0.6)	51 (0.8)	0.845	50.3 (0.5)	49.0 (0.6)	0.023*	1.19 (0.4)	0.001**
Autonomy	53 (0.7)	55 (0.8)	0.001**	53.3 (0.5)	54.7 (0.6)	0.026*	1.2 (0.4)	0.004*
Peers and social	51 (0.7)	50 (0.9)	0.085	51.2 (0.5)	50 (0.5)	0.031*	-0.4 (0.4)	0.909
School	53 (0.7)	53 (0.8)	0.621	51.3 (0.5)	49.9 (0.6)	0.016*	2 (0.4)	0.017*
n	197			447				
Vitality	4.7 (0.1)	4.8 (0.1)	0.412	4.8 (0.0)	4.5 (0.1)	0.000**	0.3 (0.0)	0.000**

Note: * statistically significant difference p < 0.05, ** statistically significant p < 0.001. Abbreviations: SE = Standard Error, BMI = body mass index, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate- to vigorous intensity physical activity, CRF = Cardiorespiratory fitness, HRQoL = Health-related quality of life, in the five domains; Physical well-being, Psychological well-being, Autonomy and parent relationship, Peers and social support and School environment.

Table 6 is an edited version of Table 3 in the published *Article I*. Corrections can be seen in the appendix Errata.

Results from the linear mixed model analysis with cluster random effects are shown in Table 7, a new version of Table 4 in the published *Article I*. The intervention had no effect on students' full day physical activity levels. For school time physical activity levels, the intervention had a positive effect on total physical activity (p = 0.005) and MVPA (p = 0.003), with an estimated average difference between groups of 70.24 counts per minutes (cpm) (95% CI 21.4 to 119.06) and 3.49 min/day (95% CI 1.21 to 5.78) spent in MVPA.

For other outcomes showing a significant effect, the students in the intervention group covered a longer distance in the Andersen field running test of 20.32 meters (95% CI 2.99 to 37.65), jumped farther by 2.67 centimeters (95% CI 0.00 to 5.32), and reported higher vitality than the controls, with a score of 0.29 (95% CI 0.08 to 0.51) (Table 7).

Comparing effects across variables (standardized β from Table 7), the greatest effect of the intervention was found in school time physical activity (Total PA β = 0.3 with 95% CI 0.10 to 0.55 and MVPA β = 0.34 with 95% CI 0.12 to 0.57).

Table 7

Effects of the intervention between intervention and control groups from baseline to follow-up

	Linear mixed model interaction (group x time)				
	Unstandardized B	95% CI [LL, UL]	Standardized β	95% CI [LL, UL]	P-value
PA full day					
Total PA (cpm)	2.90	[-46.53, 52.35]	0.01	[-0.25, 0.26]	0.908
SED (min/day)	-0.34	[20.19, 19.51]	-0.00	[-0.25, 0.24]	0.973
MVPA (min/day)	0.70	[-4.85, 6.24]	0.03	[-0.21, 0.27]	0.804
PA school time					
Total PA (cpm)	70.24	[21.4, 119.06]	0.3	[0.10, 0.55]	0.005*
SED (min/day)	5.46	[-4.70, 15.62]	0.14	[-0.12, 0.39]	0.292
MVPA (min/day)	3.49	[1.21, 5.78]	0.34	[0.12, 0.57]	0.003**
CFR (m)	20.32	[2.99, 37.65]	0.17	[0.03, 0.32]	0.022*
Strength (cm)	2.67	[0.00, 5.32]	0.1	[8.05, 0.20]	0.05*
HRQoL					
Physical	1.06	[0.74, 2.86]	0.11	[-0.07, 0.29]	0.247
Psychological	1.28	[0.54, 3.09]	0.13	[-0.05, 0,31]	0.168
Autonomy	1.22	[-0.91, 3.57]	0.11	[-0.08, 0.31]	0.260
Peers	0.00	[2.02, -2.02]	0.00	[0.19, -0.19]	0.999
School	1.21	[-0.81, 3.23]	0.11	[-0.08, 0.30]	0.241
Vitality	0.29	[0.08, 0.51]	0.24	[0.06, 0.42]	0.008**

Note: Group = intervention and control, Time = Baseline measurements and follow-up. Students and schools were included as random effects to account for clustering. * statistically significant difference $p < 0.05$, ** statistically significant $p < 0.001$. Abbreviations: B = unstandardized regression coefficient, indicates differences between intervention and control groups from baseline to follow-up, β = standardized regression coefficient, indicates impact of the effect, CI = confidence interval, LL = lower limit, UP = upper limit, SE = standard error, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate- to- vigorous physical activity, CRF = cardiorespiratory fitness, HRQoL = health-related quality of life, in the five domains; Physical well-being, Psychological well-being, Autonomy and parent relationship, Peers and social support and School environment.

Effects for boys in the intervention group are shown in Table 8, a new version of Table 5 in the published *Article I*. There was no effect on full day physical activity level, but there was an effect on school-based physical activity for the boys, total PA ($p = 0.002$) and MVPA ($p < 0.001$), with an estimated average difference between groups of 127.94 cpm (95% CI 47.10 to 208.78) and 6.31 min/day (95% CI 2.87 to 9.76) spent in MVPA. For the boys in the intervention group, the implemented program had the largest effect on school-based physical activity (school time total PA β = 0.59 with 95% CI 0.22 to 0.96, school time MVPA β = 0.61 with 95% CI 0.28 to 0.94).

Effects for girls in the intervention group are shown in Table 9, a new version of Table 6 in the published *Article I*. There was no effect on full day or school-time physical activity, but there was a negative effect on girls' sedentary school time (p = 0.021) with an estimated average difference between groups of 16.40 min/day (95% CI 2.46 to 30.34). There was an effect on girls' cardiorespiratory fitness, HRQoL, and vitality (Table 9).

The largest effect found among girls, although a negative effect, was on sedentary time in school (β = 0.41 with 95% CI 0.06 to 0.75). This effect was caused by a much larger reduction in sedentary school time in the control group than in the intervention group.

Table 8

Characteristics and effects for boys

	Intervention		Control		Linear mixed model interaction (group x time)				
	Baseline M (SE)	Follow-up M (SE)	Baseline M (SE)	Follow-up M (SE)	Unstandardized B	95% CI [LL, UL]	Standardized β	95% CI [LL, UL]	p-value
PA full day									
Total PA (cpm)	507.74 (21.7)	487.34 (23)	509.39 (16.7)	478.44 (20.7)	10.55	[-56.88, 77.98]	0.05	[-0.29, 0.38]	0.758
SED (min/day)	540.85 (8.9)	563.81 (9.6)	521.09 (6.9)	547.25 (8.8)	-3.19	[-34.77, 28.38]	-0.04	[-0.42. 0.35]	0.842
MVPA (min/day)	57.87 (2.7)	55.96 (2.7)	58.29 (2.1)	52.28 (2.6)	4.10	[-4.95, 13.14]	0.18	[-0.21, 0.57]	0.373
PA school time									
Total PA (cpm)	477.08 (25.2)	511 (25)	460.39 (18.3)	366.84 (20.8)	127.94	[47.10, 208.78]	0.59	[0.22, 0.96]	0.002*
SED (min/day)	178.3 (4.3)	168.19 (4.2)	181.02 (3.1)	175.78 (3.5)	-4.87	[-19.34, 9.60]	-0.12	[-0.48, 0.24]	0.508
MVPA (min/day)	18.55 (1.1)	19.7 (1.1)	18.38 (0.8)	13.21 (0.9)	6.31	[2.87, 9.76]	0.61	[0.28, 0.94]	<0.001**
CFR (m)	1040.19 (12.3)	1065.71 (12.6)	1006.34 (8.9)	1016.04 (8.7)	15.82	[-10.02, 41.65]	0.14	[-0.09,0.36]	0.229
Strength (cm)	171.21 (2.8)	181.09 (2.8)	164.47 (1.9)	171.66 (2.8)	2.69	[-1.21, 6.58]	0.10	[-0.04, 0.25]	0.175
HRQoL									
Physical	46.43 (1.0)	47.31 (1.0)	46.71 (0.7)	48.02 (0.7)	-0.43	[-3.03, 2.17]	-0.04	[-0.30, 0.22]	0.744
Psychological	50.99 (1.0)	50.92 (1.0)	50.67 (0.7)	50.84 (0.7)	-0.22	[-0.28, 2.34]	-0.02	[-0.27, 0.23]	0.868
Autonomy	52.91 (1.1)	55.54 (1.1)	52.06 (0.8)	55.13 (0.8)	-0.44	[-3.58, 2.71]	-0.04	[-0.33, 0.24]	0.785
Peers	49.49 (1.1)	48.49 (1.1)	50.60 (0.8)	49.91 (0.8)	-0.32	[-3.26, 2.62]	-0.03	[-0.31, 0.25]	0.830
School	52.88 (1.1)	53.12 (1.1)	50.59 (0.8)	49.73 (0.8)	1.08	[-1.89, 4.05]	0.10	[-0.18, 0.38]	0.474
Vitality	4.75 (0.1)	4.86 (0.1)	4.77 (0.1)	4.76 (0.1)	0.11	[-0.18, 0.40]	0.09	[-0.15, 0.33]	0.447

Note: Group = intervention and control, Time = Baseline measurements and follow-up. Students and schools were included as random effects to account for clustering. * statistically significant difference $p < 0.05$, ** statistically significant $p < 0.001$. Abbreviations: B = unstandardized regression coefficient, indicates differences between intervention and control groups from baseline to follow-up, β = standardized regression coefficient, indicates impact of the effect, CI = confidence interval, LL = lower limit, UP = upper limit, SE = standard error, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate- to- vigorous physical activity, CRF = cardiorespiratory fitness, HRQoL = health-related quality of life, in the five domains; Physical well-being, Psychological well-being, Autonomy and parent relationship, Peers and social support and School environment.

Table 9

Characteristics and effects for girls

	Intervention		Control		Linear mixed model interaction (group x time)				
	Baseline M (SE)	Follow-up M (SE)	Baseline M (SE)	Follow-up M (SE)	Unstandardized B	95% CI [LL, UL]	Standardized β	95% CI [LL, UL]	p-value
PA full day									
Total PA (cpm)	464.69 (22.4)	517.87 (24.1)	434.41 (15.3)	483.8 (19.8)	3.79	[-67.13, 74.71]	0.02	[-0.33, 0.36]	0.916
SED (min/day)	549.37 (8.4)	553.38 (9)	546.94 (5.8)	551.37 (7.4)	-0.42	[-25.40. 24.55]	-0.01	[-0.32, 0.31]	0.973
MVPA (min/day)	53.92 (2.3)	54.77 (2.4)	48.62 (1.5)	51.1 (2)	-1.62	[-8.33, 5.12]	-0.07	[-0.36, 0.22]	0.637
PA school time									
Total PA (cpm)	406.38 (18.4)	394.34 (18.7)	347.47(12.3)	324.5 (13.1)	10.93	[-44.20, 66.07]	0.05	[-0.20, 0.31]	0.697
SED (min/day)	184.67 (4.1)	183.33 (4.2)	199.43 (2.7)	181.69 (2.9)	16.40	[2.46, 30.34]	0.41	[0.06, 0.75]	0.021*
MVPA (min/day)	16.36 (1.0)	14.99 (1.0)	14.10 (0.7)	12.08 (0.7)	0.66	[-2.26, 3.66]	0.06	[-0.23, 0.35]	0.672
CFR (m)	966.50 (11.4)	983.11 (11.4)	972.46 (7.7)	962.54 (7.8)	26.53	[3.68, 49.38]	0.23	[0.03, 0.42]	0.023*
Strength (cm)	153.63 (2.6)	160. 74 (2.6)	159.47 (1.7)	163.9 (1.7)	2.68	[-0.93, 6.29]	0.10	[-0.03, 0.24]	0.144
HRQoL									
Physical	46.08 (0.1)	46.97 (1.0)	45.99 (0.7)	44.33 (0.7)	2.54	[0.08, 5.01]	0.25	[0.01, 0.50]	0.043*
Psychological	51.38 (1.1)	51.30 (1.1)	49.89 (0.7)	47.06 (0.7)	2.76	[0.2, 5.32]	0.27	[0.02, 0.52]	0.035*
Autonomy	52.98 (1.1)	55.58 (1.1)	54.44 (0.7)	54.17 (0.7)	2.87	[0.03, 5.72]	0.26	[0.00, 0.52]	0.048*
Peers	53.53 (1.1)	52.48 (1.1)	51.84 (0.7)	50.44 (0.7)	0.35	[-2.46, 3.15]	0.03	[-0.23, 0.30]	0.807
School	54.01 (1.1)	53.34 (1.1)	51.86 (0.7)	49.87 (0.7)	1.32	[-1.44, 4.07]	0.12	[-0.14, 0.38]	0.348
Vitality	4.70 (0.1)	4.74 (0.1)	4.76 (0.1)	4.3 (0.1)	0.47	[0.16, 0.78]	0.38	[0.14, 0.64]	0.003*

Note: Group = intervention and control, Time = Baseline measurements and follow-up. Students and schools were included as random effects to account for clustering. * statistically significant difference $p < 0.05$, ** statistically significant $p < 0.001$. Abbreviations: B = unstandardized regression coefficient, indicates differences between intervention and control groups from baseline to follow-up, β = standardized regression coefficient, indicates impact of the effect, CI = confidence interval, LL = lower limit, UP = upper limit, SE = standard error, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate- to- vigorous physical activity, CRF = cardiorespiratory fitness, HRQoL = health-related quality of life, in the five domains; Physical well-being, Psychological well-being, Autonomy and parent relationship, Peers and social support and School environment

4.2 Article II

Young adolescents' lived experience with teacher-led classroom-based physical activity: a phenomenological study.

The aim of this article was to identify and describe the general meaning structure of secondary school students' experience of classroom-based physical activity as structured by the Active and Healthy Kids Program and how this related to their psychosocial health and well-being in school.

The main result of a descriptive phenomenological analysis is the general meaning structure, in this case an essential summary of the psychologically relevant aspects of the informants' experience of classroom-based physical activity, a new whole representing all informants' experiences of this phenomenon.

The general meaning structure:

The essence of the study and Article II was that classroom-based physical activity in secondary school is experienced as a new movement setting where the integration of physical activity into a subject lesson transfers the students into a different space, where the school, the classroom lesson, the other students and teachers and the students themselves emerge in a different light. One moves from a familiar to an unfamiliar use of this space, for example by running inside the school and dancing in slippery socks. Or one transfers a familiar type of work, such as classroom lessons, to an outdoor space. Outdoors, schoolwork is embraced by fresh air, an aroused body, and novel ways of being with classmates.

The changing nature of the school workspace can be disruptive when one is concentrating and comfortably occupied with schoolwork. However, when one accepts the invitation to move and join the physical activity, opportunities to engage the creative side of oneself appear. Suddenly, one may feel unstuck and freed from all the brain work. Only using one's head for understanding, processing and remembering knowledge can be exhausting. Moving one's body while solving a given task provides a newly felt

freedom to explore a variety of solutions to the task in a more integrated way, by engaging both body and mind in a practical setting.

The active use of the school space in unfamiliar ways may compromise the status of regular schoolwork. One starts to wonder how important academic work is in comparison to the social dynamics between classmates that emerges. As one sees classmates acting in awkward settings doing unfamiliar tasks, the social hierarchy of the class may change. Who and what is most important now? In the search for answers to issues of social hierarchy, the class may re-group in new ways. New bonds between students are formed and some social walls are broken down. Collaboration materializes through a merging of trust, growing respect, and the sharing of a sense of victory when one's group achieves something the individual could not have done alone.

The pleasures of a shared victory can be jeopardized if one surrenders to the inner competitor where winning obscures both social togetherness and schoolwork. Competition thus throws into relief possible trade-offs between the physical part of the task, being with others, and engagement with academic content.

How important is the academic content in comparison to the physical activity itself? A question like this brings to light another facet of this physical school activity: an increased awareness of one's preferred way of doing schoolwork along with one's ambitions and priorities. The awareness of a possible conflict between these preferences and priorities is itself an outcome of the unfamiliarity with how this physical activity is framed. At the same time, the unfamiliar setting offers a space to experiment with one's priorities. Now one can see oneself learning and moving in novel ways, and one can compare this with the familiar ways of doing schoolwork.

The comparison with familiar ways of doing schoolwork becomes highlighted in two ways: the way the teacher handles education via physical activity and one's return to the chair and desk. This shift can be challenging as one's body has been aroused and it takes a while before the mind and body are calm and back in place – a slightly different place now.

In this general meaning structure, we identified three essential parts, referred to as constituents, as they are interrelated, not independent of each other. The structure is based on the relationship between the constituents (Giorgi, 2009). The following constituents were identified: (1) engaging with the school environment in a different way, (2) a changed experience of togetherness and classroom dynamics, and (3) an increased awareness of preferences regarding the learning setting.

4.3 Article III

Secondary school teachers' experiences with classroom-based physically active learning: "I am excited, but it's really hard".

The aim was to explore subject teachers' lived experience of classroom-based physical activity with an emphasis on PAL, and to identify and describe secondary school teachers' general perception of this phenomenon.

The main result of a descriptive phenomenological analysis is the general meaning structure, in this case an essential summary of the psychologically relevant aspects of the teachers' experiences of classroom-based PAL, a new whole representing all interviewed teachers' experiences of this phenomenon.

The general meaning structure:

The teacher finds that implementing PAL into lessons provides an experience of leaving known teaching practices and treading on less familiar ground. The good intentions of PAL are endorsed as they are in accordance with the teachers' own beliefs that students need more physical activity. PAL is a rewarding contribution to everyday teaching and seems to fill several identified gaps for improving teaching and accommodating student needs. The students have an active break during the lesson, which improves their attention and concentration and counteracts the often experienced drop in energy level during regular classes. It also reduces sedentary time, which teachers consider important for students' overall health and well-being. Furthermore, glimpses of

desirable learning outcomes are revealed when the educational tasks are well integrated with the physical activity component, and when the students subsequently respond positively to this.

At other times, teachers feel overwhelmed by the complexity of integrating academic schoolwork with physical activity, the difficulty of making it work in practice and of ensuring relevant learning outcomes as defined by the curriculum. The novelty and creativity needed are challenging; no matter how hard one tries, one just does not get it quite right, making one feel inadequate, or not creative enough, and realizing something more is needed to make this way of teaching viable in the long run. Teachers may resort to their individually preferred solutions. In addition, they seek support among colleagues, assigned resource persons, and the school leadership. Especially when concrete support is not forthcoming, teachers' uncertainty is resolved by falling back on a few successful strategies.

Good outcomes become outweighed by the extra time and engagement that is required and demotivation creeps in. The teachers wonder what to focus on, facilitating physical activity or offering relevant schoolwork. A separation of the two becomes opportune, as do the moments when PAL is used. Physical activity in lessons then becomes a meaningful tool to use occasionally when students need variation or as a tool to liven up a sedentary classroom and school day when the teacher is motivated, or students ask for it.

Three themes emerged from the analysis: 1) Motivated by relevance, 2) A more complex reality than expected, and 3) Resigned to simpler solutions.

5 Discussion

5.1 Methodological reflections

A strength of this thesis is the use of both qualitative and quantitative methods, which allowed for different perspectives to gain insight into how the students' health and well-being was influenced by classroom-based physical activity. The quantitative perspective allows for the inclusion of a large number of participants, the study of changes over time and isolation of variables to study how these correlates with other variables. The qualitative method allows for the in-depth description of an individual's experienced meaning in his or her context. Trustworthiness of research should be evaluated within the framework of the epistemological assumptions that underpin the procedures used to generate findings (Stige et al., 2009). Methodological coherence is especially important when considering the validity of findings; the research question and methodological steps are to be coherent with the stated scientific perspective (Morse et al., 2002). Thus, the quantitative and qualitative studies in this thesis are evaluated differently below.

5.1.1 The quantitative study (Study 1)

Study 1 was conducted based on the epistemological assumption that the world can be observed and measured, and therefore that knowledge of how the Active and Healthy Kids Program influenced the students' health could be seen and measured objectively. The study is interdisciplinary as it combines the natural science data of measuring physical activity and physical fitness with psychological data, representing social science. Neither natural science nor social science is entirely objective (Kuhn & Hacking, 2012; Lowe et al., 2013), but an attempt is made to uncover truths about the natural world by eliminating personal biases, emotions, and false beliefs. The positivistic/post-positivistic tradition aims to generalize, understand, predict, and discover the relationship between variables and the trustworthiness of such studies is to a large extent dependent on the quality of the measurement tools, i.e., whether we measure what we want to measure. Some methodological reflections about Study 1 have already been mentioned in the

method section in Table 4 and in the list of data collection challenges. Below I will address internal and external validity.

5.1.1.1 Internal validity

Internal validity, understood as the extent to which the research condition is controlled so that the independent variable causes an effect or a change in the dependent variable (Berg & Latin, 2008), is evaluated in the following. The study design may affect internal validity in several ways. Selection bias is possible. The municipalities and schools invited to the intervention may have been considered as particularly motivated. Further, since the intervention group was aware that the experiment had been tested, they might also have been more motivated to implement classroom-based physical activity than if it had not been tested. This is called the Hawthorne Effect: if subjects know they are being studied, they try harder (McCambridge et al., 2014). The use of a representative control group strengthens the study's internal validity.

Due to the naturalistic quasi-experimental design with a practice/community-based intervention and the researchers' role as evaluators, the setting was not strictly controlled as is more common in researcher-driven studies (Craig et al., 2012). One consequence of this design was that we did not measure the extent of implementation delivery, i.e., how much classroom-based physical activity that was actually implemented by the teachers is not reported in *Article I*. This is an important bias common in natural experiments (Craig et al., 2012), thus an important limitation to our conclusions. This bias results in difficulty in determining to what extent the results found are caused by the intervention. When uncertainty about amount of exposure is present, association between variables and outcomes becomes difficult; associations may be underestimated or even missing altogether (Hutcheon et al., 2010). *Articles II* and *III* provide some information on adherence to the program's guidelines at the schools where informants were selected, and this information indicated that less classroom-based physical activity was implemented than the program recommended. This is not surprising as other studies have found adherence to vary, and that teachers often use physical activity in classes less frequently and/or for shorter periods of time than the

recommended/required levels (Quarmby et al., 2019; Solberg, 2022; Webster et al., 2015). Information on accuracy of exposure and outcome can influence the results and is a key factor for the interpretation of research findings (Hutcheon et al., 2010). Thus, the lack of figures on the extent of implementation stands as a major limitation to the study, leaving the effects and effect sizes to be interpreted with caution.

Instrument accuracy is important, and we therefore used validated tests and questionnaires. However, the question of instrument accuracy arises when more than one person is collecting data. In Study 1, several researchers and master's students took part in the testing and data collection, and all received detailed instructions on how to test and collect data to maximize instrument accuracy. However, some concerns still need to be mentioned. The process of being tested provides a subject with some experience of the test that may influence test performance, called a practice or learning effect (Berg & Latin, 2008). The testing experience may also provide an increased incentive to improve in some manner. This might have been evident in physical tests such as the Andersen field running test and the standing long jump, where students may have performed better at post-test since they were familiar with the tests. Aadland et al., (2014) found a learning effect of 3% in the Andersen field running test between tests 1 and 2. Ideally, we should have performed a "familiarization trial" or "the best of two" for baseline measurements of physical fitness as recommended by Aadland et al. (2014). However, the learning effect was described in a sample that performed the test with only 14 days apart (Aadland et al., 2014). Since approximately 8 months elapsed between tests, the learning effect in the Andersen test might be less profound in our sample.

The final reflection on internal validity concerns student motivation to take part in the Andersen field running test and answering the questionnaire. Since participation in the running test was voluntary, several students chose not to participate. It was sometimes difficult to assess whether the participating students made efforts as instructed with the aim of increasing the reliability of the test. This should be taken into account when evaluating the reliability of physical fitness measurements. The questionnaire was

relatively long as there were additional questions to those used for this thesis. The students spent from 30 to 60 minutes answering the questionnaire. The questionnaire was revised and shortened at post testing; questions considered unnecessary to ask again were removed. Despite this, the questionnaire might have been too long to keep students focused and motivated to answer.

5.1.1.2 External validity

External validity, understood as the appropriateness to use the results of a study in other conditions or settings (Berg & Latin, 2008), is evaluated in the following. Since the students were exposed to several intervention components, it is more difficult to determine the direct cause if change is detected, referred to as multiple treatment interference (Berg & Latin, 2008). The Active and Heathy Kids Program had several intervention components, involving physical activity and diet (shown in Table 3), which in total resulted in the changes observed after nine months of the program and are important to take into account when interpreting the results. With regard to the generalizability of the study, the more artificial and constrained a research setting becomes, the lower the ability to generalize from it becomes (Berg & Latin, 2008). Thus, a strength of this study is its practice near approach conducting naturalistic quasi-experimental research in school settings, this might have greater external validity compared to a strict randomized controlled study. The student response rate of 79% was considered acceptable.

5.1.1.3 Strengths and limitations

Every study has limitations and weaknesses. Strengths in Study 1 that I would like to highlight are its practice-near approach in researching a naturalistic school setting. The study is unique because it is a study of natural evolution in a community introducing an intervention independently of researchers, a so-called natural experiment, a form of research that widens the range of what can usefully be evaluated (Craig et al., 2012). Strengths are the use of validated instruments and objective measurements of physical activity and the use of a control group. However, Study 1 had the following limitations:

- Study period: 1) The study covered one school year, and is thus not suitable to draw conclusions on long-term changes. A prospective observational design over three years after the start of implementation could have provided trends and changes beyond the first year. 2) Seasons during and between data collection might influence physical activity levels, as has previously been found to impact physical activity levels (Turrisi et al., 2021). However, this might not be as evident in adolescents. A study conducted in Norway concludes that seasons appear to have less influence on adolescents' physical activity levels (Kolle et al., 2009). Data collection for *Article I* took place in September and from mid-April to mid-May. Although these are different seasons and April is normally slightly colder than September, data from weather reports showed that these months were quite similar in temperature, wind, and rainfall (yr, 2022). Although research has shown that adolescents' physical activity levels in general are not significantly influenced by the season (Kolle et al., 2009), it is likely that the late autumn and winter seasons influenced the adherence to classroom-based physical activity, either by avoidance or by moving the activities indoors. In *Article III*, the data do suggest that especially PAL was challenging to perform outdoors when the school grounds were icy and weather was windy and rainy.
- Missing data: A considerable number of parents did not give permission for their children to participate, representing 163 out of 813 possible students (see Figure 5, the flow chart for Study 1). Several attempts were made to obtain permission, but at a certain point we as researchers have to make a decision not to contact or disturb people more than necessary. Further, it was difficult to achieve complete data sets for all participants and the data sets had missing data. Missing data in such intervention studies are common as people participate voluntarily and cannot be forced. Missing values were handled with statistical actions when analyzed (described in methods). No satisfactory solution exists for missing data (Altman & Bland, 2007), thus transparency for how these are dealt with is important. We found that the most missing data was for physical activity measurements. This had three main causes: 1) many students did not agree to

wear the accelerometers (it was not cool), 2) lost accelerometers (16 in total) and loss to follow-up, and 3) many students had low wear time compliance, thus their data were excluded. For physical activity for a full day 66 recordings were excluded at pre-test because of too little wear time (484 recording was valid and included), and at post-test 193 recordings were excluded (329 recordings were valid and included). This affects the validity of the physical activity measurements. That said, these are familiar challenges in school-based intervention studies (Solberg, 2022; Sutherland et al., 2016). Alternatively, instead of hip-worn accelerometers, those worn on the wrist may promote more adherence (Schaefer et al., 2014). Effective solutions could greatly benefit the research field.

- Number of days of objective measurements: Since the WHO physical activity recommendations have changed since we conducted this study it would have been beneficial to measure a whole week of seven days, to enable the measurements of daily physical activity to be accumulated across the week. Physical activity during the week in school hours was based on two days of measurements; more days could have provided much more data and a better reflection of the students' different physical activity behaviors across several days.
- Implementation fidelity: Level of teachers' adherence to the program has not been recorded (mentioned and discussed under internal validity). As previously discussed, this is a major limitation to the study.

5.1.2 The qualitative studies (Studies 2 and 3)

The methodological approach for Studies 2 and 3 was guided by Giorgi's descriptive phenomenological method, based on the epistemological assumption that meaning exists for the subject, that "consciousness is the medium of access for any knowledge whatsoever" (Giorgi, 2009, p. 68). Malterud (2001, 2017) emphasizes three central quality criteria in qualitative research: reflexivity, relevance and validity, while Kvale (1996) states that in phenomenology the researcher should address credibility, rigor and

trustworthiness. As mentioned earlier, research has to be evaluated from the perspective and research paradigm/epistemology in which it was designed and conducted. In qualitative research and within phenomenology there are different views of how we can access knowledge, such as "Is the epoché necessary, possible or desirable?". Thus my methodological reflections will be centered on methodological coherence in relation to Husserl's descriptive phenomenology and the descriptive phenomenological psychological method of Giorgi.

Phenomenology opposes the idea that we can have objective knowledge of the world in itself, and argues that all knowledge goes through consciousness, and that knowledge is always incomplete (Giorgi, 2009). Descriptive phenomenology involves the belief that we can, from within a given perspective, describe whatever presents itself to consciousness, however incomplete and ambiguous it may be (Giorgi, 2009). The researcher gains knowledge through access to the conscious experience of others and the researcher's role when conducting a descriptive phenomenological study is different from the role in a quantitative study, as the researcher is part of the method. It is also through my consciousness that the explored phenomenon of classroom-based physical activity is understood, described, and its general structure found and reported, all based on the informants' descriptions.

5.1.2.1 Some reflections on the quality of the interviews

The quality of the data can be discussed. For a phenomenological study, a researcher ideally wants specific, not general, descriptions (Giorgi, 2009). This is a goal to be aimed at, but in fact the practical interview situation often provides a mixture, as was the case in Studies 2 and 3. Danish is my native language, which could have influenced the study as language is the key to communication and understanding a person's descriptions. I conducted the interviews in a suitably adjusted mixture of Norwegian and Danish and the informants could speak to me freely in Norwegian. I have lived in Norway for seven years now and have become quite familiar with the language and some dialects. In this respect, I do not believe that language has negatively affected my understanding of the informants' descriptions and thereby the quality of the research.

5.1.2.2 Reflections on recruitment and selection of informants

Regarding the selection of informants, "how the who of the study was selected" is important for quantitative researchers as this relates to the evaluation of the generality of the results (Englander, 2012). This aim of representativeness is not the same in phenomenological enquiry; here, the researchers are simply not primarily interested in knowing how many or how often one has had a particular experience, although such information might show in the data (Giorgi, 2009). The question is more about asking oneself if the informant has the experience that the researcher is looking for (Englander, 2012). In phenomenological research it is the phenomenon and the general meanings structure (worked out in the fourth step of Giorgi's method) that should be general, not the population studied (Englander, 2012). This explains why the selection of informants aimed for sufficient variation of the experience with the phenomenon of interest in the study and not for a representative sample in the sense of having all intervention schools in the Active and Healthy Kids Program represented. Therefore, the selection of informants for these two qualitative studies can be described as a convenience sample.

The number of informants included in the two phenomenological studies is based on several arguments. First, "a large representative sample" is not a focus for a phenomenological study. Second, the phenomenological approach requires a minimum of three participants because this has shown to provide enough material to engage in imaginative variation (see section 3.4.2; Giorgi, 2009). Third, for *Article II* when nine student informants had been interviewed, themes reoccurred, which suggested that the researcher may have reached saturation, i.e. sufficient data to answer the research question, that further data collection may not bring something new. The criterion of informants with varied physical activity habits was met with the help of the teachers in recruitment. Further, transcripts from nine informants were a relatively large set of data for a phenomenological analysis, thus more informants could have made the analysis more difficult without enhancing the quality of the study. Fourth, for *Article III*, 14 teachers were relevant for this study, but only six agreed to take part. Several attempts were made with various strategies to recruit more teachers without success. I tried recruiting through my contact teacher at the local schools, then I provided an

information letter about the study, with a presentation of myself and finally I contacted teachers directly, either in person, by e-mail or by phone. My impression was that many teachers did not feel that they had much to say, and that they had not used the approach of classroom-based physical activity to the extent recommended in the program and therefore doubted what contribution or relevance they could bring to my study. To those whom I had a chance to meet and talk to, I emphasized that the interview was not to evaluate them, how much or how little they applied the approach, but to hear their individual experience of integrating physical activity into their teaching. Although this was pointed out in earlier information, when I had the opportunity to explain it orally, more teachers now agreed to participate. Since six informants is more than Giorgi recommends for a phenomenological analysis along with an evaluation of the quality of the interviews, we concluded that the six transcriptions ranging from 21 to 32 pages with rich descriptions provided material that was sufficient for this phenomenological study.

5.1.2.3 One's natural attitude

In descriptive phenomenology, my subjectivity as a researcher is not eliminated as in quantitative research, it is more a question of clarifying it. What matters is the researcher's presence in relation to the phenomenon under study (Giorgi 2002). The researcher seeks to minimize his or her presence to enable a full focus on the participant's experience, adopting the phenomenological attitude (described in the method section). In the analysis of the data for Studies 2 and 3, rigorous methodological steps as developed by Giorgi were followed. This ensured that the whole description was analyzed in a way that could be repeated by other researchers familiar with the method, thus making the analysis and approach highly transparent. In the analysis the researcher's ability to adopt the phenomenological attitude is an important methodological step as it helps the researcher to focus on the described experience from the informant's perspective, staying true to the analysis of the phenomenon under study. The researcher's awareness and skills in adopting this attitude and knowledge of phenomenology are therefore important. The psychological reduction is the minimum needed to conduct research based on a phenomenological theory of science (Giorgi,

2009). An example of being aware of the natural attitude or withdrawing from it is how the description of the constituent of "togetherness" developed in Study 2. Being in the natural attitude, I could fairly easily shift to recognition and affirmation of the concept of "relatedness" from the theory of self-determination (Ryan & Deci, 2017), when the student informants described how social walls were broken down in PAL. By being aware of the natural attitude and avoiding the temptation of seeing what seems to be there, what I am already familiar with, I stayed with the description and experience of the informants, which resonated with the material, and described what the informants were experiencing. This could have ended up in a close similarity between "togetherness" and "relatedness"; however, describing outside of the natural attitude enables one to see something one is unfamiliar with, and then one can compare where contrasts and similarities are revealed. As Applebaum (2011) describes it, the descriptive phenomenological method teases out and articulates meanings that are already in the data. In contrast, interpretive phenomenology requires the researcher to come up with meanings to account for the data (Applebaum, 2011) or other qualitative methods with an inductive approach; here, theory determines the elements most important to examine.

5.1.2.4 Some final reflections

The descriptive method aims for knowledge that is systematic, methodical, general, and critical (Giorgi, 2009), where interpretive phenomenology and other qualitative analysis methods often accentuates the richness and diversity of the data and tends to resist articulation into more general structures (Giorgi 1992). The descriptive phenomenological method in its search for a general meaning structure cannot make statistical generalizations based on the results but instead makes analytical generalizations (Kvale, 1996), where generalization springs from the meaning structure (Englander, 2012; Giorgi, 2009). In this thesis, the results have been raised from a particular level (the experiences of the informants) to a more general and essential level through the analysis, which makes is reasonable to assume that the findings can be useful in the understanding of classroom-based physical activity in other situations.

5.2 Discussion of findings

In pursuit of the aim to gain knowledge of classroom-based physical activity in secondary school, how it influences the health of the target group (students), and how this new way of teaching is experienced by the individuals performing and living it (students and teachers), three research articles have been produced and presented as the main content of this thesis. The three articles all contribute to this thesis, having their individual aims, methodological approach, and results that together help to provide perspectives on the overall research question: "How does classroom-based physical activity influence student health and well-being?" and a more solid knowledge base for the research field. In this section, the discussion will be at an overall level, and results will be considered as they relate to the socio-ecological model presented in 2.3. First, changes in health and well-being due to the new school policy of the health-promoting program Active and Healthy Kids will be discussed. Then, the discussion is structured around 1) individual factors influencing adolescents' health behavior, 2) the social/cultural environment at school, 3) the physical/built environment of the school, and 4) the policy environment surrounding classroom-based physical activity.

5.2.1 Changes in adolescent health and well-being after implementation of the Active and Healthy Kids Program

5.2.1.1 Physical activity and physical fitness

Overall, classroom-based physical activity seems to influence physical activity behavior in a way that leads to increased physical activity levels during school time, and improves students' physical fitness.

We did not find any effect or significant changes in the students' physical activity levels across an entire day. However, we found significant changes in total physical activity and MVPA when considering school time. These results are not surprising, as a recent review concludes that current school-based efforts do not positively impact young peoples' physical activity across the entire day even though most interventions are designed to focus on increasing physical activity for the whole day (Love et al., 2019). School-based

physical activity interventions have not been effective in increasing children's accelerometer-measured daily time spent in MVPA across gender and socio-economic status (Love et al., 2019). A review of PAL specifically found a non-significant or small increase in overall physical activity and a large significant increase in lesson-time physical activity (Norris et al., 2019). The lack of results in whole day physical activity may indicate challenges with implementation fidelity or that the promise of schools as a universal context is not enough, when the wider environment inadequately supports for behavior change (Love et al., 2020). From an ecological perspective a broader environmental focus could be needed, targeting other physical activity domains, transport, home and recreation (Sallis et al., 2006).

We did not measure lesson-time physical activity as reported and explored in Norris et al. (2019), instead we measured physical activity during school hours. We found a positive significant change in school-based physical activity levels, an estimated change of 70.2 cpm, and time spent in MVPA, an estimated change of 3.49 min/day, for the whole intervention group compared to controls. In Norway, the effect on physical activity in classroom-based physical activity interventions, covering PAL and PA breaks, has shown varying results. The ASK study of 10-year-olds observed no significant differences between intervention and control school students' physical activity levels, for a full day or in school hours, due to high levels of physical activity in the control group (Resaland et al., 2016). The School in Motion Project, studying secondary school, found favorable changes in total physical activity, MVPA, and sedentary time during the whole day (Kolle et al., 2020). They also found a significant change in physical activity in school time with effect sizes slightly larger than we found (86.4 cpm and 5.6 min/day in MVPA) (Kolle et al., 2020). Although all of the above-mentioned studies measured physical activity with accelerometers, it is important to bear in mind that this tool has some limitations, an important one being that it cannot detect certain activities and upper body movements (Trost, 2001).

In *Article I*, the control group decreased physical activity levels during school time, and this tendency is also seen in other intervention studies in secondary schools (Gammon

et al., 2019; Kolle et al., 2020). This may indicate the general decline we see in adolescents' physical activity. Although these studies, including our *Article I*, do not show any increase in physical activity levels in adolescents, classroom-based physical activity interventions in secondary school seem effective in attenuating the physical activity decline in this age group. It has been argued that initiatives that attenuate this decline could be considered effective (Dumith et al., 2011).

A review of PAL did not find PAL sufficient to improve cardiorespiratory fitness (Norris et al., 2019). In contrast we report in *Article I*, a modest positive effect on physical fitness (20.3 meters more than the controls), aligning with the recent study of the effects on aerobic fitness of school-based physical activity interventions (Hartwig et al., 2021). Similar to our study, positive effects on physical fitness have been found in three Norwegian classroom-based physical activity intervention studies: the ASK study only for girls (Stavnsbo et al., 2020), the School in Motion for the whole group (Kolle et al., 2020) and the Active School Study for the least fit students (Seljebotn et al., 2019). Kolle et al. (2020), who also report on adolescents, found approximately the same relatively small change, reporting a change of 19.8 meters where we found a change of 20.3 meters, compared to controls. This may indicate that classroom-based physical activity was performed with a high amount of total physical activity and/or vigorous physical activity, since these have been correlated with cardiorespiratory fitness (Aires et al., 2010; Pozuelo-Carrascosa et al., 2018). Though the change is modest, it is important to note that physical fitness is a powerful marker of health and is important for future health (Högström et al., 2014; Ortega et al., 2008). Further, it is linked to adolescents' mental health (Raghuveer et al., 2020), and associated with having a protective effect on youth obesity (Aires et al., 2010), thus relevant and important in a general public health perspective.

5.2.1.2 Well-being

Students in the classroom-based physical activity intervention reported a more positive improvement in general well-being during the study period than those in the control group (*Article 1)*. Well-being at school was however more diverse when a group of

students' lived experiences were explored in *Article II*. There is a potential of classroom-based physical activity not exclusively leading to positive emotions but also social exclusion and negative emotions, challenging well-being for all students.

In *Article I* we reported on students' self-reported HRQoL and vitality (general well-being) and found a significant difference between intervention and control groups in vitality but no differences in their HRQoL. Other research projects using classroom-based physical activity to explore aspects of student well-being are the ASK study and the School in Motion Study. The ASK study on 10-year-olds explored students' HRQoL and also did not observe any significant change (Resaland et al., 2019). The School in Motion Study on adolescents did not find that classroom-based physical activity improved mental health, but showed favorable results for the subgroup of students with the highest levels of psychological difficulties at baseline (Åvitsland et al., 2020).

Based on the results of *Article I*, it cannot be concluded that classroom-based physical activity improves well-being, but the findings indicate that it may prevent poor well-being in this age group. Although the students reported various experiences with classroom-based physical activity in relation to their own well-being, we concluded that classroom-based physical activity generally improved the students' psychosocial health and well-being, and made them more aware of their own preferences and strengthened their internal voice (*Article II*).

5.2.2 Individual factors

At the center of the socio-ecological model are individual factors influencing adolescents' health behavior, and thus their health and well-being.

Factor 1) Sex differences. We found that the changes in physical activity levels, physical activity, and well-being differed between boys and girls. Among boys in the intervention group, the increase in physical activity during school time was 127.9 cpm and 6.3 min/day spent in MVPA when compared to controls. This is a slightly larger difference than found in the School in Motion project (Kolle et al., 2020), which reported effects for boys of 76.6 cpm and 5.1 min/day in MVPA. Girls in the intervention group showed

a negative development in sedentary time, 16.4 min/day more than the controls (which may be explained by a reduction in sedentary time in the girls from the control group) and a positive increase in cardiorespiratory fitness with 26.5 meters more in the running test. It is not unusual that boys and girls respond differently to physical activity interventions. The ASK study also found an effect on cardiorespiratory fitness in favor of girls (Stavnsbo et al., 2020). The School in Motion study found a positive effect for girls' school time physical activity but not for their cardiorespiratory fitness (Kolle et al., 2020). Some evidence exists that girls respond better to in-school physical activity than boys (Pangrazi et al., 2003) and in a review of the effects of school-based physical activity on cardiorespiratory fitness, significant increases were found among girls but not among boys (Pozuelo-Carrascosa et al., 2018). One explanation of this tendency could be that girls have lower levels of cardiorespiratory fitness at baseline, thus the potential and capacity for improvement is higher (Pozuelo-Carrascosa et al., 2018). This is especially interesting as girls' cardiorespiratory fitness levels have been shown to stagnate or even decrease after the age of nine (Stavnsbo et al., 2018). Further, girls in the intervention group reported positive changes in vitality and HRQoL (physical well-being, psychological well-being, autonomy, and parent relationship). These are interesting findings as no other similar study has found the same results, and because the annual report on Norwegian youth reports that psychological difficulties are increasing at the beginning of secondary school, especially in girls (from 16% to 33% in girls and from 6% to 14% in boys) (Bakken, 2019).

The following factors in *Article II* influenced students' health and well-being in a positive way: **factor 2)** feelings of togetherness by connecting more with different classmates and feeling a sense of shared victory when solving tasks, **factor 3)** feeling more competent when working with academic content in a physically active way, and being able to work in a way that worked better for them and therefore increased their motivation for schoolwork, **factor 4)** feeling enjoyment and fun as a result of positive experiences with classroom-based physical activity.

One aspect of enjoyment that stood out was the physical aspect of moving outdoors as a break/variation from traditional teaching. Ingulfsvann (2018) reported a similar finding in 10-year-olds' experiences with classroom-based physical activity. It seems that well-being was especially related to transitions from being sedentary to moving.

Factors 2 and 3 are of most importance for students' well-being from a self-determination theory (SDT) perspective, as these are related to the basic psychological needs in SDT of feeling related and competent, which together with a feeling of autonomy are the nutrients for well-being (Ryan & Deci, 2017). Studies have found that physical activity environments that provide adolescents with positive experiences of their own competence, relations to others, and a sense of autonomy increase well-being and motivation (Hagger et al., 2005; Hagger et al., 2003; Pelletier et al., 2001; Standage et al., 2003; Standage & Treasure, 2002). Others have pointed out the elements in factor 4, namely that positive experiences of physical activity are especially important for well-being (Bailey et al., 2013) and, as highlighted by van Sluijs and Kriemler (2016), physical activity interventions with young people need to include what they call "fun fun fun" to be successful and sustain ongoing participation.

Factors challenging health and well-being were **factor 5)** some students feel awkward and uncomfortable, making them withdraw from activities, **factor 6)** students feeling mocked and socially excluded in a competition, especially when competitive students are allowed to dominate **factor 7)** not feeling that the active learning activities matched their academic level and aspirations.

These latter factors are likely to influence participation in classroom-physical activity negatively; Bailey et al., (2013) point out that negative experiences transform the relationship into a vicious cycle in which the person becomes more and more disaffected with physical activity. Further, these factors show not only a lack of basic needs satisfaction but may show basic needs frustration (Deci & Ryan, 2000). This can create feelings of rejection/exclusion and incompetence, and thus create aversion to the specific activity (i.e., classroom-based physical activity) (Costa et al., 2014). This may not

only limit psychological growth and well-being, but may lead to non-optimal functioning and foster mental health challenges (Deci & Ryan, 2000; Costa et al., 2014).

5.2.3 The social/cultural environment at school

5.2.3.1 Gender as an aspect when creating and planning PAL and PA activities

Factor 8) Gender cultures may influence how boys and girls deal with classroom-based physical activity. In *Article II* we found that PAL and PA breaks could be experienced as a disruptive element, as also found in similar studies (Gammon et al., 2019; Holt et al., 2019). They did not seem to decrease the students' well-being but were perceived as conflicting with their academic development and aspirations. *Article II* was based on a small number of student informants, but I believe it is still worth mentioning that the informants who raised concerns about classroom-based physical activity being a disruptive element in their learning were female students. Since this section addresses the social and cultural environment, the term "gender" is applied instead of "sex" to acknowledge that gender is a construct of our social and cultural setting (Lorber, 2018). There are indicators that classroom-based physical activity does not positively influence academic performance in girls who are already doing well academically. In the ASK study, which is based on the same approach, using PAL and PA breaks in 10-year-old Norwegian school children, the authors found gender to be the only moderator that reached statistical significance in change in academic performance; boys demonstrated a positive trend and girls a negative trend (Resaland et al., 2016). This was further explored, showing that moderate and high academically performing girls responded negatively to classroom-based physical activity (Resaland et al., 2018). This might be part of a gendered culture where girls at school are good at focusing during sedentary work tasks, and thus thriving and doing well in the traditional sedentary classroom. The key factor here might be the transition to adopting other learning approaches and a new culture of learning, and this might have implications for the future use of classroom-based physical activity, where new solutions and strategies will be needed to ensure the academic development of high-performing students. Further, in *Article II*, we report on a student excluding himself as he felt he was a bad dancer, and it was foolish for "big

kids" to dance about. In previous research, it was found that girls showed greater enjoyment of interactive dance games than boys (Gao et al., 2014), which illustrates how activities may appeal to genders differently. The same example leads to **factor 9)**, i.e. that some activities may be seen as childish, which makes some adolescents hesitate to participate. When designing or planning classroom-based physical activities it may be relevant to bear in mind that young adolescents are at a life stage where social acceptance ("fitting in") is especially important. School-based subjective social status shows great relevance for adolescents' health and well-being (Sweeting & Hunt, 2014) and social status may be more important in early and mid-adolescence where peer acceptance needs may be highest (Goodman et al., 2001).

5.2.3.2 Organization and peer interaction

The social climate seemed especially important to how the physical activities influenced the students' psychosocial well-being and their physical activity participation, and thus their health, as found in *Article II*. Several of the mentioned individual/intrapersonal factors identified were directly connected to the social and cultural environment at school and how students interacted with their peers. We found in *Article II* that classroom-based physical activity seemed to change the social dynamics between classmates and these dynamics can result in both positive and negative experiences and emotions.

Factor 10) When activities focused on fair play and students were grouped with classmates that they normally did not interact much with, students experienced aspects of psychosocial well-being (feeling included and accepted), shown in the students' descriptions of how the organization of activities matters. Though some students were motivated by a more competitive setting, (**factor 11)** competition and a competitive culture challenged others in how to act, behave and prioritize, having a negative effect on their co-students' participation, motivation, and well-being. Ingulfsvann (2018), exploring 10-year-olds' experience of classroom-based physical activity, also found that a competitive environment could be experienced as demanding, leading to negative emotions and exclusion. The focus in sports activities has been found to be important,

i.e., whether it is on personal development and mastery or on objective performance criteria and competition (also referred to as task- or ego-centered) (Vingdal, 2021). One aspect addressed in *Article II* is how the purpose of the activity was unclear to the students, i.e., whether they should prioritize competition, solving tasks, academic achievements, or group well-being. In *Article II* we report on a non-competitive PA break which led to exclusion, which illustrates the complexity in organizing and facilitating well-being for all students when using classroom-based physical activity. Classroom-based physical activity is not sport and differs from other physical activity environments in its purpose and focus on learning, highlighting the multiple pedagogical skills required of the teacher to create and facilitate physically active relevant learning activities that ensure well-being for all students.

5.2.3.3 Teachers as facilitators

In the students' social and cultural environment at school, teachers are of great importance as they influence classroom cultures and norms and plan, develop and lead the classroom-based physical activities in the program studied. A key feature of the program is that the activities are teacher-led. **Factor 12)** The way teachers facilitate, organize, and run classroom-based physical activity matters and impacts students' well-being and participation (based on *Articles II* and *III*). In the Move for Well-being Study, involving Danish school children, it was found that the students who had the most PA breaks reported decreased well-being (Smedegaard, 2018). This was speculated as being related to the social setting and teachers' skills in planning, organizing and facilitating such activities, lending support to factor 11. This is an important finding as addressed in *Article III*; teachers themselves described finding it difficult to follow the guidelines of the approach, lacking proper support and professional development for taking on this task. This affects leadership style and focus in the activity, which strongly influence whether the adolescents experience positive social relations and feel competent and autonomous, essential to motivation and well-being (Ryan & Deci, 2017). Illustrative of the complex interactions in the social and cultural environment is how the teacher and students affect each other. Without student enjoyment teachers would struggle to implement classroom-based physical activity as studies have found student enjoyment

especially important for teachers' motivation (Dinkel et al., 2017; McMullen et al., 2014). Teachers in *Article III* described their motivation as related to a belief that classroom-based physical activity will have a positive effect on students' health and well-being. Further, it was important that students had fun when participating. The teachers both observed and received positive feedback from their students, which may enhance teachers' intrinsic motivation for teaching classroom-based physical activity (Ryan & Deci, 2017). Thus, positive student feedback is an important contributor to teachers' efforts to adopt classroom-based physical activity in their teaching.

5.2.4 The built and physical environment at school

According to the ecological perspective, the physical environment affects our experience and it can therefore hinder or motivate for physical activity (Sallis et al., 2006; Stokols, 1996). The built and physical environment can thus influence how classroom-based physical activity is performed and how it is experienced by students. **Factor 13)** We found that being outdoors was connected to well-being because of a larger space to move in and being in the fresh air (found in *Article II*). Taking education outside provides a space, a larger space than the classroom, which is argued in itself creates more movement (Vingdal, 2014; Fjørtoft, 2009). The new school policy (the Active and Healthy Kids Program) did not target the built and physical environment at schools, thus no changes were made to the schools' indoor or outdoor space. In *Article III*, the teachers addressed the built and physical environment, preferring to be outdoors as this space is more suitable for physical activity and activities that produce some noise. The indoor space was felt to be a challenge for classroom-based physical activity because the rooms were not designed or built for high intensity activities, which affects possibilities for physical activity and learning, as also found in other related studies (Daly-Smith et al., 2020). However, aspects of the school's outdoor space may also pose challenges to teachers, as supported by McMullen et al. (2016) and Daly-Smith et al. (2020). **Factor 14)** is that schools' built and physical environment could be better designed for physically active ways of learning, allowing for all-weather activity, since rain, wind and snow are common in many parts of Norway. This is addressed in *Article*

III, and also represents aspects of the natural environment of the socio-ecological model.

5.2.5 The policy environment surrounding classroom-based physical activity

5.2.5.1 School policy

The school policy explored in this thesis is implemented at several levels: county level, municipal level, and school level. Norway does not have a national policy for the implementation of one hour of physical activity per school day. One was suggested in 2017, but this goal was removed again in 2020, as it was considered too difficult to implement and would interfere with the autonomy of schools and their teaching staff (Alliancen for fysisk aktivitet i skolen, 2021). Further, the Department of Education has argued that teachers are not interested, although a recent report shows that approximately 70% of teachers support the policy of more physical activity in schools (Alliancen for fysisk aktivitet i skolen, 2021). In short, there are conflicting views in educational policy as to whether to have a national policy that requires schools to have one hour of physical activity per school day. Current arguments and recommendations from experts advocating for a national policy are to increase physical activity in Norwegian schools through PAL and PA breaks, as this supports learning and does not take time away from academic teaching (Alliancen for fysisk aktivitet i skolen, 2021; Kreftforeningen, 2021).

5.2.5.2 User perspectives in health policies

Users' motivation and well-being are important for effective change in organizations and behavior change (Deci & Ryan, 2000). Students' perspectives should thus be important when developing or evaluating policies that regard them, as students should not be seen as passive receivers of a new policy, but as active influencers of their social and physical world. **Factor 15)** is that most students and teachers welcomed the new school policy of classroom-based physical activity as a regular part of teaching. In *Article II* we found that this new policy was embraced by the adolescents. In fact, they consistently

reported that they believed too little classroom-based physical activity was being implemented. As reported in *Article III*, teachers acknowledge both their own and the schools' role in student health promotion as important. Several teachers had identified and reflected on the sedentary nature of both individual lessons and the school day in general, accompanied with reflections on their students' sedentary behavior after school. Breaking this sedentary behavior was viewed and acknowledged by several teachers as part of their responsibility. Other studies have found that teachers do not believe that improving students' health and physical activity should be part of a teacher's job (Jørgensen, 2019). The fact that teachers in *Article III* view the new school policy as valuable is promising for the implementation of the Active and Healthy Kids Program, since, according to the SDT, when activities do not hold the appeal of motivation and interest, the principle of satisfying the basic psychological needs will not apply (Deci & Ryan, 2000).

Teachers' opinions and attitudes toward physical activity have been recognized as the greatest obstacles to physical activity promotion in the classroom (Morgan & Hansen, 2008). They function as a main barrier, as research from this thesis and elsewhere has found that teachers vary as to whether they use the approach or not and several seem to use it much less or for a shorter time than program guidelines recommend (Quarmby et al., 2019; Webster et al., 2015). Thus, teachers function as key facilitators and determinants of student health promotion in classroom-based physical activity.

In practice we see that teachers felt that the policy did not align with the practical everyday work of the secondary school teacher. There was a discrepancy between the program ideals and the practical reality, which was frustrating (found in *Article III*). The recent report on Norwegian teachers' opinions of school-based physical activity mentions similar challenges (Alliancen for fysisk aktivitet i skolen, 2021). The report states that even though it should not take time away from teaching, this is a major concern, and teachers demand to be part of the planning, be given flexible solutions and more competence. The aspect of competence is interesting, as teachers' perceptions of

their own competence have been shown to be important for implementing classroom-based physical activity (Bartholomew & Jowers, 2011; Webster et al., 2013).

Competence is one of the building blocks of motivation (Ryan & Deci, 2017) and, as already mentioned, teachers' motivation is important for implementation. Motivation is also more likely to flourish in contexts that provide a sense of security and relatedness, according to the SDT. This supports the finding from *Article III* that teachers found support and engagement/focus from their leaders to be especially important for including the task of implementing PAL in their teaching practice. Across teachers, PAL was experienced as an individual task and responsibility, in contrast to what they were seeking, namely a more shared project or vision to be part of. Many found that school leaders' support and focus declined over time, and several teachers described a demanding work culture where only a few colleagues were motivated for PAL, and they thus often felt alone among the teaching staff. This leads to **factor 16)** that teachers' experience of competence and support from colleagues and leaders is important for their adoption and continued implementation of classroom-based physical activity. It also demonstrates the need for more focus on how to support teachers. Collegiality has been highlighted in a recent study, where pre-service secondary teachers found it simple, fun and inspirational to implement physical activity in lessons, where a factor of this experience was the effect of collegiality the teachers experienced when planning and reflecting across subject boundaries in small groups (Romar et al., 2020). The importance of collaboration, especially teacher collaboration, has also been addressed in other studies (Goh et al., 2017; Langille & Rodgers, 2010; Sulz et al., 2016; Webster et al., 2018). Teacher collaboration may be an underutilized resource for implementing physical activity in lessons (Dinkel et al., 2017). For these reasons, it is important to elicit the teachers' perspective when introducing a new policy into their work to enable policy makers to be informed about possibilities, limitations and effects of the policies.

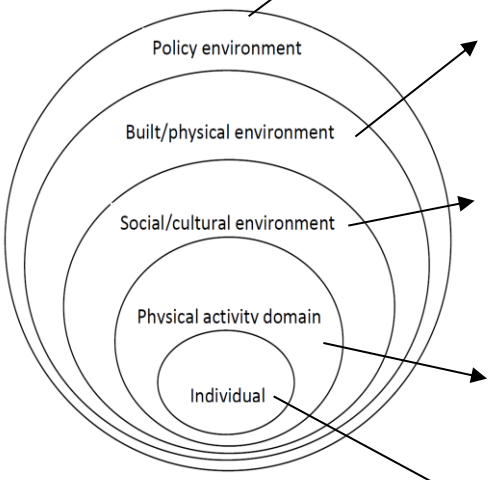
5.2.5.3 Schools as a target for health policies

Schools have been subject to a substantial amount of change initiatives, innovation processes and reforms, in what can be described as an "overdose" of initiatives. It is

easy to imagine a form of “reform fatigue” that makes school leaders and staff develop a certain cynicism towards the long-term implementation of new initiatives, and resistance to spending time, resources, and engagement in them, when they may be replaced or removed in the near future. Although this did not directly show in the results presented in this thesis, some of the teachers brought it up in conversations with me in formal and informal settings. Basically, they questioned the long-term educational and school policy interest in the project/program: “Why spend so much time and energy on something that will soon be gone anyway when other projects come?”. Few successful physical activity initiatives in schools are being scaled up and implemented as long-term established elements of the school (Chilton et al., 2015; Hunt & Metzler, 2017). Experience and knowledge of this might decrease initial teacher motivation from the beginning, which would be a key barrier to implementation and health promotion.

Importantly, collaboration between policy makers and researchers may improve the likelihood of translating research findings into changes in environments, policies and practices (Sallis et al., 2006). A consistent finding in health research is the failure to translate research into practice (Grimshaw et al., 2012). A strength of the Active and Healthy Kids Program is its close collaboration with research; evaluation of the program increases the chance of research findings having an effect in practice settings. Although challenges exist for the implementation of classroom-based physical activity, this thesis shows that the local policy of including PAL and PA breaks in subject teaching can benefit secondary students’ health. A positive effect on health and well-being took place although the policy had a top-down approach with little control over how much or how often the policy was turned into practice. This lends support to the argument that schools are one of the main areas with potentials for improving public health (Alliancen for fysisk aktivitet i skolen, 2021; Kreftforeningen, 2021; World Health Organization, 2018). Figure 6 below sums up the findings across the three articles related to the layers of the socio-ecological model.

Figure 6
Socio-ecological model linked to research results of this thesis.



Factors 15-16: Students and teachers welcomed the new policy. Teachers experience challenges in matching it with practical reality, stressing importance of competence development and continued support from colleagues and leaders.

Factors 13-14: Both teachers and student valued the outdoors providing a larger space and fresh air. School grounds and classrooms as physical activity environments are not adjusted to PAL situations.

Factors 8-12: Gender culture influences how the activities are received, childish activities + competitive culture challenge well-being, fair play and groupwork foster positive relations and experiences. Teachers are important facilitators for student well-being.

The Active and Healthy Kids Program target schools. implementing classroom-based physical activity as an intervention to increase physical activity.

Factors 1-7: Sex, feeling related, competent, motivated for schoolwork, enjoyment, awkward, uncomfortable, mocked, socially excluded, and feeling less academically challenged

Outcome of policy:
Students' health and psychosocial well-being (the focus of this thesis) were influenced (mostly) in a positive way.

5.2.6 Discussion of the socio-ecological model

The purpose of using the socio-ecological model in this thesis has been to connect and discuss the results of the three articles within an ecological perspective. The socio-ecological model is a simplification of the real world, and therefore has both strengths and weaknesses (Wold & Mittelmark, 2018; Sallis & Owen, 2015). The layers of the model are more closely connected than visualized in the heuristic layers. This showed especially when addressing the students' positive and negative feelings as individual factors, while the experienced emotions were directly related to the students' feelings of togetherness and bonding across social structures in the classroom. Also, factors related to sex/gender were at time difficult to separate, whether this related to

individual factors or factors from the social and cultural environment. In addition, the different layers are interdependent, e.g., how the built/physical environment influences a person might be a result of policy (school building policy) and the natural environment at the specific location. The model itself lacks information on how the broader levels of influence operate or how constructs interact across levels. It is accepted in today's health promotion research and initiatives that several layers should be targeted, not only one (Sallis & Owen, 2015; World Health Organization, 2018), but the model broadens perspectives without identifying specific constructs or providing guidance about how to use ecological models to improve research or interventions (Sallis & Owen, 2015).

The socio-ecological model was developed as a framework for developing health change initiatives. The way the socio-ecological model has been used in this thesis is as a framework to discuss and evaluate the different findings in *Articles I*, *II* and *III* from an ecological perspective. Factors influencing health and well-being have been identified, informed by student and teacher perspectives, and numbered throughout the discussion and summed up in the end. These numbered factors are not fixed, as some may overlap, while others may function as overarching factors covering several factors. Further, as the aim was to identify factors that influence adolescents' health and well-being, every factor reveals something about what may enable or constrain implementation. An example is factor 14: "… schools' built and physical environment could be better designed for physically active ways of learning, allowing for all-weather activity, since rain, wind and snow are common in many parts of Norway. This is addressed in *Article III*, and represents aspects of the natural environment of the socio-ecological model". This factor describes what may enable implementation but also covers barriers to implementation: rainy, windy and snowy weather, lack of outdoor facilities for PAL, lack of focus in the program to make changes to the physical environment, lack of focus or willingness by the school to prioritize outdoor space for more than recesses.

Ecological principles point to complex interactions of personal, social, and community characteristics that are difficult to manipulate experimentally. Experimental designs, with the typical goal of isolating a single intervention from the effects of its context, are conceptually at odds with the ecological emphasis on studying how intervention components interact with their context (Sallis et al., 2006). Thus, results from *Article I* are discussed in the beginning of this section in relation to health outcomes of the policy. The socio-ecological model is then used to structure contextual factors influencing the students' health and well-being with results from *Article II & III*. Further, Sallis et al. (2006) recommend that psychological models can be integrated into the ecological framework. In this thesis I have used SDT as a way to better understand psychological factors affecting students' and teachers' motivation and well-being. It has been introduced in the discussion as a form of "informant", giving structure to the empirical findings.

5.3 Practical implications

This thesis has addressed a student age group that has been underrepresented in school-based physical activity research. Previous literature has addressed this age group as more challenging with regards to increasing physical activity levels and implementing classroom-based physical activity into their school setting (Dumith et al., 2011; Ottesen, 2017; Smith & Biddle, 2008). My suggestions for practical implications, based on my insights from the three articles presented in this thesis are:

- Adolescents are motivated to move – this motivation and expressed wish for a more active school day should be respected, acknowledged and acted on.
- The teacher and especially the student perspective should be emphasized to a greater extent when classroom-based physical activity is planned and implemented, and their views and opinions taken into account. Their views and involvement may make the implementation more successful.
- More support in learning about classroom-based physical activity and adapting it into teachers' general teaching should be prioritized.

- Teachers' pedagogical skills in planning and organizing PAL and PA activities should be developed to better ensure psychosocial well-being for all students, where especially competition should be addressed and used purposefully.
- More curriculum and grade based PAL teaching materials should be developed and made available to teachers.
- PAL is not only about creating physical activity and thereby health promotion, it is a teaching strategy/method that potentially can both improve learning and better the learning environment. By highlighting this, teachers can identify with their professional identity as teachers and a "side effect" is the health perspective.
- There should be a rethinking of indoor and outdoor spaces for PA breaks and PAL, to be more suitable for physical and noisy activities and spaces should be created that are available regardless of weather or season.
- The Active and Healthy Kids Program aims to reach an average of one hour of physical activity per day accumulated across the school week through PAL and PA breaks. As this thesis is not based on a randomized controlled study and adherence to the program was not controlled or measured, we do not know the numbers of PAL and PA breaks implemented. Little suggests that the goal of one hour of physical activity is being reached based on the students' physical activity levels in school found in *Article I*, based on students' descriptions of frequency of classroom-based physical activity in *Article II* and teachers' descriptions of how they struggled to meet the program guidelines in *Article III*. The implementation of the program did not affect overall physical activity levels, which suggests that implementation can be improved as similar interventions on the same age group have found more favorable results (Kolle et al., 2020). It may also indicate that other initiatives are needed to increase overall physical activity levels and to reach the goal of one hour of physical activity per day.

5.4 Recommendations for future research

Research in classroom-based physical activity is relatively new and little has been conducted in secondary school. Future research may take many directions. Based on the research findings and experiences I have gained, I will address three recommendations for future research.

1) Increasing physical activity: The approach of classroom-based physical activity as it was applied in the schools included in this thesis showed its limitations to increase physical activity levels in young adolescents. More effective and sustainable interventions are needed that increase physical activity levels among adolescents. Worth noting is that other qualities were demonstrated, such as increased motivation for schoolwork, improved psychosocial classroom environment, promotion of well-being related to disrupting sedentary behavior, a more diverse way of engaging with and learning curriculum content and important increased student enjoyment – these are valuable outcomes in themselves.

We were not able to detect how much teachers used the approach of classroom-based physical activity or how active students were in a PAL activity or a PA break. As a key purpose of implementing classroom-based physical activity is to increase physical activity levels, more research is needed on how active the students are in such lessons, and how much physical activity PAL and PA breaks contribute across a school week. More research is needed on how school-based physical activity programs can increase adolescents' physical activity levels.

2) User involvement: Since some students experienced some classroom-based physical activities as demanding (in regard to the competitive environment, lack of variation, exclusion by others and oneself and lack of proper academic integration in PAL), encouraging students to be more involved in design and development of classroom-based physical activity would be a valuable contribution to the research and practice field. This is also relevant for teachers as they are one of the main barriers to the implementation of classroom-based physical activity, where research is needed on how

it can add more value for teachers, rather than being additional work. Research involving co-creation with students and teacher to develop classroom-based physical activity could help in designing classroom-based physical activities.

3) Teachers' professional development and creative methodological skills: Teaching PAL was found to be a methodologically challenging task requiring creativity that not all teachers have or are trained in. There is a need to work towards more long-term professional development for teachers to make PAL a regular part of subject teaching in secondary school, thus ensuring the quality of the approach. Future research could explore how the approach of classroom-based physical activity could be organized and facilitated in a way that ensures more high-quality PAL and PA breaks. Research on teachers' professional development through their career and earlier in their career (in teacher education) would be valuable. Especially I think research on how teachers' formal education could be adapted to include PAL and PA breaks as pedagogical learning approaches would be especially valuable to make the integrations of physical activity and bodily movement part of education.

5.5 The "Active and Healthy Kids" model, development and implementations: Some final remarks

In addition to my work on the articles in this thesis regarding the Active and Healthy Kids program, I have also participated in evaluation and implementation research of the overall program. Through the years of working with this research project, the research team, including myself, have reported to the project owners and implementers in the County Council, project leaders in the municipalities, and school staff to provide the field of practice with knowledge about the program's effects and facilitators and barriers to implementation. This forms a basis for the actors involved to improve their initiatives. As stated in this thesis, classroom-based physical activity is considered beneficial and relevant not only for primary school but also secondary school. The County Council of Vestfold and Telemark is currently pilot testing the program at a high school. I am participating in this process evaluation that runs over three semesters, developing my

research skills further by applying a participatory approach through a student panel (Shamrova & Cummings, 2017; Svendby et al. 2019) and using focus group interviews as a method to gather information from students, teachers, school health workers and school leaders on process implementation (Hamilton & Finley, 2019).

6 Conclusion

Classroom-based physical activity can provide small benefits to students' school-based physical activity levels, physical fitness, and well-being. Especially female students seem to have moderate benefits on psychosocial health and well-being. While students support and embrace classroom-based physical activity, asking for more, some students also criticized aspects of the approach leading to negative effects such as social exclusion, negative emotions, and a lack of adequate facilitation of academic development. Although the teachers acknowledged the intentions of classroom-based physical activity, they seem to struggle to implement and apply it in a regular and meaningful way that supports its coherence and the consistent provision of more physical activity. The program could benefit from a greater focus on teachers' professional development and pedagogical skills to organize and facilitate classroom-based physical activities in a way that ensures psychosocial well-being and supports the academic level and learning objectives at secondary level. Support and focus on teachers' professional development are critical for PAL to become a regular part of subject teaching in secondary school.

7 References

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Article 1

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International Journal of
Environmental Research and Public Health

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Article

Changes in Physical Activity, Physical Fitness and Well-Being Following a School-Based Health Promotion Program in a Norwegian Region with a Poor Public Health Profile: A Non-Randomized Controlled Study in Early Adolescents

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Received: 3 January 2020; Accepted: 30 January 2020; Published: 31 January 2020

Abstract: The purpose of this study was to examine the changes in physical activity (PA), physical fitness and psychosocial well-being in early adolescents following implementation of a school-based health promotion program in secondary schools. Methods: Six municipalities in Telemark County, Norway, were recruited into intervention (6 schools) or control groups (9 schools). A total of 644 pupils participated in the study (response rate: 79%). The schools in the intervention group implemented the Active and Healthy Kids program, where the PA component consisted of (1) 120 min/week of physically active learning (PAL) and (2) 25 min/week of physical active breaks. Furthermore, both the intervention and control schools carried out 135 min/week of physical education. The primary outcome was PA. Secondary outcomes were sedentary time, physical fitness, subjective vitality and health-related quality of life (HRQoL) in five domains: physical health, psychological well-being, parent, peers and school. Results: There was a group x time effect on school-based PA ($p < 0.05$), but not total PA, as well as on physical fitness ($p < 0.05$) and vitality ($p < 0.01$). In girls, there also was a group x time effect on three out of the five domains on HRQoL ($p < 0.05$). Conclusions: A multi-component, school-based health-promotion program with emphasis on the use of PAL led to positive changes in school-based PA levels. Furthermore, positive changes were seen in physical fitness, vitality and HRQoL among early adolescents in a county with a poor public health profile. This might have implications for the development and promotion in schools of general health and well-being throughout adolescence.

Keywords: adolescents; school-based physical activity; physically active academic lessons; intervention; well-being

1. Introduction

There is a well-documented overall positive effect of physical activity (PA) on mental health and well-being [1]. Indeed, PA is widely recognized as an important determinant of physical and psychosocial health and development among children and adolescents [1–3]. Although most adolescents report good mental health and quality of life, the prevalence of mental health challenges in this age group is increasing [4]. Norwegian national representative data showed that from 2011 to 2016

the levels of mental health symptoms increased by 24% in adolescent girls [5], and the prevalence of diagnosed mental illnesses in adolescent girls increased by 40% [5]. Similar trends have been reported in other countries [6,7]. Simultaneously, there is a steady decrease in PA levels from childhood to adolescence in Norway [8]. Many adolescents in Norway and other Western countries are insufficiently physically active to benefit from the positive factors of PA, as only about 50% of 15-year-olds meet the recommendation for daily PA [9–11]. The World Health Organization (WHO) have launched a PA action plan [12] aimed at reducing physical inactivity and a comprehensive school-based PA program [13]. In addition, the WHO and UNESCO launched a global standard for health promotion in schools because schools are identified as a key arena for promoting health, well-being and a healthy lifestyle [14].

Although Norway as a country has relatively high ratings on public health indicators compared with other countries [15], Telemark County in Norway has a poor public health profile with a higher prevalence of mental health challenges and shorter life expectancy than average in Norway [16]. To this end, the Telemark County Council initiated the Active and Healthy Kids program in 2016. This is a school-based, health-promoting program, which aims to improve living conditions for children and adolescents through increased school-based PA, healthier school meals and an improved psychosocial environment. One of the components, school-based PA, is built on the WHO's comprehensive school-based PA program. PA in classrooms/physically active learning (PAL) is one important component and strategy to reach higher PA levels among children and adolescents [17]. PAL is the use of PA as a pedagogical tool for learning academic content in other subjects than physical education (PE) [18]. This strategy has been used by several school-based PA interventions [19–21]. Most studies have examined the use of PAL in children [22]; less is known about how early adolescents in secondary schools will respond to such an intervention. Studies on school-based PA and adolescents often use other strategies for increasing school-based PA, such as increasing the number of PE lessons and/or active breaks/recess [23,24].

The way we approach mental health has changed, and the concept of salutogenesis represents a shift from preventing mental health challenges, such as anxiety and depression, to promotion of well-being and quality of life [25]. Using this perspective, positive emotions in early adolescents are linked to fewer relational problems and better work functioning in adulthood [3]. The development of life skills, such as good health, has also been acknowledged as important and is included as part of the OECD Education 2030 [26]. The effects of school-based PA interventions have mostly focused on improving physical fitness, reducing the risk of non-communicable diseases, increasing learning and decreasing mental-health challenges [20,27–31]. Less knowledge and attention have been given to the potential of school-based PA to improve health-related quality of life, vitality and well-being associated with increased school-based PA [32]. Subjective vitality emerges as one component under the umbrella of well-being [33], and is conceptualized as a psychological sense of aliveness, enthusiasm and/or energy. Nix and colleagues highlight that vitality has a regenerative capacity that is not necessarily representative of happiness but of broad emotional states, which is a common conception of well-being [34]. Baily and Colleagues [35] underline that positive development associated with PA does not occur automatically; PA's contribution to well-being is conditional to the context and especially the social climate generated by, e.g., educators [35]. To evaluate and get a more comprehensive picture of how a school-based PA program with PA and academic content combined affects adolescents' health and well-being, we need to not only investigate the impacts on more objective outcomes like PA, cardiovascular indicators and aerobic fitness, but also well-being and sedentary time.

As mentioned, schools have been identified as a key setting to ensure adequate PA levels; however, a recent review from Love et al. [36] finds that current school-based efforts do not positively impact young people's PA across the full day. When looking at PA in school time, a recent meta-analysis from Norris et al. [22] looked specifically at interventions using PAL and concluded that there is a positive effect of PAL on PA compared to a normal subject lesson. When looking at overall PA they found a non-significant or small effect [22]. Because of a lack of results on PA across the full

day, Love et al. [36] recommend that, for now, school-based PA interventions should continue to be conducted in a research context. Further, Norris et al. states that more studies should include secondary schools and assessment of a more diverse range of health outcomes [22]. This study aims to examine whether the Active and Healthy Kids program led to changes in PA, sedentary time, physical fitness, well-being and health-related quality of life (HRQoL) in early adolescents. The research questions were as follows: (1) do PA, physical fitness, well-being and HRQoL change in early adolescents following a school-based, health-promoting program? and (2) are there gender differences in the changes observed following the Active and Healthy Kids program?

2. Materials and Methods

2.1. Participants and Study Design

To evaluate the implementation of PA in schools by the Telemark County Council, we conducted a quasi-experimental seven-month study using a pre–post control group design. In Norway, the secondary school consists of three years referred to as 8th, 9th and 10th grade, and pupils are between 13 and 15 years of age. Inclusion criteria for this evaluation were enrolment as a pupil in the 8th grade in the 2017/2018 school year, and being in a public secondary school in the six municipalities that were enrolled for implementation of the Active and Healthy Kids program by Telemark County Council. One rural and one urban municipality implemented the program in 2017/2018 and therefore served as the intervention group, whereas three rural municipalities and one urban municipality planned to implement the program in 2018/2019 and hence served as the control group. The 1:2 ratio for intervention and control municipalities is therefore a pragmatic approach due to the naturalistic setting of the implementation. The six municipalities had a total of fifteen secondary schools and 813 pupils registered in 8th grade, all of whom were invited to participate (Figure 1).

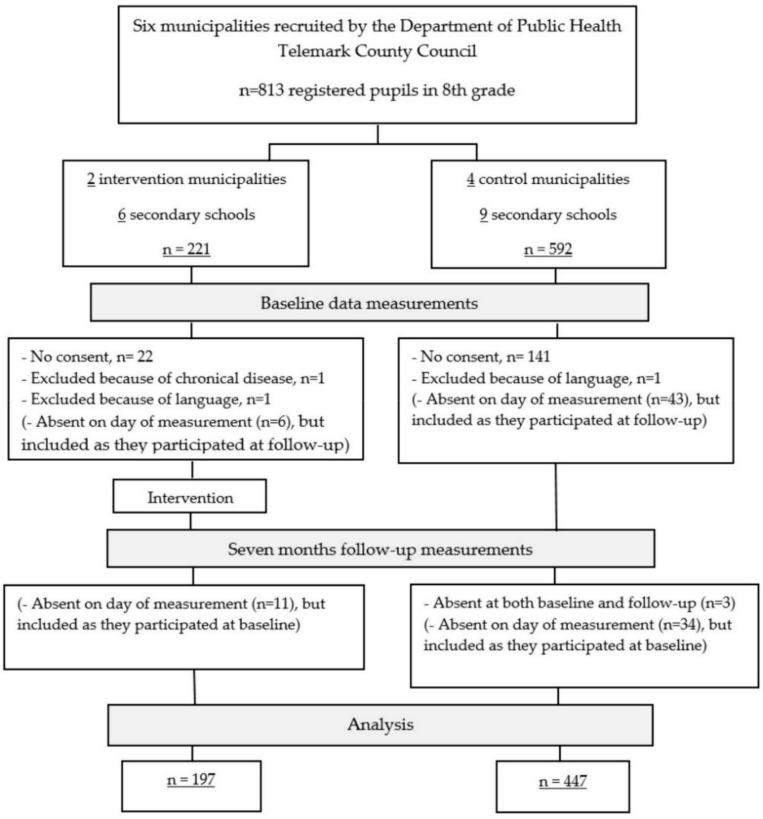

Figure 1. Flow of pupils and study design.

The research group provided oral and written information about the study to school principals and staff, and the primary teachers for each included class distributed written information about the study to the pupils and their parents on behalf of the research group prior to data collection. Written consent was obtained from parents for all included pupils. Data collection was performed during one school day, and pupils absent from school that day were unable to participate; however, they were included if they provided data at one of the measurement times. A total of 644 pupils were included. The major reasons for non-participation were lack of consent from a pupil or a parent and absence on the day of measurement. Exclusion criteria for participation were language barriers and/or injuries and illness that influenced the assessment of physical fitness and PA. There were specific challenges with recruitment and retention regarding the accelerometer to measure PA. At baseline, 484 pupils attained the minimum four days of valid accelerometer recordings for a full day, while 66 recordings were excluded because of invalid wear time. At follow-up, 329 pupils had sufficient wear time and 193 were excluded because of invalid wear time. During school hours (09:00–14:00) more students were included because of valid wear time in that period: 539 pupils at baseline and 473 pupils at follow-up. Lost accelerometers (10 at baseline and 6 at posttest) accounted for a small proportion of missing data with the majority due to refusal to wear the monitor and to low wear time. This study was conducted in accordance with the Helsinki Declaration, approved by the Norwegian Data Protection Services (ID number 54327) and registered in ClinicalTrials.gov (NCT03906851). The data was collected at two times at the local school; baseline September 2017 and follow-up April/May 2018.

2.2. Intervention Program

The Active and Healthy Kids program is a health promoting multi-component program, developed and implemented by the Telemark County Council to increase learning, well-being and health for pupils in elementary and secondary schools. It is conducted within a socio-ecological framework that recognizes that PA behavior is influenced by multiple levels [37]. Further, it is based on a salutogenic perspective [25] and basic principles of the self-determination theory [38], wherein the facilitation of the three basic psychological needs (Autonomy, Relatedness and Competence) promote intrinsic motivation and well-being. However, no specific motivational training of teachers was performed. The program was pilot tested at one secondary school in 2015–2016 before the experimental study began. The program consists of three main strategies to reach the overall goal: (1) healthy diet, (2) awareness of important lifestyle factors, and (3) increased PA. In this paper, we will focus on the PA strategy, and therefore the other strategies will only be briefly described.

The healthy diet strategy introduces national guidelines for food and meals in schools, providing varied school cafeteria menus and reducing unhealthy and sugar-rich foods and drinks in the school cafeteria. A trained cook facilitated the training of cafeteria staff. The pupils were informed about the importance of a healthy lunch packet and the school focused on creating a social eating environment in the lunch break. Awareness of important lifestyle factors is based on knowledge and experience with the associations between PA, a healthy diet, learning, health and well-being.

The strategy to increase PA is based on a modified Active Smarter Kids model, where PA activity is being used as a teaching tool for repetition and overlearning of already-known school material [20,39]. This model offered a solution to meet the goal of 60 min of daily PA through teacher-led activities. It consisted of three components: PAL (135 min/week), physically active 5-min breaks (25 min/week) and PE as usual (135 min/week). Adding the weekly minutes of physical activities divided across the school week of five days meant that the pupils would be physically active 59 min/day. PAL is a normal subject lesson planned and led by the classroom teacher where the whole lesson, or part of the lesson, is performed outside the classroom, often in the schoolyard, where pupils are physically active while working with school material, mainly repetition of already-learned material. Furthermore, PAL is an integrated part of the teaching, not a break; it consists of teacher-implemented academic lessons that utilize moderate to vigorous movement in the review or teaching of core academic content. PAL is mainly used in conjunction with the three major subjects taught in secondary schools: English, Math,

and Norwegian, without reducing educational time. The teachers were trained in PAL as described in Table 1. Furthermore, each school appointed a resource teacher, who took part in resource teacher gatherings once every semester.

Table 1. PAL competence development of teachers.

Before Start	Follow-up Training
One-day course on how to teach PAL and inspiration to 5-min physical active breaks.	One-day follow-up course on how to facilitate activities indoor.
Afternoon meeting at the local school planning PAL (mandatory, however not all teachers participated).	Afternoon meeting at the local school to share experiences and plan PAL (mandatory, however not all teachers participated).

Note: PAL = physical active learning.

The program is a collaboration between teachers, school leaders, project leaders at the municipality, the school health service and the school nurses. The Health Department at Telemark County Council is the program leader and has facilitated competence development and training for all partners.

2.3. Instruments and Measures

2.3.1. PA and Sedentary Time

PA was objectively assessed using accelerometers (ActiGraph GT3X+, LLC, Pensacola, FL, USA) at 10 s epoch intervals. Each participant was fitted with an accelerometer in an elastic belt around their waist placed on the right hip, worn for four consecutive days (two weekdays and two weekend days). Participant were instructed to wear their accelerometers during the whole day except during water-based activities or while sleeping. Accelerometers were initialized to start recording at 6 a.m. on the day after they were distributed. Criterion for a valid day was set as a wear time of ≥ 480 min/day accumulated between 06:00 and 24:00 and ≥ 2 (out of 4) days were applied as criteria for a valid measurement for a full day. All sequences of ≥ 20 min or more of consecutive zero counts from each subject recording were excluded and defined as non-wear time, as this implies time where participants did not wear the accelerometer [40]. These criteria were the same as used in the PA among Norwegian Children study [11]. For a valid school day the criteria was set to a wear time of ≥ 180 min/day accumulated between 09:00 and 14:00, same as in the Active Smarter Kids study [39], with a total of ≥ 1 (out of 2 days). We used the ActiLife software (ActiGraph, LLC, Pensacola, FL, USA) to initialize the monitors and to download the accelerometer files. The outcomes for total PA were counts per minute (cpm) from the accelerometers' vertical axis (cpm axis 1). Sedentary time was defined as all activities < 100 cpm, a threshold that corresponds with sitting, reclining or lying down [41,42]. Evenson [41] was used for defining cutoffs for sedentary time in min/day (0–100 cpm) and for moderate-to-vigorous PA (MVPA) (≥ 2296 cpm). The Evenson cut-off points have shown acceptable classification accuracy for activity intensities among children [43]. We analyzed all accelerometer data by using ActiLife software (ActiGraph, Pensacola, FL, USA). Additionally, we reported the proportion of participants who achieved the guideline PA level on a daily basis (a minimum of 60 min/day of MVPA).

2.3.2. Cardiorespiratory Fitness

The Andersen test, which is found to provide reliable and valid data on a group level [44], was used for assessing cardiorespiratory fitness. The Andersen test is a 10 min intermittent running field test: Pupils ran from one line to another (20 m apart) in periods of 15 s work and 15 s rest [45]. The test was indoors on a wooden or rubber floor. Distance covered in meters was recorded as the outcome for the analysis.

2.3.3. Strength

The standing long jump test (SLJ) was used to measure lower- and upper-body muscular strength/power. The SLJ is a practical, time-efficient and cheap method of assessing the muscular fitness of children and adolescents in a school environment [46]. The pupils had to stand with both feet behind a line and were allowed to swing their arms and bend their knees to create momentum. The pupils were instructed to jump as far as possible landing on both feet, without falling. Two attempts were allowed for each pupil and the best attempt in terms of longest distance recorded was the outcome. Distance was measured from take-off line to the back of the heels.

2.3.4. Anthropometric Measurements

Height and body weight were measured wearing light clothing and without shoes. Height measurements were collected using a wall-mounted standardized or stadiometer placed at the school nurse's office, and was measured to the nearest 0.1 cm. Body weight was measured to the nearest 0.1 kg using an ADE electronic weight (ADE, Hamburg, Germany), and electronic scale weights belonging to the school nurse's office at each school. BMI was calculated as weight in kilograms divided by height in squared meters ($kg \cdot m^{-2}$).

2.3.5. HRQoL

To obtain information regarding pupils' perception of general well-being we used the KIDSCREEN-27 questionnaire. This was developed to construct a shorter version of the original KIDSCREEN-52, and consists of the five domains "Physical well-being" (5 items), "psychological well-being" (7 items), "autonomy and parent relationship" (7 items), "peers and social support" (5 items) and "school environment" (5 items). KIDSCREEN is a multi-dimensional, widely used and validated instrument that covers physical, psychological, social and behavioral components of well-being in children and adolescents aged 8-18 years [47,48]. Higher scores indicate better HRQoL.

2.3.6. Well-Being and Vitality

Subjective Vitality Scale: The concept of subjective vitality is developed within the framework of the self-determination theory (SDT) [49]. It refers to a person's energy and its relation to psychological well-being and has been defined as one's conscious experience of possessing energy and aliveness [50]. Subjective vitality has shown associations with self-actualization, self-determination, mental health and self-esteem, and the subjective feeling of aliveness and vitality potentially represents a significant indicator of personal well-being. We have used The Subjective Vitality Scale by Ryan and Frederick [50], a short instrument used to measure vitality consisting of 7 items (e.g., I feel full of energy). Responses were given on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). We have used the Individual Difference Level Version that ask participants to respond to each of the items by indicating the degree to which the item is true for them in general in their life. In previous research, this scale has been found to be valid and reliable [50,51].

2.3.7. Demographic Characteristics

Parental education level has been stated as the most fundamental indicator for socio economic status (SES) [52,53]. The parents of each participant were thus asked to classify their completed educational level within one of the five following categories: "lower secondary school", "vocational school", "high school", "higher education, undergraduate level" or "higher education, graduate level". The highest educational level from each family was used for the analyses. Parental education level at the intervention group showed lower secondary school 2.4%, vocational school 14.4%, high school 10.4%, undergraduate level 51.2% and graduate level 21.6% (91 families provided data). Parent education at the control group showed lower secondary school 1.1%, vocational school 16.5%, high school 13.3%, undergraduate level 45.5% and graduate level 23.8% (273 families provided data).

2.4. Statistical Analysis

SPSS 26.0 was used for the statistical analyses. Little's MCAR test showed that data were not missing completely at random ($p < 0.001$). Analysis of the missing values pattern showed that the dataset was non-monotone, hence we used multiple imputation of data to complete the dataset for the baseline analysis and for the t-test analysis from baseline to follow-up. Independent sample t-test and chi-square were used to analyze differences between the intervention and control groups at baseline. All dependent variables were standardized prior to analysis. A linear mixed model was conducted for all dependent variables to consider cluster random effects. The effects of the intervention were assessed by examining 2-way interactions (group x time) with a nested random effect of each subject of school with Bonferroni corrections. The minimum significance level was set at $p < 0.05$.

3. Results

A total of 644 pupils provided written consent to participate: 197 pupils enrolled at the intervention schools and 447 pupils from control schools, with an even proportion of male and female participants across intervention and control schools ($p > 0.05$). Descriptive baseline characteristics of the intervention and control groups are presented in Table 2. The intervention and control group did not statistically differ with respect to demographic data (gender, age and SES), but the intervention group reported a significantly greater baseline level of the HRQoL domain "school environment" ($p = 0.018$).

Table 2. Demographic data at baseline. Data are presented as means (±SE).

	n	Intervention M	n	Control M	*p*-Values
Demographics					
Age (years)	197	13.2 (0.0)	447	13.2 (0.0)	0.13
Sex (% girls/boys)	197	47/53	447	51/49	0.314
Anthropometry					
Body mass (kg)	197	52.5 (0.7)	447	52 (0.5)	0.503
Height (cm)	197	162.2 (0.6)	447	161.3 (0.3)	0.15
BMI (kg/m^2)	197	19.8 (0.2)	447	20.0 (0.2)	0.472
PA full day					
Total PA (CPM)	197	492.2 (13.2)	447	466.2 (9.8)	0.121
SED (min/day)	197	543.2 (5.7)	447	535.8 (3.9)	0.266
MVPA (min/day)	197	56.1 (1.7)	447	52.3 (1.2)	0.067
PA school time					
Total PA (CPM)	197	440.7 16.3)	447	403.8 (12.5)	0.099
SED (min/day)	197	175.3 (3.2)	447	177.1 (2.4)	0.674
MVPA (min/day)	197	17.6 (0.8)	447	16.4 (0.6)	0.268
Physical fitness					
CRF (m)	197	1005.1 (8.1)	447	990.5 (6.6)	0.173
Strength (cm)	197	163.4 (1.8)	447	161.5 (1.3)	0.423
HRQoL					
Physical well-being	197	46.3 (0.6)	447	46.3 (0.5)	0.981
Psychological well-being	197	51.1 (0.6)	447	50.3 (0.5)	0.369
Autonomy and parents	197	53 (0.7)	447	53.3 (0.5)	0.707
Peers and social support	197	51.4 (0.7)	447	51.3 (0.5)	0.840
School environment	197	53.4 (0.7)	447	51.3 (0.5)	0.018*
Vitality	197	4.7 (0.1)	447	4.8 (0.1)	0.635

Note: * significant baseline difference between the intervention and control group. Abbreviations: SE = standard error, BMI = body mass index, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate-to-vigorous intensity physical activity, CRF = cardiorespiratory fitness, and HRQoL = health-related quality of life.

Changes in Intervention and Control Group at Baseline and Follow-up

Changes between the groups were observed for school-based PA level, physical fitness, HRQoL and vitality (Table 3). The control group increased sedentary time for full day, and there was a tendency of such an increase also in the intervention group. The Actigraph monitor measurements of time daily spent in MVPA showed that 36% of the adolescents adhered to the PA recommendations of a minimum of 60 min/day of MVPA. This adherence rate did not change between baseline and follow-up.

Table 3. Mean (SE) baseline, follow-up and group (intervention–control) differences (SE) with *p*-values indicating significant changes.

	Intervention			Control			Group diff. (SE)	*p*-Value
	Baseline (SE)	Follow-up (SE)	*p*-Value	Baseline (SE)	Follow-up (SE)	*p*-Value		
n	197			447				
BMI (kg/m^2	19.8 (0.2)	20.2 (0.2)	0.000 **	20.0 (0.2)	20.4 (0.2)	0.007 *	−0.01 (0.1)	0.934
PA full day								
n	197			447				
Total PA (cpm)	492 (13.1)	505 (20.1)	0.512	466 (9.8)	470 (15.6)	0.762	6,6 (9.1)	0.467
SED (min/day)	543 (5.7)	557 (6)	0.057	536 (3.8)	553 (0.9)	0.012 *	−2.68 (3.7)	0.466
MVPA (min/day)	56 (1.7)	55.9 (1.9)	0.916	52 (1.1)	51 (1.4)	0.485	0.76 (1)	0.446
PA school time								
n	197			447				
Total PA (cpm)	492 (13.1)	505 (20.1)	0.512	466 (9.8)	471 (15.6)	0.762	54.7 (9.7)	0.000 **
SED (min/day)	182 (2.6)	175 (3.2)	0.098	190 (2.2)	177 (2.4)	0.000 **	6.5 (2)	0.001 **
MVPA (min/day)	17 (0.8)	17 (10.8)	0.585	16 (0.6)	13 (0.5)	0.000 **	2.8 (0.4)	0.000 **
n	197			447				
CRF (m)	1005 (8.1)	1021 (7.3)	0.076	990 (6.6)	999 (5.3)	0.164	8.7 (4.1)	0.035 *
Strength (cm)	163 (1.8)	171 (1.8)	0.000 **	161 (1.3)	167 (1.4)	0.000 **	2 (0.5)	0.000 **
HRQL								
n	197			447				
Physical	46 (0.6)	47 (0.7)	0.366	46.3 (0.5)	46.1 (0.5)	0.648	0.9 (0.4)	0.012 *
Psychological	51 (0.6)	51 (0.8)	0.845	50.3 (0.5)	49.0 (0.6)	0.023 *	1.19 (0.4)	0.001 **
Autonomy	53 (0.7)	55 (0.8)	0.001 **	53.3 (0.5)	54.7 (0.6)	0.026 *	1.2 (0.4)	0.004 *
Peers and social	51 (0.7)	50 (0.9)	0.085	51.2 (0.5)	50 (0.5)	0.031 *	−0.4 (0.4)	0.909
School	53 (0.7)	53 (0.8)	0.621	51.3 (0.5)	49.9 (0.6)	0.016 *	2 (0.4)	0.017 *
n	197			447				
Vitality	4.7 (0.1)	4.8 (0.1)	0.412	4.8 (0.0)	4.5 (0.1)	0.000 **	0.3 (0.0)	0.000 **

Note: * statistically significant difference, $p < 0.05$; ** statistically significant, $p < 0.001$. Abbreviations: SE = Standard Error, BMI = body mass index, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate-to-vigorous intensity physical activity, CRF = cardiorespiratory fitness, and HRQoL = health-related quality of life in the five domains, namely physical well-being, psychological well-being, autonomy and parent relationship, peers and social support and school environment.

The control group showed a reduced score on HRQoL psychological well-being, peers and social support and school environment, as well as a reduced score on vitality (Table 3). Both the intervention group and control group had an improved score on HRQoL autonomy and parent support with greater improvements in the intervention group (Table 3).

The linear mixed model showed no effects on total PA level, but there was a group x time effect for the total sample on school-based PA level, physical fitness and vitality (Table 4). When analyzing boys and girls separately, there was a group x time effect on school-based PA for the boys (Table 5), and a group x time effect on physical fitness, HRQoL physical well-being, psychological well-being and autonomy and parent relationship, as well as on vitality for the girls (Table 6).

Table 4. Effects for the whole sample.

	Group					Time					Group x Time		
	df	**F**	***p***	**Mean diff (SE)**	**95% CI**	**df**	**F**	***p***	**Mean diff (SE)**	**95% CI**	**df**	**F**	***p***
PA full day													
Total PA (cpm)	538.32	1.44	0.23	0.06 (0.06)	−0.06–0.19	425.27	1.26	0.26	−0.02 (0.05)	−0.11–0.07	424.27	0.01	0.91
SED (min/day)	508.71	2.3	0.13	0.08 (0.63)	−0.42–0.21	407.00	6.67	0.01 *	−0.06 (0.05)	−0.15–0.03	407.00	0.00	0.97
MVPA (min/day)	510.53	3.09	0.08	0.08 (0.06)	−0.05–0.21	392.52	0.31	0.58	0.03 (0.05)	−0.07–0.12	392.52	0.06	0.80
PA school time													
Total PA (cpm)	554.87	25.23	0.00 **	0.23 (0.06)	0.11–0.34	520.83	3.11	0.08	0.10 (0.04)	0.01–0.19	520.83	7.99	0.005 *
SED (min/day)	5552.18	5.91	0.02 *	−0.12 (0.05)	−0.22–(−)0.01	544.88	11.74	0.00 **	0.08 (0.04)	−0.01–0.16	544.88	1.12	0.29
MVPA (min/day)	536.04	17.17	0.00 **	0.19 (0.06)	0.08–0.31	483.26	9.26	0.00 *	0.12 (0.04)	0.04–0.21	483.26	9.04	0.003 **
CRF (m)	582.85	7.57	0.00 **	0.13 (0.07)	−0.00–0.27	458.72	5.61	0.02 *	−0.03 (0.04)	−0.11–0.06	458.72	5.31	0.02 *
Strength (cm)	609.17	1.12	0.29	0.04 (0.07)	−0.1–0.18	469.02	113.55	0.00 **	−0.14 (0.04)	−0.23–(−)0.05	469.02	3.87	0.050 *
HRQoL													
Physical	621.19	0.39	0.53	0.03 (0.06)	−0.1–0.15	566.23	0.58	0.45	−0.02 (0.04)	−0.10–0.07	566.23	1.35	0.25
Psychological	621.84	4.15	0.04 *	0.01 (0.06)	−0.03–0.22	566.62	2.28	0.13	0.05 (0.04)	−0.03–0.14	566.62	1	0.17
Autonomy	619.73	0.14	0.71	0.02 (0.06)	−0.1–0.13	575.67	13.72	0.00 **	−0.09 (0.04)	−0.18–(−)0.00	575.67	1.77	0.26
Peers	606.21	0.05	0.82	0.01 (0.06)	−0.11–0.13	560.06	4.09	0.04 *	0.05 (0.04)	−0.04–0.14	560.06	0.00	0.99
School	625.08	13	0.00 **	0.17 (0.06)	0.05–0.28	578.53	2.42	0.12	0.08 (0.04)	−0.01–0.16	578.53	1.38	0.24
Vitality	608.53	1.61	0.22	0.05 (0.06)	−0.07–0.18	550.09	1.64	0.20	0.03 (0.04)	−0.05–0.12	550.09	7.20	0.008 **

Note: Group = intervention and control, Time = baseline measurements and follow-up. Pupils and schools were included as random effects to account for clustering. * statistically significant difference, $p < 0.05$; ** statistically significant, $p < 0.001$. Abbreviations: CI = confidence interval, SE = standard error, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate-to-vigorous intensity physical activity, CRF = cardiorespiratory fitness, HRQoL = health-related quality of life in the five domains, namely physical well-being, psychological well-being, autonomy and parent relationship, peers and social support and school environment.

Table 5. Effects for boys.

	Group					Time					Group x Time		
Boys	**df**	**F**	***p***	**Mean diff (SE)**	**95% CI**	**df**	**F**	***p***	**Mean diff (SE)**	**95% CI**	**df**	**F**	***p***
PA full day													
Total PA (cpm)	252.01	0.02	0.88	0.08 (0.09)	−0.10–0.26	185.93	2.26	0.14	0.13 (0.07)	0.00–0.27	185.93	0.09	0.758
SED (min/day)	235.15	3.90	0.05 *	0.09 (0.09)	−0.09–0.26	204.09	9.41	0.00 *	−0.18 (0.07)	−0.32-(-)0.04	204.09	0.04	0.842
MVPA (min/day)	246.53	0.32	0.57	0.14 (0.10)	−0.05–0.33	197.17	2.99	0.09	0.19 (0.07)	0.04–0.33	197.17	0.80	0.373
PA school day													
Total PA (cpm)	288.57	10.96	0.00 **	0.43 (0.09)	0.25–0.61	267.23	2.08	0.15	0.31 (0.07)	0.17–0.45	267.23	9.71	0.002*
SED (min/day)	281.09	1.69	0.19	−0.24 (0.08)	−0.39–(−)0.09	271.58	4.37	0.04 *	−0.08 (0.07)	−0.21–0.05	271.58	0.44	0.508
MVPA (min/day)	265.66	8.90	0.00 *	0.34 (0.08)	0.18–0.51	235.39	5.29	0.02 *	0.28 (0.07)	0.15–0.41	235.39	13.05	0.000 **
CFR (m)	293.27	9.21	0.00 *	0.45 (0.10)	0.26–0.64	236.81	7.22	0.01 *	0.20 (0.06)	0.07–0.32	236.81	1.46	0.229
Strength (cm)	305.96	6.08	0.01 *	0.38 (0.10)	0.179	243.62	74.62	0.00 **	0.06 (0.06)	−0.06–0.19	243.62	1.85	0.175
HRQoL													
Physical	315.26	0.21	0.64	0.04 (0.09)	−0.13–0.21	290.05	2.73	0.20	0.01 (0.06)	−0.11–0.13	290.05	0.11	0.744
Psychological	308.20	0.04	0.84	0.08 (0.08)	−0.09–0.24	282.88	0.01	0.93	0.06 (0.06)	−0.05–0.18	282.88	0.03	0.868
Autonomy	313.08	0.31	0.58	0.12 (0.08)	−0.15–0.07	293.77	12.70	0.00 **	−0.15 (0.06)	−0.27–(−)0.02	293.77	0.07	0.785
Peers	304.80	1.31	0.25	−0.17 (0.09)	−0.34–(−)0.00	283.45	1.29	0.26	−0.07 (0.06)	−0.20–0.05	283.45	0.05	0.830
School	313.29	6.76	0.01 *	0.14 (0.08)	−0.02–0.30	293.12	0.18	0.68	0.02 (0.06)	−0.01–0.1	293.12	0.51	0.474
Vitality	309.28	0.11	0.74	0.08 (0.08)	−0.08–0.25	281.71	0.45	0.51	0.05 (0.06)	−0.07–0.16	281.71	0.58	0.447

Note: Group = intervention and control, Time = baseline measurements and follow-up. Pupils and schools were included as random effects to account for clustering. * statistically significant difference, $p < 0.05$; ** statistically significant, $p < 0.001$. Abbreviations: CI = confidence interval, SE = standard error, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate-to-vigorous intensity physical activity, CRF = cardiorespiratory fitness, HRQoL = health-related quality of life in the five domains, namely physical well-being, psychological well-being, autonomy and parent relationship, peers and social support and school environment.

Table 6. Effects for girls.

	Group					Time					Group x Time		
Girls	**df**	**F**	***p***	**Mean diff (SE)**	**95% CI**	**df**	**F**	***p***	**Mean diff (SE)**	**95% CI**	**df**	**F**	***p***
PA full day													
Total PA (cpm)	286.85	1.95	0.16	0.05 (0.09)	−0.13–0.23	237.49	8.12	0.01 *	−0.25 (0.07)	−2.28–(−)0.02	237.49	0.01	0.916
SED (min/day)	272.79	0.06	0.80	0.07 (0.09)	−0.10–0.25	207.65	0.44	0.51	0.036 (0.06)	−0.09–0.16	207.65	0.00	0.973
MVPA (min/day)	266.5	3.51	0.06	0.03 (0.08)	−0.14–0.19	200.60	0.94	0.33	−0.12 (0.06)	−0.22–0.01	200.60	0.22	0.637
PA school time													
Total PA (cpm)	275.84	13.4	0.00 **	−0.00 (0.07)	−0.14–0.13	256.61	1.56	0.21	−0.11 (0.05)	−0.21–(−)0.01	256.61	0.25	0.697
SED (min/day)	518	3.41	0.07	0.03 (0.07)	−0.12–0.17	518	7.23	0.01 *	0.23 (0.06)	0.11–0.35	518	5.34	0.021*
MVPA (min/day)	274.35	6.89	0.01 *	0.014* (0.08)	−0.14–0.17	253.28	4.93	0.03 *	−0.23 (0.06)	−0.12–0.09	253.284	0.18	0.672
CFR (m)	287	0.34	0.56	−0.22 (0.09)	−0.39–(−)0.43	221.88	0.33	0.57	−0.26 (0.06)	−0.38–(−)0.15	221.88	5.23	0.023*
Strength (cm)	299.50	2.32	0.13	−0.34 (0.09)	−0.52–(−)0.15	222.95	39.75	0.00 **	−0.36 (0.06)	−0.47–(−)0.25	222.95	2.15	0.144
HRQoL													
Physical	304.15	1.68	0.20	0.01 (0.09)	−0.17–0.18	273.98	0.38	0.54	−0.04 (0.06)	−0.16–0.08	273.98	4.13	0.043*
Psychological	310.94	6.80	0.01 *	0.11 (0.09)	−0.06–0.29	280.61	5.00	0.03 *	0.05 (0.06)	−0.08–0.17	280.61	4.5	0.035*
Autonomy	303.45	0.00	0.98	0.02 (0.09)	−0.15–0.19	277.47	2.61	0.11	−0.04 (0.06)	−0.15–0.08	277.47	3.95	0.048*
Peers	297.63	3.12	0.08	0.21 (0.08)	0.04–0.38	273.80	0.06	0.81	0.18 (0.06)	0.06–0.3	273.80	0.06	0.807
School	308.58	6.46	0.01 *	0.20 (0.08)	0.03–0.37	281.67	3.61	0.06	0.13 (0.06)	0.01–.25	281.67	0.89	0.348
Vitality	297.27	1.6	0.20	0.01 (0.09)	−0.17–0.20	265.46	5.77	0.02 *	0.02 (0.06)	−0.11–0.15	265.46	8.75	0.003*

Note: Group = intervention and control, Time = baseline measurements and follow-up. Pupils and schools were included as random effects to account for clustering. * statistically significant difference, $p < 0.05$; ** statistically significant, $p < 0.001$. Abbreviations: CI = confidence interval, SE = standard error, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate-to-vigorous intensity physical activity, CRF = cardiorespiratory fitness, HRQoL = health-related quality of life in the five domains, namely physical well-being, psychological well-being, autonomy and parent relationship, peers and social support and school environment.

4. Discussion

The main findings were the positive effects on school-based PA levels and the lack of effects on total PA level. Furthermore, we found positive effects on physical fitness and vitality in the total sample, and on vitality and domains of HRQoL among the girls. We found negative effects on sedentary time among the girls.

The program showed positive effects on school-based PA level across a full day. This is in accordance with findings from Dobbins et al. [54], who reported that school-based PA interventions lead to more engagement in MVPA during school hours. In our study, the intervention group is stable over time in minutes spent in MVPA during school hours, where the control group declines. Similar results were found by Gammon et al. [55] who implemented PAL in secondary schools [55]. Because of the general decline in PA levels from child to adolescent, it is argued that interventions that attenuate PA decline could be considered effective [56]. However, the analysis showed that only boys had significantly increased time spent in MVPA. This supports results from other studies, which found that both children and adolescent boys were more involved in MVPA than girls [57,58]. Increased PA during school supports finding by Norris et al. [22]. The lack of effects on total PA level supports the results of Love et al. [36], who found no positive effect of school-based PA across the full day. It must be emphasized that previous studies have mostly examined populations of children in elementary school, and these results are not necessarily transferable to adolescents in secondary schools. Potential challenges for PAL in secondary schools are age, pubertal status, a more advanced curriculum and learning outcomes, as well as a focus on academic testing. In addition, the general PA level is lower among adolescents compared to children [8] and this might require more advanced skills in motivating and encouraging adolescents to actively participate in PAL. Furthermore, adolescence is a time period in life with large dropout rates from organized sports [59], and this requires even greater efforts in order to improve total PA levels. Therefore, it can be argued that the observed effects on school-based PA level were more difficult to achieve than in the previous findings from elementary school. It must also be noted that the objective measurement of PA was conducted for four days (two weekdays plus Saturday and Sunday), and not for an entire week. This might have influenced the total PA level, since the inclusion of more weekdays in the measurement period would have provided measurement of more school hours as well.

As shown in another Norwegian school-based PA intervention that included PAL [57], adolescents at the intervention schools increased cardiorespiratory fitness compared to the control schools. The intervention group also showed increased strength. This indicates that the activities in the school-based PA with emphasis on PAL had sufficient intensity and movement activities to achieve improvements in cardiorespiratory fitness and strength, resulting in overall improvements in physical fitness. Cardiorespiratory fitness is a powerful marker for health as it is associated with, among others, total abdominal adiposity, cardiovascular disease risk factors, positive effects on depression, anxiety, mood status and self–esteem [60]. Hence, Ortega and colleagues conclude that health promotion policies and PA programs should be designed to improve cardiorespiratory fitness [60]. However, the findings contradict those reported in the review of Norris et al. [22], who conclude that PAL was not sufficient to improve cardiorespiratory fitness [19,61,62].

The effects on vitality were shown by an actual reduction in vitality in the controls and a stability in vitality in the intervention group. The time period of early adolescence has previously shown that well-being can be impaired during this time [63], hence the potential of implementing a school-based PA intervention with emphasis on PAL to prevent such impairments are very interesting.

There is compelling evidence that regular PA can have a positive effect on emotional well-being, especially the well-being of children and adolescents. PA is also linked to a variety of mental health outcomes [1], yet this is to our knowledge the first study to show this effect using a school-based health promotion program with emphasis on PAL on adolescents. The positive findings on vitality and well-being indicate that the program holds some qualities that can improve the fulfilment of the three basic psychological needs that lead to intrinsic motivation and well-being, where vitality is an

indicator [49]. The specific effects on vitality and HRQoL observed among girls are interesting as this is the gender group where highest rates of mental health challenges are reported. The findings can be seen in relation to, e.g., Harrington et al. [64], who found effects on self-esteem among girls following a school-based PA intervention. Especially interesting are the positive effects among girls on the HRQoL domains physical well-being, psychological well-being and autonomy and parents, in addition to their vitality. Improvement of these HRQoL domains might serve as a protector towards negative body image and body dissatisfaction in an age group with perceived pressure of achieving a certain type of body and appearance [65]. In this study, the negative effect on sedentary time among girls is a result of an improvement in reduced sedentary time amongst girls in the control group. The girls from the intervention group did not increase their sedentary time during the study period nor did they significantly reduce their sedentary time. This program did not demonstrate any effectiveness for reducing pupils' sedentary time on a full day or during school time in the short timeframe where pupils wore the accelerometers. The lack of results in reducing sedentary time in secondary schools is in accordance with a recently published pilot study from the UK, who found no evidence of reduced sedentary time after implementing PAL [55]. This indicates the importance of examining levels of PA and sedentary time as individual and independent constructs [66].

The findings are strengthened by use of an objective assessment of PA and physical fitness, as well as by validated instruments for assessment of vitality and HRQoL. The implementation by the Telemark County Council and the naturalistic setting increases the external validity of the findings. The non-randomized design is a limitation, and the power and sample size were small. Yet, this makes the statistically significant findings even more robust. Unfortunately, the delivery of the intervention is not systematically documented, and the naturalistic setting provide natural variations both within and between schools. Hence, the naturalistic setting is also a limitation to the internal validity of the results.

The results of this study should be viewed in light of the mentioned limitations. However, implications of the findings include the need for long-term follow-up in order to examine sustainability of the effects. Furthermore, examining the choice of activities and organizational forms during PAL lessons will provide more in-depth knowledge about the PA behavior in PAL.

5. Conclusions

The seven-month Active and Healthy Kids program led to overall increased school-based PA and MVPA and further improved physical fitness, vitality and HRQoL among adolescents. The program did not positively influence total PA or total MVPA levels and did not show efficacy in reducing total sedentary time or sedentary time spent in school. Further, the program seemed to benefit girls and boys in different ways.

Author Contributions: Conceptualization, M.S.R., G.K.R. and S.B.-S.; data curation, S.K.S., M.S.R. and S.B.-S.; formal analysis, S.K.S., M.S.R. and S.B.-S.; methodology, M.S.R., G.K.R. and S.B.-S.; project administration, S.B.-S.; supervision, S.B.-S.; writing—original draft, S.K.S. and S.B.-S.; writing—review and editing, S.K.S., M.S.R., G.K.R. and S.B.-S.; all authors have critically revised and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Sparebankstiftelsen Sparebanken Sør. They had no influence on development or content.

Acknowledgments: The authors would like to acknowledge all who contributed to data collection, specially the master students who was involved in the project. The authors would like to thank all staff and pupils, past and present, at all participating schools, who without their help this study would not be possible. Furthermore, the authors would also like to thank Telemark County Council for the collaboration'.

Conflicts of Interest: The authors declare no conflict of interest.

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Article 2

Schmidt S, K., Bratland-Sanda, S., & Bongaardt, R. (2022). Young adolescents' lived experience with teacher-led classroom-based physical activity: A phenomenological study. Teaching and Teacher Education, 116, 103777. https://doi.org/10.1016/j.tate.2022.103777

Teaching and Teacher Education 116 (2022) 103777

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

Research paper

Young adolescents' lived experience with teacher-led classroom-based physical activity: A phenomenological study

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HIGHLIGHTS

- Students' experiences of classroom-based physical activity is important.
- Classroom-based physical activity is experienced as a meaningful movement setting in secondary school.
- Students' psychosocial health is influenced by form and organization of the physical activities.
- It is important to focus on fair play, rules and norms to ensure well-being for all.
- Students' academic and maturity level is important to consider in secondary school.

ARTICLE INFO

Article history:
Received 5 December 2020
Received in revised form
30 March 2022
Accepted 7 May 2022
Available online 19 May 2022

Keywords:
Adolescents
School-based physical activity
Physically active learning
Classroom physical activity breaks
Psychosocial well-being
Qualitative method

ABSTRACT

This study aims to identify and describe the general meaning structure of secondary school students' experience of classroom-based physical activity. The nine students interviewed in this study experienced classroom physical activity as (1) engaging with the school environment in a different way, (2) a changed experience of togetherness and classroom dynamics, and (3) an increased awareness of preferences regarding the learning setting. Students found physically active learning and physical activity breaks to be a valued and meaningful movement setting that improved their psychosocial health and well-being, made them more aware of their own preferences and strengthened their internal voice.

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1. Introduction

Physical activity (PA) is associated with a multitude of health benefits and is widely recognized as an important determinant of children and young people's physical and psychosocial health and well-being (Biddle et al., 2019; Janssen & LeBlanc, 2010; Lubans et al., 2010; Penedo & Dahn, 2005). Schools are acknowledged as key settings in discussions of how to combat physical inactivity and ensure good public health, as PA is declining in childhood and adolescence and especially in the transition between these age stages (Guthold et al., 2020). The WHO has devised a European PA strategy, identified schools as a key setting to implement PA interventions to ensure adequate levels of PA (World Health Organization, 2016). There is growing political interest in developing and implementing more opportunities for PA in schools to increase PA levels among children and youth across the world (Campbell et al., 2020; Centers for Disease Control and Prevention, 2019; Chen et al., 2020; Mooses et al., 2021; World Health Organization, 2018). A novel strategy is to integrate PA and bodily movement into the classroom as a resource for learning (Daly-Smith et al., 2020; Norris et al., 2015). This strategy has been named physically active learning (PAL), which is growing in importance, has expanded internationally, and is recognized as a strategy to increase PA across the school day (Daly-Smith et al., 2020). There are examples of this strategy across the world, mostly in western countries, such as Denmark, Norway, Ireland, the US, and Canada (Bartholomew & Jowers, 2011; Gammon et al.,

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https://doi.org/10.1016/j.tate.2022.103777
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2019; Resaland et al., 2016; Smedegaard et al., 2016; Webster et al., 2013).

We explore the phenomenon of integrating PA and bodily movement into classroom lessons, based on the "Active and Healthy Kids Program", which is a comprehensive and ambitious health-promoting multi-component program implemented in the region of Telemark in South-Eastern Norway. It is designed for elementary and secondary schools. The program aims to implement classroom-based PA to increase PA levels and well-being as well as improve learning outcomes. PAL is the main component of the program to increase PA where the teacher combines or integrates PA with educational content. As conceptualized in the Active and Healthy Kids Program, PAL is a normal classroom lesson planned and led by the regular teacher. All or part of the lesson preferably takes place outdoors and with moderate to vigorous physical activity. Students are physically active while working with core subject matter, mainly repetition of the curriculum they have already been introduced to in other lessons. PAL is mainly used in conjunction with the three major subjects taught in secondary schools: English, Mathematics and Norwegian. PA breaks take place during a classroom lesson, inside or outdoors, as a 5-min physical activity targeting moderate to vigorous PA. Schools using the Active and Healthy Kids Program are encouraged to implement at least 135 min of PAL and 25 min of PA breaks per week and teachers were given a one-day generic training course in advance of the implementation of the program. Schmidt et al. (2020) include a further description of the program and training of teachers.

In the research field of school-based PA, cognitive function and academic achievement have received considerable attention in both elementary/primary and secondary school (Ahn & Fedewa, 2011; Donnelly et al., 2016; Mavilidi et al., 2021; Rollo et al., 2019; Watson et al., 2017). This is also the case in reviews of PAL, which mostly cover elementary/primary school, finding that PAL improves students' time-on-task, slightly improves educational outcomes, and has a positive association with school engagement (Daly-Smith et al., 2018; Martin & Murtagh, 2017b; Norris et al., 2019). Research indicates also that PAL and PA breaks have a positive effect on adolescents' well-being (Schmidt et al., 2020; Mavilidi et al., 2021). However, little research focuses on students' experiences of PA and on how classroom PA relates to their psychosocial health and well-being. Here, psychosocial health and well-being refers to inter- and intraindividual levels of positive functioning that can include one's relatedness with others and self-referent attitudes that include one's sense of mastery and personal growth, along with resources to cope with everyday demands and challenges (Burns, 2017). School-based PA intervention projects rarely address secondary school students' experiences as expressed in their own words and when they do, this often merely serves to supplement information on the feasibility of the program (Dyrstad et al., 2018; Gammon et al., 2019). Qualitative studies of how students experience PAL have mainly been conducted with primary school students, leaving a gap to explore young adolescents' experiences. Moreover, research on adolescents has been criticized for being almost exclusively quantitative, with the adolescents' voices missing or being reduced to numbers (Arnett, 2005). A research-based knowledge gap exists concerning secondary students' experiences of teacher-led PA activities integrated into lessons. The aim of this paper is to identify and describe the general meaning structure of students' experience of classroom-based PA, as structured by the Active and Healthy Kids Program, and how this relates to their psychosocial health and well-being in school.

2. Method

2.1. Design

This study is grounded in descriptive phenomenology. Students' experiences of classroom-based PA were explored through individual in-depth interviews analyzed with Giorgi's descriptive phenomenological method (Giorgi, 2009).

2.2. Participants

In Norway, elementary and secondary school education is mandatory for all children aged 6–16 years. Secondary schools in Norway cover the 8th, 9th, and 10th grades, and students are aged 13–16 years. Participants in this study were students from two secondary schools in Telemark County, South-Eastern Norway that had adopted the Active and Healthy Kids Program and were taking part in a larger intervention-based research project (Schmidt et al., 2020). Two schools were selected, one rural and one urban, equal in size in terms of staff and students. Students were recruited with help from their teachers. We shared the following two criteria for the selection of participants with the teachers: 1) students that were interested and willing to take part in a conversation about their experiences with PAL and 2) students with varied PA habits and experiences of PAL suggested by teachers based on their observations. Based on these criteria, the teachers recruited students and introduced these to the first author. To ensure recruitment of students with varied PA habits and experiences with PAL, we mapped PA habits during data collection and were thus able to keep track and adjust recruitment. After conducting interviews with nine students, we found that their PA habits varied in type and form from being engaged in competitive sport, fitness/strength training, non-engagement in physical active activities, dance, and self-organized physical activities. Between them, these provided us with rich information, to the point of saturation, about their experiences with PAL and PA breaks, which we considered sufficient to answer the research question. Three males and six females were interviewed, all aged 14 or 15 years old. Participating students and their PA profiles are summarized and presented in Table 1.

2.3. Ethical considerations

The Norwegian Centre for Research Data (NSD) approved the study (ID number 54327), and the project was evaluated by the Norwegian Regional Committee for Medical and Health Research Ethics (REK) (NR 2017/387) and registered in ClinicalTrials.gov (NCT03906851). The research group provided oral and written information about the study to school principals and staff, and the main teachers of each participating class distributed written information about the study to the students and their parents on behalf of the research group prior to data collection. Written consent was obtained from parents of all included students. All students agreed to participate and before the interview they were orally informed about the study and reminded that they could withdraw at any time without any consequences and were assured of confidentiality.

2.4. Interviews

The Active and Healthy Kids Program was initiated by Telemark County Council in fall 2017 and was still continuing at the time of writing. The interviews were conducted in April and May 2019. Before this, to gain a sense of the setting in which PA was integrated into classroom lessons, the first author observed PAL lessons in all the secondary schools that implemented the Active and Healthy

Table 1
PA profiles of participants.

Student	Gender	Regular active	Physical activities/sports
Student 1	Female	no	None. Tried sports but does not like competition
Student 2	Male	yes	Climbing
Student 3	Female	yes	Handball, football
Student 4	Female	yes	Handball, football, cross-country skiing, hiking
Student 5	Male	no	Camping, self-organized physical activities
Student 6	Female	yes	Handball
Student 7	Male	yes	Fitness and strength training
Student 8	Female	yes	Volleyball and watersports
Student 9	Female	no	Dance, injuries put a stop to hockey and football

Note. "Regularly active" was determined based on the participant's current physical activity habits. A participant was considered regularly active if the person regularly participated in physical activities 1–2 times per week or more.

Kids Program in 2017 (n = 6). The observations were used as preparation to enhance the interview questions and knowledge of the phenomenon, making it easier to have a natural conversation with the students and knowing what they were referring to in the interview. Data for this study were collected through semi-structured, in-depth individual interviews during school hours in an available room at the schools. In agreement with teacher and student preferences, students were interviewed during class time. Interview questions and method were developed and discussed with co-author RB. Questions were used to guide the interview into descriptions of experiences of interest, which is in line with the descriptive phenomenological method of Giorgi (2009) who points out that the researcher must direct to have the participant speak to the researcher's phenomena of interest. The questions used were not the same in all interviews, but all questions functioned to track the phenomenon as described by the particular participant. Examples of these questions are: "Think back to a PAL that you remember well – tell me about that" and "What do you think about this way of teaching?". The interviews were conducted by the first author, lasted between 40 and 50 min, and were audiotaped and transcribed verbatim.

2.5. Data analysis

Secondary school students' experience with classroom-based PA has been very little explored, hence we decided to base the study and analysis on Giorgi's (2009) descriptive phenomenological psychological method, which helps explore the participant's lived experience presented in a way that enables this experience to be the main focus. This method provides a rigorous analysis of the experiences without invoking theoretical assumptions or general folk-psychological assumptions. The method is based on principles by Husserl (1983) and Merleau-Ponty (1962) and is a search for a structure of meanings of the phenomenon. The researcher uses intuition, i.e., a perception of meanings, as well as imaginative variation, i.e., an exploration through imagining of various alternative understandings of the meaning, to find what is essential to the phenomenon being studied.

Important to this approach and analysis is the adoption of the so-called phenomenological psychological attitude to enhance understanding of our natural attitude. The latter refers to how we see the world and interpret it based on an assumption that the world is "just there" and that the natural and human environments simply exist and are as real as perceived. The phenomenological psychological attitude, in contrast, involves use of (1) the epoché and (2) the phenomenological psychological reduction. The use of the epoché means to bracket assumptions pertaining to the phenomenon in question. This allows the researcher to see the data in a new light and attend to the participants' descriptions (p. 100). Giorgi writes: "everything in the raw data is taken to be how the objects were experienced by the describer, and no claim is made that the events described really happened as they were described" (Giorgi, 2009, p. 99). The idea is not to forget everything about the phenomenon; it is merely that we should not let our past knowledge be engaged while we are determining the mode and content of the present experience (p. 92). The ensuing phenomenological psychological reduction aims to derive a description of the phenomenon's meaning structure.

Adopting the phenomenological attitude, we followed the four steps of the descriptive phenomenological psychological method when analyzing the interviews: (1) all transcripts were read closely to gain a sense of the whole, (2) the text was re-read in-depth and divided into psychological meaning units, and (3) the meaning units were re-written into psychologically sensitive expressions that highlighted the psychological meanings lived by the students. In this step, the first author also transformed the meaning units into the third-person perspective, and (4) based on the transformed meaning units, a general psychological meaning structure of the experience was written by the first and last author. We then used imaginative variation to bring forward and describe the invariant meanings in a general structure. This implied asking ourselves: "What is general about the experience of having PAL and PA breaks? What is essential about that experience? If I remove this aspect from the structure, how does that change the description of the phenomenon?". Giorgi points out that one should be aware that the general meaning structure of the phenomenon can never grasp the totality of the original experience of each participant (Giorgi, 2009).

Steps 1 to 3 were conducted in two Nordic languages, Norwegian and Danish, while the meaning structure (Step 4) was written in English from its first draft onwards.

The descriptive phenomenological analysis process is demanding, as Giorgi's approach requires all parts of the text to be included in all steps of the analysis. Giorgi's (2009) research method usually involves at least three separate interviews with different persons who share their views and experiences of the phenomenon under study. We considered nine informants with transcribed interviews ranging from 13 to 25 pages to be more than sufficient for a phenomenological study.

3. Results

Based on the empirical variation of the experience with classroom-based PA for the students in this study, the descriptive phenomenological method elicited what is called a general psychological meaning structure of the experience. This structure is a general description representing and integrating all nine informants' experiences of the phenomenon and the main findings, which is consistent with common practice in descriptive phenomenology. Presented first is the general meaning structure of the

phenomenon, followed by a more detailed analysis of essential parts of the students' experience of the phenomenon based on the data.

3.1. The general meaning structure of having PA integrated into lessons in secondary school

In line with Giorgi's descriptive phenomenological method, we first present a general meaning structure describing how the integration of PA into lessons was experienced between the nine participants. This underscores the coherence and integrity of the phenomenon. The meaning structure reads as follows:

A new movement setting where PA is integrated into a classroom lesson transfers one into a different space, where the school and the classroom, the other students and the teacher, but also oneself, emerge in a different light. One moves from a familiar to an unfamiliar use of this space – for example by running inside the school and dancing in slippery socks. Or one transfers a familiar type of work – classroom lessons – to an outdoor space. Outdoors, schoolwork is embraced by fresh air, an aroused body, and novel ways of being with classmates.

The changing nature of the school workspace can be disruptive when one is concentrated and comfortably occupied with schoolwork. However, when one accepts the invitation to move and join the physical activity, opportunities to engage the creative side of oneself appear. Suddenly, one may feel unstuck and freed from all the brain work. Only using one's head for understanding, processing and remembering knowledge can be exhausting. Moving one's body while solving a given task provides a newly felt freedom to explore a variety of solutions to the task in a more integrated way, by engaging both body and mind in a practical setting.

The active use of the school space in unfamiliar ways may compromise the status of regular schoolwork. One starts to wonder how important academic work is in comparison to the social dynamics between classmates that emerges. As one sees classmates acting in awkward settings doing unfamiliar tasks, the social hierarchy of the class may change. Who and what is most important now? In the search for answers to issues of social hierarchy, the class may re-group in new ways. New bonds between students are formed and some social walls are broken down. Collaboration materializes through a merging of trust, growing respect, and the sharing of a sense of victory when one's group achieves something the individual could not have done alone.

The pleasures of a shared victory can be jeopardized if one surrenders to the inner competitor where winning obscures both social togetherness and schoolwork. Competition thus throws into relief possible trade-offs between the physical part of the task, being with others, and engagement with academic content.

How important is the academic content in comparison to the physical activity itself? A question like this brings to light another facet of this physical school activity: an increased awareness of one's preferred way of doing schoolwork along with one's ambitions and priorities. The awareness of a possible conflict between these preferences and priorities is itself an outcome of the unfamiliarity with how this physical activity is framed. At the same time, this unfamiliar setting offers a space to experiment with one's priorities. Now one can see oneself learning and moving in novel ways, and one can compare this with the familiar ways of doing schoolwork.

The comparison with familiar ways of doing schoolwork becomes highlighted in two ways: the way the teacher handles education via physical activity and one's return to the chair and desk. This shift can be challenging as one's body has been aroused and it takes a while before the mind and body are calm and back in place – a slightly different place now.

In this general meaning structure, we identified three essential parts. We refer to them as constituents, as they are interrelated, not independent of each other. The structure is based on the relationship between the constituents (Giorgi, 2009, p. 102). They emerge from one another and at the same time facilitate each other. The following constituents were identified: (1) engaging with the school environment in a different way, (2) a changed experience of togetherness and classroom dynamics, and (3) an increased awareness of preferences regarding the learning setting.

3.2. Constituents

3.2.1. Constituent 1: Engaging with the school environment in a different way

Several students described how they found it challenging to be focused and take in learning in the regular school day: "I can get sort of tired in my head then I get, I'm just sitting there, I can't concentrate a lot because I'm just sitting there and I'm just really unmotivated" (Student 9, female). All students related to the contrast of being physically active during a lesson. They much appreciated variation where their bodies were free to move around. One student described it as follows: "It's fun because you get to move around and run and it's not just sitting and doing assignments" (Student 7, male). Another student highlighted that PAL was also a variation and contrast to screen-based learning activities: "We were running around and searching for documents (…) it was fun (…) because we didn't have to sit indoors and stare at a screen" (Student 5, male). Further, this student gave a description of how he experienced changes in his level of concentration: "I get unfocused and can't be bothered to work, but after an activity I can manage to focus much better and to follow the lesson" (Student 5, male). Apart from improving concentration, classroom movement integration made it easier to get through the day:

> I can't sit still all the time, it gets so boring, and I think it's the same in class, you can get so fed up, especially if the teachers are just standing and talking and you have to sit and write down everything the teacher says and you just have to work on assignments, it can get really crappy and boring sometimes (…) when we've had a PA break, then you feel you're much more concentrated and ready to do some math when you get back to your desk (Student 6, female).

Moving to an unfamiliar setting where the students were invited to move around while solving a given schoolwork task allowed them to engage with a space of more freedom, fun and the creative side of oneself: "I think it's fun because you get to run and move in different ways, hop on one leg or move like a crow (…) you're moving while you're doing schoolwork" (Student 9, female). There was a shared experience of a positive attitude towards having PAL and PA breaks despite personal preferences. The sensations described and the experience of an activated body became linked to increased motivation for performing schoolwork in a more integrated manner. It was the combination of being outdoors and doing something practical with the learning material that made the students more receptive to learning. This gave them a pleasant feeling of being competent and able to work in a way that worked for them:

> When we're outdoors, for example running and finding different documents, we write it down afterwards, you've read it and been more focused than when you're sitting and writing about it, I feel like I'm more focused when I'm outdoors and for example running, looking for documents, I feel it helps a bit and then it's very nice to have that kind of little break (…) you get a

kind of break while you're working on something (Student 2, male).

To learn and be a successful student is a valued goal; students want to do well in school. One student highlighted how PAL boosted his motivation for schoolwork and how this increased motivation for school was perceived as the most valued aspect of PAL:

I feel that it helps me learn and I feel that it's YES! we're having PAL, then we can go outside and do something else than sitting and writing, it kind of gives me extra motivation for schoolwork, I think that's the most positive part of it (Student 2, male).

3.2.2. Constituent 2: A changed experience of togetherness and classroom dynamics

Integrating movement into classroom lessons changed the experience of togetherness and led to a shift in classroom dynamics. All students highlighted how they preferred to be working in groups when they had PAL as it gave them time and space to connect to different classmates and a sense of shared victory when solving tasks. It made some of them feel more secure and connected to classmates they normally would not interact with: "If I don't understand something then the others can help me to get it (…) I think when we're outdoors we also talk about other stuff and not just the schoolwork" (Student 5, male). PAL can help to break down social walls:

The teacher put us in teams, otherwise we'd be with the ones we sit near in the classroom, then you get to know them a bit more, the ones you normally don't talk to so much, so it's fun being in a team and kind of getting to know other students more (Student 4, female).

However, not all students participated at all times and several students described how they were conscious of this and made an effort for everyone to participate. One student said that it was often the same people, and that she had given up trying to involve them.

It's a bit difficult because they're so stubborn, I've been trying in different ways (…) but I've kind of given up, I try sometimes but it's difficult (…) I know they're having a hard time with themselves in a way, they're almost never in class so I know they're not getting on too well (Student 8, female).

Some types of activities made the students increasingly aware of how they were seen by others. One student, who generally preferred low-intensity self-organized PA like hiking and camping in nature, stated that he was uncomfortable dancing, partly because he felt he was a bad dancer and it was foolish for "big kids" to dance about. This kind of PA created an awkward situation for him, and he chose to sit at the back of the room.

I don't know, I just didn't take part the first time and then it kind of got into a habit not to join (…) I think it's uncool to have five or seven big kids standing in a small classroom jumping around and dancing (…) I sit at the back of the classroom on my phone (…) I'd look like an idiot standing there and dancing to those figures on the screen, I'd rather be the idiot sitting at the back [In this example, he refers to a PA break where the students had to imitate a sequence of "Just Dance", which is on e.g. YouTube] (Student 5, male).

The pleasure of shared victory and increased connectedness can be jeopardized when winning and competition are in focus and competitive students are allowed to dominate the activity. While competition in PAL can motivate students to participate and work harder with the tasks, in some cases, non-competitive, less active students may be mocked and socially excluded, leaving an emotional footprint.

I guess it's fun, however, sometimes some kids in the class are like really competitive people and they can really spoil the atmosphere for the others, so they make it a bit difficult (…). I wasn't fast enough to run there and back compared to them, they got annoyed with me (…) just because I'm not good enough, then the whole day gets a negative atmosphere (Student 1, female).

The students' experiences revealed different motivations to participate in PAL, which could create conflicts. Some students wondered how to balance the competitive and physical aspects of the activity and group wellbeing. One student described his frustration in this way:

I want to be first but some of the others in the group don't care, then there's a bit of a negative atmosphere, should I start to walk more slowly with this student or should this student start to run with me? What's right? I don't know (Student 2, male).

One student said that the point was "to win", while another stated that the most important thing was to be in a supportive group: "I was in a group who supported each other - that made it fun, when the others trust you" (Student 1, female).

3.2.3. Constituent 3: An increased awareness of preferences regarding the learning setting

All students acknowledged that PAL and PA breaks were a teaching method they found unfamiliar. Moving from the unfamiliar to a familiar practice, the students reflected on how they experienced the new movement setting, what they preferred, and how they learned: "I think it's important to have a kind of different school, you don't need to learn everything the old-fashioned way but do some new stuff" (Student 4, female). Several students described how doing something practical with the learning material through PAL made them aware of new learning potentials and increased their awareness of how they learn. One student described how PAL enabled a learning strategy that suited her well and she believed it increased her learning: "I think I learn better by doing something (…) then you're learning more than for example in a traditional class where I write things down and then I have to remind myself and really try to remember it" (Student 9, female). Several students appreciated PAL and described how it helped them learn and do well at school:

I think it's a very good method to learn (…) suddenly we can have something from a PAL lesson in the math test, and I'll be thinking, Oh yeah I remember that because we had it in the PAL math lesson, and I think it's a very smart way of learning to both be physically active and learn something at the same time, not just sitting and writing (Student 6, male).

The new movement setting also made some of the students aware of how they make priorities. Some also explained how they did not find PAL helpful in learning or doing well at school; it was more of a disturbance. One female student preferred short breaks so that she could return to a state of quiet concentration at her

desk:

> Actually, I don't feel that I learned so much from it, but it's very nice to get out and not have to sit still all the time (…) I just feel that I learn more when I sit still in the classroom where I'm focused and able to concentrate (Student 8, female).

Another student also emphasized how she found PAL and PA breaks to be a disturbance, especially when the schoolwork did not challenge her or when a PA break was longer than 5 min and did not have an academic focus or content. She was frustrated when the lessons did not meet her academic ambitions:

> If the activity lasts a while then maybe it's good to get some educational content in, if it's a good session and it's put together in a nice way then it's good to have PAL, but if it's like half way, then you might as well not have it (…) I think it's okay to have a physically active break but it depends a lot on whether I'm in the middle of something, whether I need a break or not (Student 3, female).

Several students experienced an increased awareness of the time when a PAL or PA break feels most stimulating and rewarding. The timing is important; while some students embraced PA in the classroom whenever it came, others found it disruptive when the activities were being organized or when they returned to their desks. One student described how PA breaks were both disruptive and helpful:

> I feel that I get more restless after a PA break, but at the same time it helps me to think so that things get clearer for me and I know more what to write if I'm stuck, but it can take some time to get back to where I was at if I was in the middle of something (Student 3, female).

Another student put it more directly: "When I work, I work well and it's unnecessary to disturb that" (Student 8, female). Further, the type of lesson/subject had an influence on whether a PAL or PA break came at a time when the students felt they needed it. Students said that the suitability of PA in a lesson depended on the level of difficulty of the subject or the assignments:

> If it's a very tough subject then yes, I'd like to have it, but if it's not, if it's like sitting and watching a film then no (…) a tough subject is when we have to sit and write a lot or just focus a lot like in math, there you sit and look at a lot of numbers that don't really make sense (Student 5, male).

There was a change in students' awareness of the learning setting, of which the teacher was a part. Some students found that the teacher's role in setting the stage mattered to the learning situation.

> There's a big difference between the teachers, some are very much into it and some aren't, that's maybe why we mostly have it in Norwegian, I'm not sure if there really are that many teachers who really go in for it (Student 2, male).

The students observed that not every teacher could handle the combination of classroom lessons and PA, and noticed the teachers struggling to integrate the schoolwork into a PAL activity and facilitate the activity. The students became aware of how PAL made them actively engage in dialog with teachers who struggled to meet their wishes: "Everyone is joining in and having fun, because when we actually have it, it's fun, when it's possible for us to make suggestions on how to improve the classroom environment, we'll say more PAL, but nothing really happens" (Student 9, female).

4. Discussion

In the discussion, we facilitate a dialog between the constituents and the research literature concerning related themes with the aim of deepening our understanding of each of the constituents. The discussion is organized based on the order of the three constituents.

4.1. Engaging with the school environment in a different way

The first constituent (*engaging with the school environment in a different way)* describes how PAL and PA breaks engaged the students in an unfamiliar way of using the school space, engaging both body and mind to make them feel unstuck.

4.1.1. Well-being and being outdoors

The shift in space took place when activities were being facilitated in the classroom or taken outdoors. The students embraced this variation in the learning setting and the space it created for moving, exploring and breathing fresh air. Physical activity in general is found to benefit child and adolescent mental health (Biddle et al., 2019), but the setting and outdoor space might also influence well-being. Moving outdoors was linked to a sense of well-being in this present study; this was also found in a study exploring students' experience with PAL outdoors (Marchant et al., 2019). Here, students were shown to experience a feeling of freedom attached to PAL outdoors, and they highlighted the fresh air and feeling more energized and engaged with learning. The students in our study described how their concentration levels increased and they felt more ready to learn after an activity that had an impact on the whole school day. They also described feeling more motivated for schoolwork. Research in the field finds evidence that PAL and PA breaks have the potential to enhance facilitators of learning such as the experience of better concentration (Gammon et al., 2019), improved time on task (Daly-Smith et al., 2018; Masini et al., 2020) and positive school engagement and classroom behavior (Masini et al., 2020; Owen et al., 2016), all of which support our findings.

4.1.2. Qualities of moving

Overall, we found that the students in our study were positive toward PAL and PA breaks and enjoyed the new movement setting. Enjoyment has been described and argued for as a key factor in the evaluation of classroom-based programs, as enjoyment has been linked to participation (Dishman et al., 2005), self-efficacy (Lubans et al., 2008) and students' academic motivation (Hopkins, 2008). Increased enjoyment as a result of increased school-based PA was also found in a study by Dishman et al. (2005), who conducted a randomized controlled trial on American adolescents in high school. Research, mostly on elementary/primary school children, shows that students enjoy classroom PA and have a positive experience of it (Dyrstad et al., 2018; Marchant et al., 2019; Martin & Murtagh, 2017). It is interesting how the students in our study described and embraced PAL and PA breaks as an escape and a break from the indoors and their sedentary desk work, which is in contrast to a common general picture of adolescents being quite sedentary. In our study, and the study by Ingulfsvann (2018), the students described increased well-being in the transition from being sedentary to moving. Increasing PA in schools is often a solution to external goals captured in quantitative ways (how much, how often, what intensity), where Larsson and Quennerstedt

(2012) argue that there is an inherent value in experiencing oneself move and move in different ways, without applying any external standards for how students should move and how movements are performed correctly. The phenomenon of humans moving, the pure feeling of moving and reflections on this, is an aspect of value in itself.

Engaging with the school environment in a different way implies that classroom PA, as experienced by the students in this study, is a meaningful and integrated learning activity that students accept and embrace. This indicates that classroom-based PA with PAL and PA breaks can be a successful strategy to motivate adolescents to engage in more PA in a way and setting they find meaningful, which also enhances their learning environment.

4.2. A changed experience of togetherness and classroom dynamics

The second constituent describes how the students felt that classroom-based PA changed their social interaction and influenced social dynamics, especially in PAL lessons. Gaining insights into social dynamics matters because functioning well together is an important part of how young people experience themselves and others; it affects motivation and importantly, it is linked to psychosocial well-being (Ryan & Deci, 2000). The physically active lessons brought the students closer together, by creating a space where they became more familiar with classmates they normally did not interact with. However, it also showed a potential for social dynamics that made some students feel excluded, while some chose not to participate, thus excluding themselves.

4.2.1. Togetherness

The students described how teacher-organized group work ensured regular changes in group constellations. This was important in becoming more familiar with different classmates. The students reported experiencing that social walls were broken down across cliques and already existing friendships in the class. The experience of togetherness, becoming better at collaborating and a shared sense of victory when solving tasks together improved the psychosocial well-being in the classroom, according to the students. Martin and Murtagh (2017) also found that students were pleased with how classroom PA influenced their social interactions. However, it emerged that students enjoyed engaging with their established friends in the lessons (Martin & Murtagh, 2017), while students in our study highlighted how PAL broke down social walls between cliques and established friendships. PAL and PA breaks providing a changed experience of togetherness across students was also found in the study by Ingulfsvann (2018). This study found that students perceived classmates in a different way from sitting in a classroom: "movement in school both facilitates 'togetherness' between children but also established an arena where some children feel weaker than others, are excluded or mocked" (p. 3).

4.2.2. Social exclusion

The purpose of PAL was not always perceived as clear, making the students wonder what to prioritize and how to behave, which in turn changed the social dynamics. There was uncertainty about what was in focus and important, whether competition, solving tasks, academic achievement or group well-being. Ingulfsvann (2018) found that PAL had the potential to establish an environment where some children felt weaker than others and were excluded or mocked. The students in our study experienced something similar; a focus on competition as well as a lack of PA skills and physical fitness could result in students being made fun of and socially excluded. Students described that when they and their teachers became more familiar with PAL and more emphasis was placed on fair play, the social dynamics changed in a positive direction when working well together in the team was in focus. Vingdal and Birch (2014) describe how PAL has the potential to create feelings of competence for all, but group work needs to function well, otherwise insecure students grow more insecure, while self-confident students will dominate (p. 72). A study by von Seelen (2012), drawing on Wenger's communities of practice (Wenger, 1999), found that physical education teachers were more concerned with participation and less with establishing norms, rules and values. A focus on establishing norms, rules and values is important, according to Wenger (1999), for a group of people to function well together, and in the case of students, for learning and being part of a meaningful practice. If students are preoccupied by winning and are self-centered, it will create problems, especially for those who feel insecure about participation in sport (von Seelen, 2012). Vingdal (2014) argues that being less physically literate or lacking PA/movement skills compared to classmates can reinforce social exclusion when PAL requires such skills (Ahn & Fedewa, 2011; Lubans et al., 2010). In our study, we found two examples of classroom-based PA leading to social exclusion. One was a PAL lesson where competition and physical fitness were in focus. Here, one student told us she was not fit enough compared to her "competitive sports classmates". Secondly, a student chose to exclude himself from a PA break with a dance activity because he would "feel like an idiot if he participated". The second example can be further understood when taking into account that some young adolescents go through a phase where they do not want to be identified as a child, and therefore hesitate to play and participate in what may be seen as "childish activities". This increased the focus on self-created discomfort, possibly even shame, as the boy saw himself through the eyes of the others when asked to engage in PA activities where he did not feel comfortable or competent. Physical activities that are playful or "childish" have been discussed in the literature as one of the specific challenges in integrating more PA into secondary school (Réol & Volshøj, 2018).

There is evidence that regular PA can have a positive effect on emotional well-being, especially for children and young people (Bailey et al., 2013; Biddle et al., 2019). However, Bailey et al. (2013) argue that we cannot assume this relationship, it does not happen automatically, and that "physical activity's contribution to well-being is conditional on certain types of context and settings" (p. 297). The present study underscores that even though PAL and PA breaks make the students move, they do not automatically ensure psychosocial health and well-being for all students. The way the PA learning activities are facilitated can have implications for learning, participation, social in/exclusion, and psychosocial well-being. These activities facilitated "togetherness" and changed classroom dynamics but uncertainty about the purpose of the activity and how to balance different motivations for taking part in PAL, and a lack of focus on "fair play" and "childish" types of activities revealed challenges for psychosocial well-being and participation.

4.3. An increased awareness of preferences regarding the learning setting

4.3.1. Self-authorship

Several students expressed increased awareness of how they experienced the academic level and how they related that to their own wishes and aspirations for school performance and thereby personal growth. The students' greater awareness of their preferred ways of doing schoolwork and of how learning takes place, along with their ambitions and priorities, is another important aspect of this constituent. A reflective awareness of how PAL facilitates togetherness helped the students learn together and from each other. Students' increased awareness of learning preferences and social integration can also be described as a strengthening of their

internal voice. Developing this capacity to determine the one's beliefs, identities, and social relations is conceptualized through the concept of self-authorship (Kegan, 1994; Magolda & King, 2004), which is crucial for successfully navigating the complexities of adult life (Magolda, 2014). "How students move from their socialization to rely on external authority towards establishing their internal authority depends on the dynamic interaction of their personal characteristics, experiences, their interpretation of those experiences and their underlying constructs of knowledge, identity and social relations" (Magolda, 2014, p. 27). Self-authorship is often developed in the transition to becoming a young adult, but some young people take more time to bring their internal voices to the foreground to coordinate external influence (Magolda, 2014). Strengthening the internal voice and developing self-authorship during adolescence in the transition to adulthood may have an impact on mental health and psychosocial well-being. Although most Norwegian adolescents report good mental health, the prevalence of mental health challenges in adolescence is increasing in the country (Surén, 2018), especially amongst girls (Reneflot et al., 2018). PA integrated into classroom lessons as a novel way of doing schoolwork offers a space to experiment with priorities and the awareness of possible conflicts between students' preferences and priorities, and is in itself an important and interesting outcome. Students' internal voices are strengthened, which may influence the development of their self-authorship (at an early age) and personal growth in order to become critical and reflective citizens.

4.3.2. PA in lessons as a disruptive element

One aspect of the third constituent was how PAL and especially PA breaks could be experienced as a disturbance when students were asked to leave the work they were doing. When some students returned to their desks, it took time to calm down their aroused bodies. Very similar findings emerged in the study by Holt et al. (2019), which explored Danish 4th and 6th graders' experiences of PA breaks (described as "in-class activity breaks"). "Pupils differed in their abilities to retain concentration and, while some pupils expressed a need for many breaks, others felt the class was disrupted by the breaks" (p. 10). Research shows a good effect on physical activity in the classroom and time on task (Daly-Smith et al., 2018; Goh et al., 2016). This suggests that the unease when returning to the desk is temporary, although some students might find it harder to transition than others. This is supported by previous studies where teachers addressed concerns about the transition back to task (Lowden et al., 2001; McMullen et al., 2014). Students in our study who experienced classroom PA as a disturbance were comfortable sitting in concentration for a long time, but all students acknowledged that timing is important for a PAL or PA break not to interfere with concentration. In the study by Holt et al. (2019), it also emerged that arranging and facilitating a PA break was challenging for teachers in terms of accommodating all students' different needs in relation to timing and quantity.

Various researchers have addressed concerns about PAL being a disruptive element, closely linked to the teachers having to find the purpose of a PAL or PA break (Variation? PA? Because they have to?) (Réol & Volshøj, 2018). Réol & Volshøj (2018) describe the risk of combining schoolwork and PA activities (PAL), which will be disruptive in relation to the more abstract academic content in focus in secondary school, and therefore recommend PA breaks for this age group and not PAL (p. 197). Our students' descriptions did not reveal that PAL was disruptive in regard to abstract academic content. However, we did find that especially PA breaks were experienced as a disturbance and that some students found the academic level to be inadequate in PAL, which made them unmotivated for the schoolwork, and they focused on the physical aspect instead. Students also expressed frustration when PA breaks were longer then 5–10 min; one student argued that schoolwork or tasks should be added, otherwise the activity ended up being meaningless. There are some very important indicators of how classroom-based PA does not meet the academic aspirations of students who are successful in schoolwork and prefer traditional sedentary teaching. Students in this study showed great interest and willingness to learn where academic development and performance were experienced as important. The larger focus on exams and academic performance that exists in secondary school (Pless et al., 2015) might challenge the integration of PA into subject lessons. While some gifted students experienced decreased motivation, many students became more motivated for schoolwork and for learning through a more practical physical approach. They also gained motivation from sharing the learning experience, which is a strong indicator of increased psychosocial health and well-being and might enhance attitudes towards school in general.

Incorporating PA breaks in lessons has been described by Holt et al. (2019) as a struggle for teachers. Students in this study reported that PA breaks were a burden for some teachers that stole time from academic learning leading to the conclusion that 'non-compliant teachers' did not incorporate PA breaks although it was scheduled on the timetable, giving the students excuses for why the PA breaks were not appropriate (Holt et al., 2019). Despite the different preferences, students in our study seemed to agree that PAL and PA breaks were valuable to them, giving them a stronger voice, where they told their teachers how this new movement setting had become an important part of strengthening the classroom environment. As part of this awareness of the learning situation, they wondered about and reflected on teachers not meeting their expectations for implementing PAL and PA breaks on a regular basis.

4.3.3. Methodological considerations

The study was conducted in Norway with Norwegian adolescents, and the cultural setting, including differences in school systems, should be considered with regard to transferability of the findings. We have mentioned some parallel findings to ours in previous studies, which indicate potential cross-cultural relevance. The relatively small sample of students could be considered a limitation of the study. Giorgi's method compensates for small samples by stressing that the entire interview is analyzed in detail rather than being skimmed for themes. We consider our findings strong, because we had a varied sample and obtained rich data on the students' experiences of the phenomenon, which we were able to analyze and describe at the level of the phenomenon itself.

5. Concluding remarks

Adolescence is the period of transition between childhood and adulthood and includes a period of major changes to the body and to the way a young person relates to and interacts with the world. Researchers have described how this transition leads to challenges in implementing PA into the classroom and lessons in secondary school (Ottesen, 2017). Being a young adolescent in school implies a large number of hours at a desk and this period in life is recognized as accompanied by declines in PA and increases in sedentary behavior, in Norway and internationally (Borraccino et al., 2009). Health behavior is embedded in multiple layers of influence (McLeroy et al., 1988), where the school setting serves as an important determinant of students' health and PA behavior (Langille & Rodgers, 2010; Sallis et al., 2008). Positive experiences of PA in school are likely to influence students' overall behavior and attitudes towards PA, making school-based PA an important element in influencing adolescents' PA behavior and health in the

future.

Findings from this study support the aim of identifying and describing the general meaning structure of students' experience of classroom PA and how this relates to their psychosocial health and well-being. Our findings indicate that secondary school students found PAL and PA breaks to be a valued and meaningful movement setting that improved their psychosocial health and well-being, made them more aware of their own preferences and strengthened their internal voice. However, the new movement setting also revealed a potential to alter the social dynamics, leading to social exclusion and associated negative emotions, thus reducing psychosocial health and well-being in some students in certain forms and organizations of PA breaks and PAL activities. This study adds to the extant literature of classroom-based PA, which is often based on cognitive outcomes and teachers' perspectives in elementary/primary school settings, by providing and elaborate an in-depth description of how secondary students experience PAL and PA breaks in normal subject lessons.

Based on the students' descriptions and our comparison with the literature, we suggest three points of emphasis for future school-based PA interventions or already existing initiatives: 1) PAL and PA breaks to increase PA levels are a health promotion strategy which secondary students accept and welcome, 2) young adolescents are motivated to move, but the challenges occur in the organization and facilitation of PA activities to ensure psychosocial health and well-being, where activities involving competition should be handled delicately, and 3) in regard to PAL, more focus should be given on how to combine or integrate PA and schoolwork that supports the students' academic and maturity levels. Future research can explore further how teachers can organize and facilitate PAL and PA breaks to ensure psychosocial well-being of all students, and also how secondary teachers experience teaching this age group using classroom-based PA to achieve physically active learning.

The motivation to implement more PA in schools is based on a policy desire to increase PA levels and thereby improve public health. If we truly want to integrate more PA into schools and classroom lessons, we need to take the experiences of students into consideration. The findings we present in this study provide valuable information on how physically active classroom lessons affect students differently, which forms a basis for further development to make the classroom PA a success.

Funding

The research was partially funded by Sparebankstiftelsen Sparebanken Sør. The funders had no influence on development or content.

Declaration of competing interest

The authors declare no conflicts of interest with respect to the authorship and/or publication of this article.

Acknowledgments

We wish to thank all the students who participated in the study.

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Article 3

Schmidt S, K., Bratland-Sanda, S., & Bongaardt, R. (2022). Secondary school teachers' experiences with classroom-based physically active learning: “I'm excited, but it's really hard”. Teaching and Teacher Education, 116, 103753. https://doi.org/10.1016/j.tate.2022.103753

Teaching and Teacher Education 116 (2022) 103753

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

Research paper

Secondary school teachers' experiences with classroom-based physically active learning: “I'm excited, but it's really hard”

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HIGHLIGHTS

- Physically active learning is embraced by secondary students.
- The required time and energy resources challenges the teachers' role as holistic educators.
- Competence-development and long-term support is important for continuance of physically active learning.
- There is a need for more research-based and tested physically active learning content.

ARTICLE INFO

Article history:
Received 30 April 2021
Received in revised form
17 February 2022
Accepted 20 April 2022
Available online 17 May 2022

Keywords:
Physically active learning
School-based physical activity
Health promotion
Classroom-based physical activity
Secondary school
Teacher experiences

ABSTRACT

Classroom-based physical activity represents a paradigm shift in education and has been understudied in secondary school. The purpose of this study was to explore secondary school teachers' experiences of classroom-based physical activity with an emphasis on physically active learning. Six 9th grade teachers were interviewed. Giorgi's descriptive phenomenological method was used to analyze the interviews and structure the findings. The findings show a general meaning structure and three interrelated themes: Motivated by relevance, A more complex reality than expected and Resigning to simpler solutions. These insights will impact the development of current and future school-based physical activity programs.

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1. Introduction

Recent decades have seen a shift from a physically active to a sedentary lifestyle, with huge consequences for public health (Blair, 2009; Bull et al., 2020). Extensive use of traditional, sedentary learning activities ignores state-of-the art cognitive neuroscience, which connects the importance of bodily movement to cognitive functioning and learning (Daly-Smith et al., 2020; de Sousa Fernandes et al., 2020; Haverkamp et al., 2020; Sheets-Johnstone, 2015). This is important as few children and adolescents globally meet the recommendation of at least 60 min of daily moderate to vigorous physical activity (World Health Organization, 2018). This is also the case in Norway, where approximately half of Norwegian youth are insufficiently physically active (Dalene et al., 2018). The WHO has identified schools as a key setting to ensure adequate physical activity for children and adolescents (World Health Organization, 2016) and initiatives have been developed and implemented worldwide at local, regional and national levels (Camacho-Minano et al., 2011; Love et al., 2019; Naylor et al., 2015; Rasberry et al., 2011). Several strategies for school-based physical activity exist. Some of these are comprehensive and multicomponent, with a focus on using several strategies within and outside the school building, and on individual, group, organizational and governmental/system levels. Others focus on a single component such as physical activity in the classroom (Bedard et al., 2019; Daly-Smith et al., 2018; Martin & Murtagh, 2017b; Norris et al., 2019). Classroom-based physical activity, also described as movement

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https://doi.org/10.1016/j.tate.2022.103753
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integration in other literature, is any physical activity performed in the lesson and includes integrating physical activity into educational activities as well as providing physically active breaks (Centers for Disease Control and Prevention, 2018). The term covers two approaches: 1) physical activity during a lesson in any subject meant to interrupt students' sedentary behavior, with or without educational content or focus. Such physical activity breaks (PA breaks) are also called brain breaks, energizers or classroom movement breaks. 2) Physical activity that is combined with or integrated into the curriculum's and thus planned as part of the lessons. This latter approach is an increasingly popular solution and referred to as physically active learning (PAL) (Daly-Smith et al., 2020; Norris et al., 2019). PAL is the main component and strategy to increase student physical activity levels in a Norwegian school-based health promoting program, the Active and Healthy Kids Program. This program is implementing classroom-based physical activity in secondary schools with an emphasis on PAL. With its focus on bodily learning processes, PAL presents a key paradigm shift in current educational practice and learning activities. However, this approach implies that teachers in any subject are responsible for transforming their teaching by introducing the broad concept of PAL. An essential methodological task for teachers is to connect physical activity to subject content. Teachers are generally not trained to teach through physical activity and bodily movement, and are therefore being asked to adopt learning activities in which they normally have limited knowledge and skill. This exemplifies rapid changes in the educational landscape that have raised expectations for teachers' skills and professionalism, requiring them to constantly learn and develop (Hargreaves, 2000). Teaching today includes a variety of curricular responsibilities and pressures in addition to expectations of professional development; many changes in a short time can lead to exhaustion, less enthusiasm for new initiatives and lower perceived ability to implement them (Fullan, 2007). A common reason why many change initiatives fail in schools is insufficient attention to the difficult internalization process that key staff must undergo. The new vision with its characteristics and beliefs has to be adopted as one's own, promoted by “external change agents”, like top-down change initiatives from leaders, or new school policies. (Assor et al., 2009). In fact it is argued that the teachers are the key staff: “Educational change depends on what teachers do and think - it's as simple and complex as that” (Fullan, 2007, p. 129). However, “external change agents” often fail to allow teachers' authentic voices to be heard when promoting new visions (Hargreaves, 1994). Therefore, researching and exploring the teacher's perspective can strengthen research that supports school practices in a robust implementation of school-based physical activity.

Classroom-based physical activity, especially PAL, is mostly being implemented and researched in elementary and primary schools. However, research recommends and supports implementation of this approach in secondary schools (Romar et al., 2020). Secondary schools may find it more challenging to implement more physical activity in the school day. One main challenge is the increasing focus on academic tests and performance and students not staying with one teacher all day (as typically is the case in primary schools) (Cothran, 2010) and another is that some young adolescents go through a phase where they do not want to be identified as a child, and therefore hesitate to play and participate in what may be seen as “childish activities” (Réol & Volshøj, 2018). More research into the use in secondary school in general is needed, as concluded in a review by Norris et al. (2019), who specifically examined how PAL affects physical activity, education, health and cognition outcomes. Here, only three out of 42 studies were from secondary school. Teacher perspectives on implementing and integrating classroom-based physical activity have been researched, but mostly in primary and elementary school settings, where time, space, a lack of training, pressures of standard tests, and lack of support and follow-up have been identified as the main barriers (Jørgensen & Troelsen, 2017; Lerum et al., 2019; Martin & Murtagh, 2015; McMullen et al., 2016; Quarmby et al., 2019). This leaves a gap to further explore and understand teachers' perspectives and implementation processes with PAL in secondary school settings. Classroom-based physical activity interventions in secondary school are often implemented by researchers (Gammon et al., 2019) or tested using preservice teachers (Dinkel et al., 2017; Goh et al., 2013; Romar et al., 2020). The present study examines a long-term health promoting program involving classroom-based physical activity, where the local County Health Department is the project owner, running the implementation in collaboration with project leaders in the participating municipalities and local school leaders. Researchers are studying and evaluating the process.

The purpose of this study is to explore subject teachers' lived experience of classroom-based physical activity with an emphasis on PAL and to identify and describe secondary school teachers' general experience of this phenomenon. PAL is in focus here because it is a relatively new approach and the main intervention component in the program. The research questions were: 1) How do secondary school teachers experience classroom-based physical activity with a focus on PAL, and 2) How do the teachers experience students' psychosocial well-being in relation to this new approach to teaching?

This study is part of a larger school-based physical activity research project on the Active and Healthy Kids Program. The research project relates to students' physical activity and psychosocial health in secondary school. Part of the project is a focus on the experiences of teachers as key stakeholders. This study will help us to understand teachers' perspectives on the PAL methodology, and their motivation and barriers to using physical activity as an approach to learning the curriculum in various subjects. A further focus area from the teacher perspective is how physical activity in the classroom might influence students' psychosocial well-being. These insights will assist in the development of current and future school-based physical activity programs.

2. Method

2.1. Setting and informants

In Norway, elementary and secondary school education is mandatory for all children aged 6–16 years. Secondary schools in Norway cover the 8th, 9th, and 10th grades, and students are aged 13–16 years. Informants in this study were teachers from two secondary schools. These two schools had implemented the Active and Healthy Kids program, taking part in a large non-randomized controlled intervention-based research project (Schmidt et al., 2020). The Active and Healthy Kids program was initiated and implemented by the health department of a Norwegian County Council in fall 2017. The overall program is a multi-component health promotion program to improve the learning, well-being, and health of students in elementary and secondary schools. Classroom-based physical activity in this program consists of the main component PAL and short physically active breaks without educational content during lessons (PA breaks). PAL is taught in the three main subjects in secondary school: English, Math and Norwegian. When PAL is used in these subjects, it is preferably outdoors in the school grounds. This has practical reasons: the outdoors provides a much larger space for movement than the classroom, which is filled with desks and chairs, and neighboring classrooms are easily disturbed by the noise. It also relates to a

belief that being outdoors, breathing fresh air, is good for the students, as Norway has a longstanding culture of appreciating the outdoors. The subject content in PAL can be familiar or new; in this program emphasis was placed on revision of already introduced learning material. PAL should an integral part of the teaching and not a break. It consists of teacher-led activities that involve moderate to vigorous movement in revising or learning new core content in the subjects. The teachers were given a one-day generic training course prior to implementing the program. Schmidt et al. (2020) include further descriptions of the training of teachers. Schools taking part in the Active and Healthy Kids program were encouraged to implement at least 135 min/week of PAL and 25 min/week of PA breaks. In the overall model, Physical Education as a subject is included, performed as usual for an additional 135 min/week, giving a mean of 59 min per school day where students potentially can get close to the daily physical activity recommendation from the WHO and the Norwegian Institute of Public Health of 60 min of moderate to vigorous physical activity per day for children and adolescents (Bull et al., 2020; Norwegian Institute of Public Health, 2021). Further descriptions of the program can be found in Schmidt et al. (2020), including results showing the effect of the intervention on students' physical activity, physical fitness, and well-being.

The teachers shared their experiences in interviews conducted in April and May 2019, 18 months after the start of implementing classroom-based physical activity. Teachers were recruited from two schools included in the larger project, the Active and Healthy Kids Program, one from each municipality. One of the municipalities only had one secondary school. A school from the other municipality equal in size in terms of staff and students was selected, resulting in one rural and one urban secondary school. All 9th grade teachers at the two schools were invited to take part in the study, 14 of whom were relevant for this study because of their experience with the classroom-based physical activity approach PAL. The first author visited the schools and invited teachers orally and in writing. Several attempts were made to recruit teachers. Four teachers from the rural school and two from the urban school with experience of teaching PAL agreed to participate. There were four females and two males aged 27–57, with teaching experience ranging from 4 to 25 years. All were given written and oral information and ensured anonymity. All gave written consent.

The Norwegian Centre for Research Data approved the research project (ID number 54237), and the project was evaluated by the Norwegian Regional Committee for Medical and Health Research Ethics (No. 2017/387) and registered in ClinicalTrials.gov (NCT03906851).

2.2. Data collection

Data were collected through individual in-depth interviews grounded in descriptive phenomenology (Giorgi, 2009). Such interviews give access to a person's verbalized lived experience of a certain phenomenon (Giorgi, 2009) and this method was considered suitable to address the research questions of this study. In phenomenology, researching lived experience is exploring what it is like from the first-person perspective to experience different events. In this study the teachers' experiences are in focus because of their specific role in adopting classroom-based physical activity and implementing it in their teaching.

Before conducting the interviews, in order to gain a sense of the setting in which physical activity was used and integrated into lessons, the first author (SKS) observed PAL activities in all secondary schools that implemented the Active and Healthy Kids Program in 2017 ($n = 6$). These observations were used to become familiar with the phenomenon and sharpen the interview questions, which allowed for a more natural conversation with the teachers based on a better idea of what they were referring to, e.g., descriptions of the outdoor or indoor areas of the schools. SKS conducted individual face-to-face in-depth semi-structured interviews at a place and time convenient for the teachers. SKS prepared a semi-structured interview guide, which was discussed and practiced with the last author (RB). The interview followed the main themes of the interview guide, but questions varied between the interviews, following the flow of the conversation which was led by the informant. Questions were centered on asking teachers to describe their experiences with PAL and PA breaks with questions such as: When you were introduced to PAL/PA breaks, what did you think? What have your experiences been? Think of a lesson where you used PAL, tell me about that, what happened? How do you think the students experience PAL/PA breaks? Interviews lasted between 50 and 80 min, and were recorded and transcribed verbatim.

2.3. Data analysis

Data were analyzed using the descriptive phenomenological method of Giorgi (2009). This method is based on phenomenological philosophy formulated by Husserl (1983) and Merleau-Ponty (1962), which aim to capture a phenomenon as it appears to a person, through that person's lived experience of the phenomenon as manifested in relationships with the environment and other people, as well as in the person's mind. The descriptive phenomenological method is a search for a structure of the meanings of the phenomenon under study. In accordance with this method, all transcripts were read closely to gain an initial sense of the whole. Then the text was re-read in depth and all material divided into meaning units, by noting every time the informant changed the direction of their attention to another aspect of their experience. Every meaning unit was transformed into the third person perspective to enable meanings to be expressed consistently with a focus on the phenomenon rather than particular features of the statements of individual informants. The meaning units were also re-written into psychologically sensitive expressions that highlighted the psychological meanings lived by the informants. Finally, a general structure of what can be described as a summary of experienced meanings was written based on the transformed meaning units. Further, a more detailed description of emerging themes was made using descriptions based in the data. The first author conducted the first part of the analysis and all authors were engaged in identifying the meaning structure and themes. Discussion between the authors provided clearer definitions of the meanings and identified their structure. A discussion between two or three people is faster and more effective than if a single person performed this process.

When using this method, it is important to adopt the so-called phenomenological psychological attitude, which will enhance understanding of our natural attitude (Giorgi, 2009). This involves the epoché and an assumption of the phenomenological psychological reduction. The epoché means that the researcher brackets her own assumptions as well as common knowledge about the phenomenon under study, not letting this past knowledge be engaged while analyzing, as this allows the researcher to see the data in a new light and attend to the informant's description (Giorgi, 2009, p. 100). Giorgi's descriptive phenomenological analysis was applied to all the transcribed interviews. Six transcriptions ranging from 21 to 32 pages with rich descriptions provided material that was sufficient for this phenomenological study. This implied that the central themes recurred between the interviews and nuanced insights into each theme could be condensed.

3. Results

The following is a general meaning structure, an essential summary of the psychologically relevant aspects of the teachers' experiences of classroom-based PAL, which is the main intervention component of the program studied.

3.1. Summary representation

Implementing PAL into lessons provides an experience of leaving a well-known teaching practice and treading on more unfamiliar ground.

The good intentions and purpose of PAL are endorsed as they are in accordance with the teachers' own beliefs that students need more physical activity. PAL is a rewarding contribution to everyday teaching and seems to fill several identified gaps for improving teaching and accommodating student needs. PAL provides students with a form of active learning break during the lesson, which increases attention and concentration and counteracts the often experienced drop in energy level during regular classes. It also reduces sedentary time, which teachers consider important for students' overall health and well-being. Furthermore, glimpses of desirable learning outcomes are revealed when the educational tasks are well integrated with the physical activity component, and when the students subsequently respond positively to this.

At other times, teachers feel overwhelmed by the complexity of integrating academic schoolwork with physical activity, the difficulty of making it work in practice and of ensuring relevant learning outcomes as defined by the curriculum. The novelty and creativity needed are challenging; no matter how hard one tries, one just does not get it quite right, making one feel inadequate, or not creative enough, and realizing something more is needed to make this way of teaching viable in the long run. Teachers may resort to their individually preferred solutions. In addition, they seek support among colleagues, assigned resource persons, and the school leadership. Especially when concrete support is not forthcoming, teachers' uncertainty is resolved by falling back on a few successful strategies.

Good outcomes become outweighed by the extra time and engagement that is required and demotivation creeps in. The teachers wonder what to focus on, facilitating physical activity or offering relevant schoolwork. A separation of the two becomes opportune, as do the moments when PAL is used. Physical activity in lessons then becomes a meaningful tool to use occasionally when students need variation or as a tool to liven up a sedentary classroom and school day when the teacher is motivated, or students ask for it.

4. Three themes to demonstrate how teachers' experiences unfold

Three themes evolved from the analysis: Motivated by relevance, A more complex reality than expected, and Resigned to simpler solutions. Here we present these with reference to quotes from the interviews and extracts from the research literature that deepen an understanding of the findings.

4.1. Theme 1. motivated by relevance

The program's overall intention to increase students' physical activity levels in school is in general supported by the teachers taking part in this study. Several point out that the school has an important mandate and opportunity to reach all students, promote equality in physical activity, and increase motivation for being physically active. In our study, classroom-based physical activity was endorsed because of the value it could bring to the classroom. It was seen as an important health promotion strategy that could enhance students' health, well-being and learning. Teacher Maria said:

> I thought that this seemed interesting and exciting (…) this was positive and something the students could benefit from because I see how much they sit still in lessons, so I was very positive when we were introduced (…) If there's one place where we can create enjoyment and motivation for being physically active, it's in schools and kindergartens. I think it's important that we make a contribution there.

The teachers' attitude is important because classroom teachers as physical activity promoters are increasingly being called upon in school-based physical activity interventions and programs (Egan & Webster, 2018) and strategies are sought to foster classroom teachers' willingness to promote physical activity in their classrooms (Russ, 2015). Teachers typically have a positive view and perception of using classroom-based physical activity (Cothran et al., 2010; Graham et al., 2014; Parks et al., 2007; Stylianou et al., 2016). However, there are also teachers who believe that improving students' health and physical activity should not be part of teachers' mandate or duties (Jørgensen, 2019). In this study, how students benefitted from classroom-based physical activity was important for the teachers' attitudes, beliefs, and motivation for implementing physical activity into their lessons.

> I really want the best for my students, and I feel strongly that they should enjoy school. I want them to enjoy my classes, to learn and experience mastery and happiness. Many students think that having physical activity in lessons is fun and they want more. That's why I want to provide physical activity in my classes wherever possible. (Teacher Maria)

Adding a physical activity component through PAL or a PA break to lessons creates variation that teachers in this study find valuable for both teaching and accommodating the students' need for a break or change of working method during a relatively long lesson; it is seen to increase students' energy, focus attention on the task at hand, and break the monotony of sitting still for a long time. Other studies have shown that teachers found that the attractiveness and relevance of classroom-based physical activity influenced their willingness to implement it in the classroom (Cothran et al., 2010; Dinkel et al., 2017; Goh et al., 2013). Many teachers have entered the profession because they find caring for others to be fulfilling (Spyridoula & Symeon, 2014). Therefore, experiencing a positive response to PAL by their students provides positive feedback for teachers. This positive feedback may enhance teachers' intrinsic motivation (Ryan & Deci, 2017), and is therefore viewed as an important factor in their efforts to adopt PAL into their teaching.

The teachers in this study observed that the learning environment changed when they used PAL in their classes: students began to enjoy classes more and seemed to have greater motivation for working with educational content. The teachers gained practical hands-on experience of how subject content and curriculum could be combined with physical activity and they experienced a variety of positive outcomes.

> So then it's all go for, well, often 20–25 minutes where you can see all the students are interested in doing their work, interested in learning and participating and then you see amazing learning. And then they're all happy and enjoying themselves and at the same time they've learnt a lot. (Teacher Michael)

This quote also illustrates that teachers in general found no difficulty in getting students to participate in PAL activities. Another teacher mentioned some observations that really surprised her, namely that PAL is well received by both genders and by students who in general are physically active as well as those who are not.

> The class that surprised me the most and who insisted on it most, that's the one I believe is the least physically active. Boys are maybe keener than girls; however, and this is quite interesting, there are some quiet girls who really come to life in these activities and who think it's fun to be seen in a different way. (Teacher Olivia)

In sum, what we see is that teachers not only find it important to incorporate physical activity into teaching but also acknowledge its potential.

4.2. Theme 2. a more complex reality than expected

The initial motivation and positive attitudes towards the program diminish especially for PAL, as teachers attempt to integrate it into their daily teaching over time. The everyday practice of incorporating PAL into subject classes turned out to be a more complex task than first anticipated.

Although some useful and meaningful combinations were found, it was found to be methodologically challenging to integrate PAL well into subject lessons and especially to fulfill the required learning objectives and ensure relevant learning outcomes. Teachers asked questions such as: How should a teacher apply PAL when students are working for several weeks on a written assignment?

> I can always manage to sneak it in here and there, but it has to fit in, in a natural way. It's very difficult when you're creating something big, to not make it too artificial so that it gets too abstract or vague. Then it gets to be more for the sake of the activity and not for the sake of learning. The students can't see the connection, I can see it but they can't. It has something to do with my communication skills, I have to practice and do it in a better way so they actually get it. I feel a bit of a novice in this, I need more experience. (Teacher Olivia)

It was often difficult to find good ways of structuring PAL; the creative process of developing PAL activities was demanding, requiring teachers to be innovative outside of their comfort zone. Moreover, "it soon gets to be a lot of work for little reward, a lot of preparation for something very small" (Teacher Olivia). In the process of trying out the new PAL methodology, the teachers struggled with the uncertainty of its outcome, which affected their motivation and willingness to continue trying to use PAL.

Recent studies have also found that the integration of physical activity and bodily movement into the curriculum in other subjects is a particular challenging task (Jørgensen et al., 2020; Knudsen et al., 2019; Larsen et al., 2012; Romar et al., 2020). In our study several teachers repeatedly mentioned concerns about their own ability to vary activities, to create new activities and to achieve the positive and meaningful integration of physical activity and subject content. Teachers' competence has been found to be a strong predictor of classroom-based physical activity implementation (Webster et al., 2013), highlighting teachers' professional development and competence as critical for implementing PAL successfully.

The following quote illustrates how various factors contribute to the complexity and how anticipated methods and solutions did not always work in practice, leading to the perception of PAL as challenging and less straightforward than originally assumed.

> What I find tiresome is if you've done it with one class … I teach three 10th grade science classes. And because of the weather and other stuff, I wasn't able to do it with the other two [classes], and they're always going on at me: "When's it gonna be our turn?" … Yes, they keep on at me, and I end up making new activities … The weather has affected it in stupid ways so that I couldn't do the same activity twice. So I've made two different ones. So all three classes have had PAL, but they've had it in three different ways. (Teacher Olivia)

Time constraints add to the complexity of teaching PAL. Time is needed to create good PAL activities, which in turn take time to set up between lessons; then more time is required to move the class out of the classroom to the site of the activity, and to explain the activity and instill the right focus in the students.

> It needs to be worthwhile for all the students and then it starts to become so complex that it takes actually two to three hours to make, write it all down, print it and get it all together. (Teacher Anders)

Time and space constraints have been a point of concern in previous classroom-based physical activity studies (Bartholomew & Jowers, 2011; Benes et al., 2016; Larsen et al., 2012; Romar et al., 2020; Stylianou et al., 2016; Webster et al., 2013). Preparation time is a key barrier to using PAL for primary teachers, especially the rearrangement of classroom furniture (McMullen et al., 2016; Quarmby et al., 2019). Where most studies have explored PAL indoors, the teachers in the Active and Healthy Kids program were encouraged to teach PAL outdoors. This was endorsed by teachers and students in this study alike because of the larger space and fresh air. However, the physical space adds to uncertainty and unpredictability and requires new strategies for teaching methods. The weather influences students' moods and motivation both positively and negatively while the cold Norwegian winter may halt physical activity outdoors. Changeable weather might challenge the regular use of outdoor teaching methods and make PAL activities somewhat chaotic.

> … we've been outside in pretty strong wind, all the sheets of paper were flying around, and you had to go around to find rocks to put on top of them. And it's hard to write when your paper gets wet. (Teacher Maria)

Other studies address the physical environment as an aspect that challenges teachers in using physical activity in lessons (McMullen et al., 2016), indicating that the physical environment of schools could be improved to better support more physically active ways of learning.

PAL is revealed as not a "one size fits all" method, neither for teachers nor for students. While most students respond positively, teachers see variations in how PAL affects their students. Teacher Olivia described how adolescent students are "turning into and moving around like six-year-olds" when they are outside having PAL. Other teachers report that some students were more hesitant to participate in parts of the activities and wondered if this was linked to students' transition through puberty and increased self-consciousness. One teacher also noted that some students have difficulty regaining focus and calming down after PAL or a PA break.

> So we come back in, and it varies how they, because maybe that's part of the point of it, how well they work afterwards. Some haven't managed to get back down to earth, they're still energized when they come back indoors and can't really get started, while others have been in activity and they're ready for more work (…) So I cannot say that today the whole class worked really well afterwards, because some of them had trouble settling down. (Teacher Anne)

Other research has also found that it is a challenge for the teacher to accommodate all students' different needs when implementing physical activity into lessons (Holt et al., 2019). Teaching and using PAL can be a greater implementation challenge in secondary school than in primary school, since adolescents may be in a phase of life where they avoid play-like or "childish" activities (Réol & Volshøj, 2018). Several studies have found that some students find it difficult to regain focus after a PA break (Holt et al., 2019; Romar et al., 2020), which suggests that this is an aspect of PA/PAL that needs to be addressed.

The way teachers organize and facilitate PAL matters, and the teachers in this study describe a need to tone down the competitive element, which is often introduced into the activities by the students. Competition is also one of the components illustrative of the complexity of PAL implementation. The outcomes of competition can be quite varied, such as increased student motivation along with the creation of division, irritation, and negative tensions between students.

> They can get a bit annoyed with each other, if some team members aren't as successful as the rest of the team, or if they don't run fast enough, or put in the effort that the others expect. (Teacher Camilla)

In our study, teachers both toned down competition in PAL and used it actively to motivate students. The competitive element in classroom-based physical activity has been addressed by Ingulfsvann (2018), who also found that students themselves often bring competition into an activity, even though the teachers explicitly told them not to. That study reported similar findings to ours, i.e., that competition may motivate some students, but may also lead to students making comparisons and belittling each other (Ingulfsvann, 2018).

The work environment, colleagues, and school leaders influenced the teachers' experience of adopting and implementing PAL. Where to seek support and help was not clear and teachers wondered who was responsible for supporting them, since several pointed out that the whole responsibility was placed on them individually. In general, the teachers wished for more support and leadership from school management, in an endeavor to make the implementation of PAL a shared project. Several teachers found that school leaders' support declined over time.

> The challenge is like: "OK, let's do it!" and then later there's no more enthusiasm (…) It's up to the individual teacher, there's no shared ownership of the project, it's an individual approach (…) we didn't do this together, it was more individual, so I didn't really feel any responsibility or a shared responsibility. (Teacher Anne)

Who is responsible for PAL and its proper integration into subject classes? Who keeps an eye on the amount of physical activity to ensure that the goal of 1 hour per day is reached? Who is in charge and who should take charge and responsibility? Teachers have reflected on these questions, trying to navigate the school's hierarchy and the strategy and goals of the program.

> I get a bit upset, upset about my colleagues, but my many years of experience tell me that if you want to get something done at school, the management must have ownership of it. Because they're the ones in power. I have no power … in the hierarchy I'm in the same place as the other teachers. Then it'll be quite hard if some people are reluctant here, it'll be quite hard for us to hopefully get them involved then. Instead of it coming from management and them saying, "We're going to do this, this is what we're going to implement, and we'll do it like this and like that". (Teacher Michael)

Collaboration between teachers varied or was non-existent. One teacher observed a work culture that resists or lacks interest in incorporating PAL and school projects in general.

> We've sort of discussed the method in our team of teachers, and I've quite often felt a bit alone there (…) it's difficult when there are few of us against many who want to motivate and who want to go through with this. (Teacher Maria)

The outcome of a lack of team spirit in handling the complexity of PAL, with the school leadership withdrawing early in the implementation process and teachers resorting to simpler solutions, is that a handful of teachers take a stand alone in keeping up the motivation.

> I'd like to use it more than I do, and I'd like to have more people on board. Because it's kind of difficult, there's a limit on how much time you can spend on it on your own. (Teacher Maria)

The importance of teacher collaboration has been addressed in several studies (Goh et al., 2017; Knudsen et al., 2019; Langille & Rodgers, 2010; Sulz et al., 2016; Webster et al., 2018) and identified as an underutilized resource for implementing classroom-based physical activity (Dinkel et al., 2017). It strengthens the implementation process if teachers experience support from colleagues and leaders (Naylor et al., 2006), but the lack of such support leads to simplified solutions. This is described below.

4.3. Theme 3. resigned to simpler solutions

The teachers realized that PAL can be taught in many ways. In the process of becoming familiar with integrating PAL into their regular classes, the teachers reflected upon their own teaching. They experienced PAL as not merely a quick fix, but more of a general change in one's teaching practice that requires new skills. Teachers became increasingly aware of their teaching style and observed and reflected on how students learn and their potential learning outcomes. Here is a teacher reflecting on the teaching approach:

> They [PE teachers] aren't afraid of using physical activity and having it take time from teaching, because they see that it gives something back. But then you might be thinking: "There's so much I need to cover, and I'm busy and it's a week till the next math class, so now I need to be done with this" (…) It's not certain that the students understand more even though I myself felt I covered the topic. Some do and some don't. (Teacher Camilla)

The expected learning outcomes were not necessarily obvious, and several teachers started questioning the potential of PAL in

supporting and increasing student learning. “Of course, you get the physical effect, but not always in terms of learning” (Teacher Olivia).

The complexity surrounding the process of adopting and implementing PAL made several teachers stop using PAL regularly, often returning to more familiar classroom practices. The positive attitude, belief in the method and good outcomes were outweighed by the challenges the teachers experienced, and they sought simpler solutions, often prioritizing physical activity instead of the more demanding task of PAL: “… it got to be too much to make schoolwork that fitted in with physical activity, so that's why I only used physical activity” (Teacher Michael).

Several teachers described using PAL and PA breaks differently than according to the program. The teachers resorted to a set of their own preferred solutions to deal with the complex demands. For instance, they reduced the number of times they used PAL and shortened the PAL activities. On the other hand, the PA breaks often became longer than the previous short 5-min activities. Facilitating physical activity was given priority, because that is simpler and easier than teaching PAL.

> In the end, I found it difficult to find motivation and to make new activities, and to make enough variety. That’s because I’m not very creative. So what happened, especially at the end of the school year, was that we just went outdoors and had 20 minutes of soccer for example, instead of the regular subjects. (Teacher Camilla)

As our findings indicate, and as found in other studies, the teachers often use physical activity in classes less frequently and for shorter periods of time, or with modifications, compared to the recommended levels (Quarmby et al., 2019; Webster et al., 2015). Fullan (2007) describes how teachers naturally become copers in change situations as they are on the receiving end of change. Secondary school teachers' coping strategies have previously been specifically addressed by Jørgensen (2019). In the present study, the teachers coped by simplifying and modifying the physical activities. Prioritization differed, however; where teachers in Jørgensen's study generally focused on schoolwork rather than physical activity, teachers in our study focused more on physical activity.

There was a discrepancy between the program ideals and the practical reality, which were experienced as frustrating even among the most motivated teachers.

> And then this comes on top of everything else, I end up feeling that this is not my problem, they can move about in recess, I just don’t have the capacity to include any more and that’s what’s frustrating. There’s so much we have to get through (…) you’d like to do it but it’s far from easy, and I don’t like to be someone who focuses on problems. I like to see solutions, but I really can’t see any here. (Teacher Olivia)

A natural solution to deal with PAL was an “either/or” approach. This meant that some teachers stopped using PAL in classes and only used PA breaks once in a while, and felt guilt or even shame about it. Others used bits of PAL occasionally, with the risk of losing the coherence of the approach.

Teachers in our study highlighted courses and training in PAL as motivating, and suggested that repeated courses, providing regular boosts of motivation, could help keep PAL warm. They further reported little access to appropriate support material for secondary school and requested more ready-made PAL activities and resources. Teachers expressing a desire for more pre-planned activities have also been reported in other studies (Delk et al., 2014; Larsen et al., 2012) and access to such activities has in several studies been identified as a key factor in promoting implementation (Delk et al., 2014; Goh et al., 2013; Holt et al., 2019; Naylor et al., 2006). The request for more ready-made “hands-on” PAL activities could be viewed as seeking a “quick fix”. However, this more pragmatic side of providing teachers with more specific practical ideas that directly relate to everyday classroom teaching is important for programs to succeed (Fullan & Miles, 1992; Guskey, 2002).

Previous studies have found that courses and training in how to teach classroom-based physical activity seem to benefit teachers’ perceived competence (Goh et al., 2013; Stylianou et al., 2016) and continuous support from experts has a positive effect on implementation (Delk et al., 2014; Lowden et al., 2001; Naylor et al., 2006). Further, the literature suggests a rethinking of training, including a more gradual introduction with the opportunity for practice during training, in addition to observation of teachers using classroom-based physical activity (Parks et al., 2007).

5. Discussion

Limited research on PAL in secondary school exists, while more research has been conducted in elementary and primary schools. Further, it has previously been argued that teachers' beliefs about the value of physical activity interventions is important for future research, as such interventions need to add value for teachers, rather than merely involving additional work (McMullen et al., 2016). We have identified classroom-based physical activity in general and PAL specifically as a process of changing teaching practice. This can be seen as part of teachers' continued professional development (Stylianou et al., 2016). According to Guskey (2002), who addresses teachers' professional development and teacher change, teachers' attitudes and beliefs are essential factors in the successful implementation of new practices, where significant changes in attitudes and beliefs occur primarily after teachers see evidence of improvements in student learning and behavior. As the findings of our study show, teachers were motivated by the relevance that PAL and PA breaks could bring to their classroom, they had positive attitudes and beliefs and observed benefits to student learning and behavior (theme 1). According to the teachers, positive student responses translated into student enjoyment, motivation and a request for regular PAL and PA breaks. However, the complex reality of implementing PAL specifically was not anticipated and there was a lack of appropriate support in the change process (theme 2) resulting in a process of surviving PAL through various coping strategies, which diminished the coherence of the approach and the program, potentially counteracting some of the core intentions of the program (theme 3). PA breaks were easier to implement, but often practiced for more than the stated 5 min, thus taking away time from education, and also potentially counteracting some of the core intentions of the program (theme 3). In terms of Guskey's model of professional development and teacher change, it is important to recognize that change is a gradual and difficult process for teachers. We found that the teachers did not receive acknowledgement and recognition that incorporating PAL into teaching is a challenging task that takes time and effort. This lack of expressed recognition from program leaders, classroom-based physical activity trainers, school leaders and even colleagues may make it difficult for teachers to address their challenges and importantly, to seek and find support in how to overcome these. Guskey (2002) further suggests that it is important to provide continued follow-up, support and pressure as helpful for teachers' sustained professional development, in accordance with the findings of this study. We suggest that teachers are provided with information and a follow-up discussion during their training

in classroom-based physical activity about the challenging sides of implementation, especially of PAL. Facilitating a conversation about the complexity of PAL and the time and effort it takes to learn to use it well, can, we hope, help them to maintain motivation while learning and working with this approach.

Since PAL is a relatively new approach in teaching, various strategies for training teachers exist. Typically in research projects, the researchers provide the training themselves, and some also assist teachers with the planning and execution of classroom-based physical activity interventions. Training typically includes lesson ideas, resources, encouragement, information about classroom-based physical activity and technical assistance (Carlson et al., 2015; Gammon et al., 2019; Knudsen et al., 2018; Martin & Murtagh, 2017a). In the present study, the implementation took place in a natural environment led by the County Council Health Department. Schools volunteered to implement the program and all teachers at these schools were offered training and information about the concepts of PAL and PA breaks in lessons. Training was planned and led by a team of two teachers who had experience of teaching PAL in secondary schools from a pilot study, thus drawing on hands-on experience. Although this builds on important bottom-up principles of involvement and ownership among users, the quality and scope of the training was not based on research-based knowledge. It can therefore be questioned whether the training was designed to empower the teachers and improve their skills for implementing and continuing with PAL. Further, a recent review of teachers' professional development concludes that the design of professional development processes should involve collaboration with all stakeholders; institutions, organizations, teachers and school leaders should act together to avoid wasting time, work and money and also focus on long-term process-oriented research over short-term research (Sancar et al., 2021).

The findings in our study support previous research showing that to integrate physical activity into the classroom and subject/curriculum teaching is a challenging task, especially with PAL, where novelty and a change of teaching practices are needed. Our research suggests that teachers find it important to add physical activity to classes in a meaningful way. As other studies have found, teachers themselves ask for availability and sharing of predefined PA breaks and PAL activities. This study also suggests the potential for more structured long-term training and professional development along with structured teacher collaboration. We found that a key barrier to implementing PAL was that the teachers found they lacked creativity to develop PAL activities and found it time consuming. To help overcome this barrier we would like to suggest, alongside more grade- and curriculum-specific ready-made PAL activities, a form of collaborative creative competence group. This could take many forms, either a group of teachers who develop and share learning material with schools and teachers, or a form of regular forum for exchange of experiences, knowledge and teaching material at school level or across schools. This could prevent teachers constantly feeling alone in being "creative and innovative". Several products have been developed to support teachers in classroom-based physical activity (Dugger et al., 2020). We believe that classroom practice would benefit from more quality tested, curriculum-specific PAL activities being made available to secondary teachers.

5.1. Methodological considerations and future directions

Several methodological considerations regarding this study should be mentioned. Firstly, the results reflect experiences described by teachers at two secondary schools in southern Norway, and the cultural setting, including differences in school systems and the specifics of the implemented program should be considered with regard to transferability of the findings. However, the findings do indicate extended relevance, as we have mentioned some parallel findings in previous studies. In the analysis, when applying the epoché, this does not mean to forget everything about the phenomenon. It is questionable whether one can completely leave out past knowledge when analyzing such data and structuring the results. Applying the epoché in our analysis, we minimized our presence by following the rigorous steps in the descriptive phenomenological method of Giorgi, focusing on the informant's experience, in order to tease out and articulate meanings that were already in the data. Findings are limited to the experiences of a small number of teachers. In descriptive phenomenology the focus is not on how many people have had a particular experience or how often a person has had it, it is more a matter of including informants who have had the experience the researcher is looking for (Englander, 2012). The aim of this study was to gain insight into the path of implementation among teachers who had implemented PAL and could thus be considered motivated. The path of implementation found and described in this study therefore reflects this. Experiences of teachers lacking this initial motivation and the shared values and beliefs of PAL might therefore have revealed different paths of implementation.

Any study must be evaluated within its epistemological framework (Stige et al., 2009). Methodological rigor is argued to be a mark of high quality across disciplines (Tracy, 2010). Here we highlight the use of Giorgi's descriptive phenomenological method, which guided the whole study, thus demonstrating methodological coherence. The method is thoroughly described by Giorgi, and we carefully applied it and described our use of it, which increases the trustworthiness and rigor of the study. We believe that we have strong findings, based on the rich data we obtained of teachers' lived experience with the phenomenon, which we were able to describe and analyze at the level of the phenomenon itself. We suggest building on our findings by conducting a study of teachers across all schools applying the Active and Healthy Kids program, which could help to establish consistency and provide a more robust evidence base to inform current and future interventions and professional development. Further, more research is needed in how to better support and train teachers in teaching PAL where movement and aspects of academic learning go hand in hand.

6. Concluding remarks

This study contributes an in-depth exploration and understanding of secondary subject teachers' lived experience of classroom-based physical activity with a special focus on PAL and the implementation process. We found that although teachers support the implementation of PAL and PA breaks into lessons they meet several challenges, resulting in resistance, frustration and potential loss of coherence of the approach. Teaching PAL is a methodologically challenging task that requires creativity and skills in facilitating physical activities, and not all teachers appear to possess such skills. There is a need to work towards more long-term professional development for teachers to make PAL a regular part of subject teaching in secondary school, thus ensuring the quality of the approach. Further, more focus is required on teachers' needs and the acknowledgement that classroom-based physical activity is a demanding process with both successes and failures, in order to keep teachers motivated to try to develop their own experiences and skills in teaching through PAL. Teachers need strategies to help to facilitate the change in teaching practice. We suggest that a

collaborative creative competence group at school level, across schools or at a national level, which develops and shares curriculum- and grade-specific PAL activities could strengthen the current implementation. This could provide hands-on teaching material but also inspiration while teachers acquire PAL skills themselves.

Funding

The research was partially funded by Sparebankstiftelsen Sparebanken Sør. The funders had no influence on development or content.

Declaration of competing interest

The authors declare no conflicts of interest with respect to the authorship and/or publication of this article.

Acknowledgments

We wish to thank all the teachers who participated in the study.

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Appendices

Appendix I: Information sheet and consent form for students and their parents

[Liv og røre i Telemark, 04.08.17, 1.0]

INFORMASJONSSKRIV TIL ELEVER OG FORESATTE:

LIV OG RØRE I TELEMARK

BAKGRUNN OG HENSIKT

Liv og røre i Telemark er et skolebasert prosjekt hvor fysisk aktivitet, kosthold og psykososialt miljø er fokus på barne- og ungdomsskoler i Telemark. Telemark fylkeskommune v/ prosjektleder Jorunn Borge Westhrin står for implementeringen av prosjektet på skolene, og Høgskolen i Sørøst-Norge v/ prosjektleder Solfrid Bratland-Sanda står for evaluering og forskning på prosjektet. I forskningsdelen av prosjektet vil vi undersøke om prosjektet påvirker fysisk aktivitet, fysisk form, kosthold, helse, trivsel, læringsmiljø og mobbing blant elever på 8.trinn. Ditt barn forespørres om å delta i studien fordi han/hun går i 8.trinn på en av ungdomsskolene i Bamble, Bø, Drangedal, Nome, Porsgrunn eller Sauherad skoleåret 2017/18.

HVA INNEBÆRER STUDIEN?

Deltakelse i forskningsstudien innebærer følgende:

- Svare på et elektronisk spørreskjema om fysisk aktivitet, kosthold, skjermaktivitet, selvrapportert helse, søvn, relasjoner til lærere og foreldre, trivsel, læringsmiljø og motivasjon, samt mobbing. Skjemaet tar cirka 30 minutter å fylle ut, og det gjøres på skolen. Det vil være personer fra prosjektgruppa til stede som elevene kan spørre dersom det er spørsmål de syns er vanskelig å forstå. Foresatte kan ved forespørsel få se spørreskjema.
- Gjennomføre en test av fysisk form (kondisjon, styrke, koordinasjon og spenst) gjennom enkle tester. Disse testene vil man kunne bli litt sliten av, men det går fort over. Total tid på testing inkludert pauser mellom de ulike øvelsene er cirka 30 minutter
- Gå med en aktivitetsmåler rundt hofta i fire dager. Denne vil måle all aktivitet eleven gjør når han/hun er våken. Den vil ikke kjennes, og den er helt ufarlig å gå med.
- Tillatelse til å hente ut opplysninger om resultater på nasjonale prøver i norsk, matematikk og engelsk fra Utdanningsdirektoratet
- Tillatelse til å hente opplysninger om høyde og vekt fra helsesøster

Dette gjøres to ganger, én gang ved skolestart (september 2017) og én gang ved skoleslutt (april/mai 2018). Dette gjør vi for å se om det har skjedd endringer i løpet av skoleåret. I løpet av skoleåret vil det også bli observert én kroppsøvingstime på alle skolene, og to økter med fysisk aktivitet i fag på intervensjonsskolene.

På høsten vil det også sendes et kort elektronisk spørreskjema til dere som foresatte, hvor dere blir spurt om aktivitetsnivå, utdanningsnivå og nasjonalitet. Dette skjemaet tar 2-3 minutter å besvare, og dere skal besvare et skjema hver.

Utvalgte elever ved intervensjonsskolene vil forespørres om å delta på intervju om deres erfaringer og opplevelser med deltakelse i Liv og røre i Telemark. Dette intervjuet vil pågå i maksimalt 90 minutter, og det vil gjøres både lyd- og videoopptak av intervjuet. Dette vil oppbevares på sikkert sted til prosjektslutt. Ettersom det er viktig for forskningsprosjektet å høre om ulike erfaringer og opplevelser ved prosjektet, så ønsker vi å intervjue elever med ulike erfaringer og opplevelser fra prosjektet. Dette vil vi ta hensyn til når vi velger ut informanter.

To kommuner (Bø og Bamble) er intervensjonskommuner, det vil si at både barne- og ungdomskoler og SFO i disse kommunene får intervensjonen i skoleåret 2017/18. Fire kommuner (Porsgrunn, Sauherad, Nome og Drangedal) er kontrollkommuner, det betyr at skolene og SFO'ene i disse kommunene fortsetter som vanlig. I forskningsprosjekter hvor målet er å se om en intervensjon har en gitt effekt, er det avgjørende at vi har kontrollskoler som gjør det de vanligvis ville gjort. Det gjør vi for å kontrollere for om det er andre faktorer som påvirker resultatene.

Elever ved skoler i intervensjonskommunene må være med på det lærerne, kantineansatte og helsesøstre planlegger og gjennomfører som del av skolehverdagen. Deltakelse i forskningsdelen av prosjektet er frivillig for elever og foresatte ved både intervensjonsskoler og kontrollskoler.

MULIGE FORDELER OG ULEMPER

Ved å delta i studien vil eleven få vite litt om sin fysiske form, kosthold og fysisk aktivitetsnivå, og dere vil bidra til at vi får mer kunnskap om hvordan ungdomsskoleelever i Telemark har det. Elevene får også være med å påvirke egen og andres skolehverdag gjennom dette prosjektet.

Det tar litt tid å fylle ut spørreskjema, men dette kan eleven få hjelp til ved behov. Testingen av fysisk form vil man kunne bli litt sliten av, men det går fort over. Dersom eleven opplever at noen av spørsmålene i spørreskjemaet kan gi vonde tanker og følelser, så kan han/hun ta kontakt med kontaktlærer og/eller helsesøster. Dersom det er elever som rapporterer om mobbing i spørreskjemaet, så vil vi gi informasjon til rektor om dette slik at rektor kan iverksette tiltak der det er nødvendig.

HVA SKJER MED INFORMASJONEN OM ELEVER OG FORESATTE?

All informasjon om elever og foresatte registreres uten navn og lagres avidentifisert. Det vil si at det opprettes en koblingsnøkkel mellom personidentifiserbare opplysninger og andre opplysninger som gis i prosjektet. Denne koblingsnøkkelen vil lagres hos Datatilsynet. I tillegg oppbevares det på sikkert sted, og det er bare prosjektgruppen som har tilgang til dine svar. Dersom eleven selv har lyst til å fortelle andre hva han/hun svarte eller hvilke resultater han/hun fikk, så har de lov til det.

Det vil ikke være mulig å identifisere verken foresatte eller elever i resultatene av studien når disse publiseres.

Prosjektet avsluttes 31.12.23. Etter dette vil opplysningene lagres i fem år, for deretter å anonymiseres.

DELTAKELSE

Det er frivillig å delta i dette prosjektet, og dere kan når som helst underveis i prosjektet og uten å oppgi grunn trekke dere uten at det får konsekvenser for eleven. Data fra de som trekker seg vil bli anonymisert. Elever som ikke skal delta i forskningsprosjektet må sitte og jobbe med skolerelaterte oppgaver i den tiden datainnsamlingen varer. Dersom du har spørsmål til prosjektet, eller ønsker å se spørreskjema og/eller intervjuguide før samtykke, så kan du ta kontakt med prosjektleder ved Høgskolen i Sørøst-Norge, førsteamanuensis Solfrid Bratland-Sanda (solfrid.bratland-sanda@usn.no, tlf 35952798).

Èn av elevens foresatte må skrive under på at det er greit at eleven er med i denne studien. Det gjøres ved å signere på vedlagt ark, og ta med det signerte arket tilbake til skolen.

Mvh

Solfrid Bratland-Sanda

Prosjektleder «Liv og røre i Telemark» - forskningsdelen

Førsteamanuensis Høgskolen i Sørøst-Norge

[Liv og røre i Telemark, 04.08.17, 1.0]

SAMTYKKE TIL DELTAKELSE I PROSJEKTET

Som foresatte til_ (Fullt navn) samtykker jeg/vi til at hun/han kan delta i prosjektet

Foresatt 1 _____ (Fullt navn) samtykker til å fylle ut spørreskjema stilet til foresatte (hver foresatt fyller ut for seg selv). Dette skjemaet kan sendes på til følgende kontaktinformasjon:

Tlf: _____

E-post: _____

Foresatt 2_____ (Fullt navn) samtykker til å fylle ut spørreskjema stilet til foresatte (hver foresatt fyller ut for seg selv). Dette skjemaet kan sendes til følgende kontaktinformasjon:

Tlf: _____

E-post: _____

Sted og dato

Foresattes signatur

Foresattes navn med trykte bokstaver

Sted og dato

Foresattes signatur

Foresattes navn med trykte bokstaver

Side 4 / 4

Appendix II: Information sheet and consent form for teachers

[Liv og røre i Telemark, 20.04.19, 1.1]

INFORMASJONSSKRIV TIL LÆRERE:

LIV OG RØRE I TELEMARK

BAKGRUNN OG HENSIKT

Liv og røre i Telemark er et skolebasert prosjekt hvor fysisk aktivitet, kosthold og psykososialt miljø er fokus på barne- og ungdomsskoler i Telemark. Telemark fylkeskommune v/ prosjektleder Jorunn Borge Westhrin står for implementeringen av prosjektet på skolene, og Universitetet i Sørøst-Norge v/ prosjektleder Solfrid Bratland-Sanda står for evaluering og forskning på prosjektet. I forskningsdelen av prosjektet vil vi undersøke om prosjektet påvirker fysisk aktivitet, fysisk form, kosthold, helse, trivsel, læringsmiljø og mobbing blant elever på 8.trinn. I tillegg vil vi undersøke hvilke erfaringer og opplevelser lærere og skoleledelse/rektorer har når det gjelder implementeringen og gjennomføringen av intervensjonen.

Du forespørres om å delta i studien fordi du har vært involvert i prosjektet ved din skole som lærer. Forskningsprosjektet gjennomføres av Universitetet i Sørøst-Norge sammen med Telemark fylkeskommunen.

HVA INNEBÆRER STUDIEN?

Deltakelse i forskningsstudien innebærer å delta i et intervju. Intervjuet tar maksimalt 1 time. Det vil tas lydopptak fra intervjuet, dette vil oppbevares på en sikker server på USN til prosjektslutt.

Ved å delta i intervjuet vil du få mulighet til å fortelle hvordan du personlig har opplevd skolehverdagen med «Liv og røre» modellen ved din skole.

HVA SKJER MED INFORMASJONEN OM DEG?

All informasjon registreres uten navn og lagres avidentifisert. Det vil si at det opprettes en koblingsnøkkel mellom personidentifiserbare opplysninger og andre opplysninger som gis i prosjektet. Denne koblingsnøkkelen vil lagres hos Datatilsynet. I tillegg oppbevares det på sikkert sted, og det er bare prosjektgruppen som har tilgang til dine svar.

Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

Prosjektet avsluttes 31.12.23. Etter dette vil opplysningene lagres i fem år. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

DELTAKELSE

Det er frivillig å delta i dette prosjektet, og du kan når som helst og uten å oppgi grunn trekke deg fra prosjektet uten at det får konsekvenser for deg Dersom du har spørsmål til prosjektet, så kan du ta kontakt med prosjektleder ved Universitetet i Sørøst-Norge, førsteamanuensis Solfrid Bratland-Sanda (solfrid.bratland-sanda@usn.no, tlf 35952798) eller Sabrina K. Schmidt, Doktorgradsstipendiat ved Universitetet i Sørøst-Norge. (sabrina.k.schmidt@usn.no)

Mvh

Sabrina Krogh Schmidt

Side 1 / 2

[Liv og røre i Telemark, 20.04.19, 1.1]

SAMTYKKE TIL DELTAKELSE I PROSJEKTET

_____ (Fullt navn) samtykker til deltakelse i prosjektet

Sted og dato

Signatur

Navn med trykte bokstaver

Side 2 / 2

Appendix III: Ethical approval – NSD

Solfrid Bratland-Sanda
Postboks 235
3603 KONGSBERG

Vår dato: 07.08.2017 Vår ref: 54327 / 3 / AGH Deres dato: Deres ref:

Tilbakemelding på melding om behandling av personopplysninger

Vi viser til melding om behandling av personopplysninger, mottatt 04.05.2017.
Meldingen gjelder prosjektet:

54327	*Liv og røre i Telemark*
Behandlingsansvarlig	*Høgskolen i Sørøst-Norge, ved institusjonens øverste leder*
Daglig ansvarlig	*Solfrid Bratland-Sanda*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database.

Personvernombudet vil ved prosjektets avslutning, 31.12.2023, rette en henvendelse angående status for behandlingen av personopplysninger.

Dersom noe er uklart ta gjerne kontakt over telefon.

Vennlig hilsen

Marianne Høgetveit Myhren

Agnete Hessevik

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

NSD – Norsk senter for forskningsdata AS Harald Hårfagres gate 29 Tel: +47-55 58 21 17 nsd@nsd.no Org.nr. 985 321 884
NSD – Norwegian Centre for Research Data NO-5007 Bergen, NORWAY Faks: +47-55 58 96 50 www.nsd.no

Appendix IV: Evaluation from REK

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Leena Heinonen	22845529	18.04.2017	2017/387 REK sør-øst D
			Deres dato:	Deres referanse:
			14.02.2017	

Vår referanse må oppgis ved alle henvendelser

Solfrid Bratland-Sanda
Høgskolen i Sørøst-Norge

2017/387 Liv og røre i Telemark

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst D) i møtet 29.03.2017. Vurderingen er gjort med hjemmel i helseforskningsloven § 10, jf. forskningsetikkloven § 4.

Forskningsansvarlig: Høgskolen i Sørøst-Norge
Prosjektleder: Solfrid Bratland-Sanda

Prosjektleders prosjektbeskrivelse
Forskningen skal gi kunnskap om hvordan «Liv og røre i Telemark» påvirker unges levekår. Vi skal undersøke eventuelle endringer i elevers fysisk aktivitetsatferd, kosthold og psykososiale helse, og skolenes psykososiale miljø. Livskvalitet, trivsel, mestring, resiliens, læring, læringsmiljø og mobbing vil bli viktige variabler for å måle dette. For å videreutvikle modellen skal forskningen også vise elevers, læreres og skoleledelsens erfaringer og opplevelser med intervensjonen. Det vil også bli viktig å finne hva som hemmer eller fremmer implementeringen ved skolene, slik at dette kan tas i betraktning når modellen skal videreutvikles, og innføres ved nye skoler og kommuner.

Vurdering
Dette prosjektet fokuserer på hvordan økt fysisk aktivitet på barne-og ungdomsskolen påvirker unges levekår. Skolene i Telemark randomiseres mellom kommuner. Studien har en pretest-test design og det skal benyttes spørreskjemaer, fysiske tester og akselerometri. Det skal rekrutteres 1500 elever, hvorav halvparten er kontrollgruppe uten intervensjon. Komiteen vurderer at prosjektet, slik det er presentert i søknad og protokoll, ikke vil gi ny kunnskap om helse og sykdom som sådan, men heller om barn-og unges mestring og læringsmiljø. Prosjektet faller derfor utenfor REKs mandat etter helseforskningsloven, som forutsetter at formålet med prosjektet er å skaffe til veie "ny kunnskap om helse og sykdom", se lovens § 2 og § 4 bokstav a).

Det kreves ikke godkjenning fra REK for å gjennomføre prosjektet. Det er institusjonens ansvar å sørge for at prosjektet gjennomføres på en forsvarlig måte med hensyn til for eksempel regler for taushetsplikt og personvern samt innhenting av stedlige godkjenninger.

Vedtak
Prosjektet faller utenfor helseforskningslovens virkeområde, jf. § 2 og § 4 bokstav a). Det kreves ikke godkjenning fra REK for å gjennomføre prosjektet.

Komiteens avgjørelse var enstemmig.

Besøksadresse: Gullhaugveien 1-3, 0484 Oslo
Telefon: 22845511
E-post: post@helseforskning.etikkom.no
Web: http://helseforskning.etikkom.no/

All post og e-post som inngår i saksbehandlingen, bes adressert til REK sør-øst og ikke til enkelte personer

Kindly address all mail and e-mails to the Regional Ethics Committee, REK sør-øst, not to individual staff

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst D. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst D, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Vi ber om at alle henvendelser sendes inn med korrekt skjema via vår saksportal: http://helseforskning.etikkom.no. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no.

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Finn Wisløff
Professor em. dr. med.
Leder

Leena Heinonen
rådgiver

Kopi til: Høgskolen i Sørøst-Norge ved øverste administrative ledelse: postmottak@usn.no

Appendix V: Errata

The errata concern Article 1: Changes in physical activity, physical fitness and well-being following a school-based health promotion program in a Norwegian region with poor public health profile: A non-randomized controlled study in early adolescents.

<table>
<tr><th>Page</th><th>Original text</th><th>Type of correction</th></tr>
<tr><td>Page 8, Table 6</td><td>Data for physical activity (PA) school time, Total PA counts per minutes (cpm) for intervention and control group was incorrect.
<table>
<tr><th></th><th colspan="3">Intervention</th><th colspan="3">Control</th></tr>
<tr><th></th><th>Baseline (SE)</th><th>Follow-up (SE)</th><th>p-value</th><th>Baseline (SE)</th><th>Follow-up (SE)</th><th>p-value</th></tr>
<tr><td>PA school time</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>n</td><td>197</td><td></td><td></td><td>447</td><td></td><td></td></tr>
<tr><td>Total PA (cpm)</td><td>492 (13.1)</td><td>505 (20.1)</td><td>0.512</td><td>466 (9.8)</td><td>470 (15.6)</td><td>0.762</td></tr>
</table></td><td>Data corrected. The journal has been notified. I have not received any response.
<table>
<tr><th></th><th colspan="3">Intervention</th><th colspan="3">Control</th></tr>
<tr><th></th><th>Baseline (SE)</th><th>Follow-up (SE)</th><th>p-value</th><th>Baseline (SE)</th><th>Follow-up (SE)</th><th>p-value</th></tr>
<tr><td>PA school time</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>n</td><td>197</td><td></td><td></td><td>447</td><td></td><td></td></tr>
<tr><td>Total PA (cpm)</td><td>441 (16.3)</td><td>449 (17.3)</td><td>0.668</td><td>404 (12.1)</td><td>359 (10.7)</td><td>0.012*</td></tr>
</table></td></tr>
<tr><td>Page 42, line 10</td><td>3) the meaning units were re-written into psychologically sensitive expressions that highlighted the psychological meanings lived by the students.</td><td>3) the meaning units were re-written into psychologically sensitive expressions that highlighted the psychological meanings lived by the informants.</td></tr>
</table>

Table 6 Corrected:

Table 3. Mean (SE) baseline, follow-up and group (intervention-control) differences (SE) with p-values for changes in:

	Intervention			Control			Group diff (SE)	p-value
	Baseline (SE)	Follow-up (SE)	p-value	Baseline (SE)	Follow-up (SE)	p-value		
n	197			447				
BMI (kg/m^2)	19.8 (0.2)	20.2 (0.2)	0.000**	20.0 (0.2)	20.4 (0.2)	0.007*	-0.01 (0.1)	0.934
PA full day								
n	197			447				
Total PA (cpm)	492 (13.1)	505 (20.1)	0.512	466 (9.8)	470 (15.6)	0.762	6,6 (9.1)	0.467
SED (min/day)	543 (5.7)	557 (6)	0.057	536 (3.8)	553 (0.9)	0.012*	-2.68 (3.7)	0.466
MVPA (min/day)	56 (1.7)	55.9 (1.9)	0.916	52 (1.1)	51 (1.4)	0.485	0.76 (1)	0.446
PA school time								
n	197			447				
Total PA (cpm)	441 (16.3)	449 (17.3)	0.668	404 (12.1)	359 (10.7)	0.012*	54.7 (9.7)	0.000**
SED (min/day)	182 (2.6)	175 (3.2)	0.098	190 (2.2)	177 (2.4)	0.000**	6.5 (2)	0.001**
MVPA (min/day)	17 (0.8)	17 (10.8)	0.585	16 (0.6)	13 (0.5)	0.000**	2.8 (0.4)	0.000**
n	197			447				
CRF (m)	1005 (8.1)	1021 (7.3)	0.076	990 (6.6)	999 (5.3)	0.164	8.7 (4.1)	0.035*
Strength (cm)	163 (1.8)	171 (1.8)	0.000**	161 (1.3)	167 (1.4)	0.000**	2 (0.5)	0.000**
HRQL								
n	197			447				
Physical	46 (0.6)	47 (0.7)	0.366	46.3 (0.5)	46.1 (0.5)	0.648	0.9 (0.4)	0.012*
Psychological	51 (0.6)	51 (0.8)	0.845	50.3 (0.5)	49.0 (0.6)	0.023*	1.19 (0.4)	0.001**
Autonomy	53 (0.7)	55 (0.8)	0.001**	53.3 (0.5)	54.7 (0.6)	0.026*	1.2 (0.4)	0.004*
Peers and social	51 (0.7)	50 (0.9)	0.085	51.2 (0.5)	50 (0.5)	0.031*	-0.4 (0.4)	0.909
School	53 (0.7)	53 (0.8)	0.621	51.3 (0.5)	49.9 (0.6)	0.016*	2 (0.4)	0.017*
n	197			447				
Vitality	4.7 (0.1)	4.8 (0.1)	0.412	4.8 (0.0)	4.5 (0.1)	0.000**	0.3 (0.0)	0.000**

Note: * statistically significant difference $p < 0.05$, ** statistically significant $p < 0.001$. Abbreviations: SE = Standard Error, BMI = body mass index, PA = physical activity, cpm = counts per minute, SED = sedentary time; MVPA = moderate- to vigorous intensity physical activity, CRF = Cardiorespiratory fitness, HRQoL = Health-related quality of life, in the five domains; Physical well-being, Psychological well-being, Autonomy and parent relationship, Peers and social support and School environment.

Appendix VI: Interview guides

Interview guide for Article II

Below are the main topics of conversation with questions. Generally, all interviews covered the topics. Questions, however, varied between interviews. The original guide was in Danish.

A. Opening questions
    - Please start by telling me a bit about yourself (age, school, free time, family)

B. Physical activity
    - Do you do any sports or other physical activities in your free time?
    - What activities do you like the best? Why?
    - How do you feel about physical education lessons?

C. Classroom-based physical activity
    - If you were to explain what Active and Healthy Kids is to someone unfamiliar with it, what would you say?
    - In what subjects have you had classroom-based physical activity? How often?
    - Think back on an activity that you remember well – try to tell me about that.
        - What do you think of this way of doing education?
        - What do you especially like/dislike?
        - What kind of activities do you do? Are you indoors/outdoors? What do you like?
    - Do you learn when you have classroom-based physical activity? How/how not?
    - What do you think your teacher thinks about classroom-based physical activity?
    - Do you have physically active homework? Do you think it would have worked?

D. General well-being
    - Do you get on well with your teacher and your classmates?
    - Are there any initiatives to help all students to feel good?
    - What does it mean to you to feel good at school?
    - Do you pay attention to see if everything is included?
    - Do you think that the activities you do (classroom-based physical activity) make you get on better with each other? Try to describe a situation to me.

- Have you noticed any changes in the classroom environment after your class started classroom-based physical activity?
- Do you and the other students have phones with you at school?

E. General physical activity
   - What do you think about more physical activity in school?
   - If you think about your future, do you see classroom-based physical activity as part of your education?

Interview guide for Article III

Below are the main topics of conversation with questions. Generally, all interviews covered the topics. Questions, however, varied between interviews. The original guide was in Danish.

A. Background
   - Please start by telling me a bit about yourself and your background as a teacher.
   - What subjects do you teach?
   - How long have you worked at this school?

B. What is Active and Healthy Kids?
   - If you were to explain what Active and Healthy Kids is to someone unfamiliar with it, what would you say?
   - Try to tell me what you thought when you were introduced to the concept.
   - What do you think about it now?

C. Facilitating physical activity
   - How have you used concepts from the Active and Healthy Kids program in your teaching? How and what?
   - Think back about a PAL you remember well - tell me about that.
   - Think of a teaching situation where you facilitated classroom-based physical activity, that you found went well. Tell me about that. Why did it go well?
   - Do the same with a teaching situation that you felt did not go so well. Tell me about that.
   - What learning experiences have you had?
   - Tell me how you plan your teaching. Where do you get inspiration?
   - Are you happy with this new concept? Why/why not?

D. Students' well-being

- How do think the students find lessons with PAL and PA breaks?
- Tell me about the classroom environment. Do you see a potential for classroom-based physical activity to strengthen or weaken it?

E. Physical activity in schools
   - What do you think about the regulation that schools should provide one hour of physical activity a day?
   - What other kind of initiative does your school have where the students are physically active?
   - What possibilities and limitations do you think your school has to facilitate physical activity?

F. End
   - Some final comments

Doctoral dissertation no. 149
2023

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Dissertation for the degree of Ph.D

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Sabrina Krogh Schmidt

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ISBN: 978-82-7206-739-6 (print)
ISBN: 978-82-7206-740-2 (online)

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