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Flipped learning in physical education

A gateway to motivation and (deep) learning

Doctoral thesis

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Trondheim, April 2020

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Abstract

The present thesis demonstrates that the learning framework flipped learning (FL) merges the use of digital technology and physical activity (PA) in a manner whereby both promote improved learning outcomes in terms of health related fitness knowledge (HRFK) and motivation for participation in learning processes in PE. It is also argued that FL promotes deep learning in PE, at least from the perspective of the concept of deep learning as understood in the present thesis.

Regarding motivation, the present thesis demonstrates that both boys and girls benefit from FL in PE, but the benefits might differ between genders. Girls find FL to redefine PE not as a boys' subject as their expectancy-beliefs, attainment value, and perceived cost of attending are changed in a positive direction. Boys find FL helps them to contextualise the activities, resulting in stabilising their intrinsic motivation for PE. Further, it seems to be important for student motivation in PE to include both physical activity and cognitive learning to provide a context, and FL seems to facilitate and promote this. In addition, FL seems to enhance students' sense of autonomy in PE, resulting in a positive impact on their autonomous motivation for both preparing for and participating in PE.

Regarding learning, FL seems to promote learning on various levels in PE, from surface to deep. Students' cognitive knowledge learning in PE was demonstrated to benefit from applying FL, as offering students the opportunity to see online videos, which included quizzes, was demonstrated to be a beneficial use of a digital tool to enhance this learning. The FL framework seemed to promote more learning, as the individuals' learning was supported by peers and the teacher in a scaffolding fashion as they were assisted through the zone of proximal development (ZPD). Further, FL seemed to enhance the students' concept of the value of PE, and this seemed to promote deep learning in PE.

Applying a FL learning framework in a thematic curriculum model would be a successful way of facilitating more student (deep) learning in the three core elements described in the new national PE curriculum passed by the Ministry of Education and Research (2018) as: 'movement and physical learning', 'participation and cooperation in movement activities', and 'outdoor activities and movement in nature'. To achieve this, schools needs to relinquish

some control over the learning processes, stretching their traditional practices to embrace the capacity of new digital technology.

Abstract (Norwegian)

Denne avhandlingen viser at læringsrammeverket omvendt undervisning (OU) fusjonerer bruken av digital teknologi og fysisk aktivitet på en måte som fremmer både læringsutbytte når det gjelder helserelatert treningskunnskap og motivasjon for deltakelse i læringsprosesser i kroppsøving. Det argumenteres også for at OU fremmer dyp læring i kroppsøving, i alle fall tatt i betraktning hvordan begrepet dyp læring er forstått i denne avhandlingen.

Når det gjelder motivasjon, viser denne avhandlingen at både gutter og jenter drar nytte av OU i kroppsøving, men fordelene ser ut til å variere mellom kjønn. Jenter rapporterer at OU hjelper de til å ikke se på kroppsøving som et guttefag fordi mestringstro, oppnåelsesverdi og opplevd kostnad ved å delta blir endret i en positiv retning. Gutter på sin side rapporterer at OU hjelper dem å kontekstualisere aktivitetene, noe som resulterer i at de bedre stabiliserer sin egen indre motivasjon for kroppsøving. Videre ser det ut til å være viktig for elevenes motivasjon i kroppsøving å inkludere både fysisk aktivitet og kognitiv læring for å gi en kontekst, og OU ser ut til å legge til rette for og er en fremmer for dette. I tillegg ser OU ut til å styrke elevenes følelse av selvbestemmelse i kroppsøving, noe som resulterer i en positiv innvirkning på deres autonome motivasjon for både å forberede seg og delta i kroppsøving.

Når det gjelder læring, ser det ut til at OU fremmer læring på forskjellige nivåer i kroppsøving, fra overflatelæring til dyp læring. Elevenes kognitive læring i kroppsøving drar nytte av å implementere OU som læringsrammeverk ettersom elevene får muligheten til å se videoer, som inkluderte quizer. OU ser ut til å fremme økt læring, ettersom elevenes læring blir støttet av medelever og læreren i et rammeverk der de bli hjulpet gjennom sonen for proksimal utvikling (ZPD). Videre syntes OU å styrke elevenes oppfattelse av verdien av kroppsøving, og dette ser ut til å fremme dyp læring i kroppsøving.

Å anvende en OU læringsramme i en tematisk undervisningsmodell kan være en fruktbar måte å tilrettelegge for mer (dyp) læring i de tre kjerneelementene som er beskrevet i den nye nasjonale læreplanen i kroppsøving som ble vedtatt av Kunnskapsdepartementet i 2018 («bevegelse og kroppslig læring», «deltakelse og samspill i bevegelsesaktiviteter», og «uteaktiviteter og naturferdsel»). For å oppnå dette, må skolene gi fra seg en viss kontroll over læringsprosessene og utfordre sin tradisjonelle praksis ved å omfavne mulighetene i ny digital teknologi.

Acknowledgments

The path that has led to this thesis is one that has been long and unexpectedly winding. From a small farm in Frosta via Spain, ending, as of now, in Trondheim, my interest in physical activity and physical education has grown with increasing interest as I have added experience and knowledge to my being. My major source of inspiration in this work has been my child Martin and my wife Ángela, so this dissertation is dedicated to you both. Ángela was the one who proposed writing a doctoral thesis based on my intervention, so without your idea I would not be writing these final words of a three-year long academic journey. Thank you so much, and I love you both very much. Further, I would like to thank my mother, father, sister and brother. My growing up has formed me into the person I am today, and I could not have asked for more or a better scaffold over the last 40-ish years.

At NTNU many colleagues and good friends have supported me in different stages of this work. I would start by thanking my excellent co-workers at the section of Arts, Physical Education and Sports, and my supervisor, Ellen Beate. You have all been a great inspiration, and many of you good discussion partners across this journey. It is a delight to work with such excellent educators and researchers as you all are. Further, I would like to thank the institute leaders and administration for supporting my ideas with uplifting conversations and arranging time on my work schedule to do this work. Your support has been key in completing this thesis.

My co-authors in Papers III, IV, V and VI have all been invaluable in this work. Without you I could not have done this, so thank you all so much. I appreciate your support and contributions from the bottom of my heart.

A great thank you goes to all students and teachers participating in my intervention. Giving me insight into your lives by answering questionnaires and participating in interviews gave me valuable data, and I hope that, in return, my work can contribute to the subject of physical education in some way.

Trondheim, October 2019 Ove Østerlie

List of papers in the thesis

Paper I: Østerlie, O. (2018). Can flipped learning enhance adolescents' motivation in physical education? An intervention study. *Journal for Research in Arts and Sports Education, 2*, 1-15. https://doi.org/10.23865/jased.v2.916

Paper II: Østerlie, O. (2018). Adolescents' perceived cost of attending physical education: A flipped learning intervention. *Journal for Research in Arts and Sports Education, 2*(3), 1-17. https://doi.org/10.23865/jased.v4.1197

Paper III: Østerlie, O., & Mehus, I. (n.d.) The impact of flipped learning on cognitive knowledge learning and intrinsic motivation in Norwegian secondary physical education. (submitted article)

Paper IV: Østerlie, O., & Kjelaas, I. (2019). The perception of adolescents' encounter with a flipped learning intervention in Norwegian physical education. *Frontiers in Education, 4*(114). https://doi.org/10.3389/feduc.2019.00114

Paper V: Østerlie, O., Løhre, A., & Haugan, G. (2018). The expectancy-value questionnaire in physical education: A validation study among Norwegian adolescents. *Scandinavian Journal of Educational Research, 63*(6), 869-883. https://doi.org/10.1080/00313831.2018.1453867

Paper VI: Østerlie, O., Løhre, A., & Haugan, G. (2019). The situational motivational scale (SIMS) in physical education: A validation study among Norwegian adolescents. *Cogent Education, 6*(1603613), 1-15. https://doi.org/10.1080/2331186X.2019.1603613

List of abbreviations

AV – Attainment value

CFA – Confirmatory factor analysis

CFI – Comparative fit index

EFA – Explorative factor analysis

EV – Expectancy-believe

EVQ – Expectancy-value questionnaire

EVT – Expectancy-value theory

FL – Flipped learning

HRFK – Health related fitness knowledge

ICT – Information and communications technology

IV – Intrinsic value

NSD – Norwegian Centre for Research Data

NSD – Norwegian Social Science Data Service

PA – Physical activity

PE – Physical education

REC – Regional Committees for Medical and Health Research Ethics

RML – Robust maximum likelihood

RMSEA – Root mean square error of approximation

SDT – Self-determination theory

SIMS – Situational motivational scale

SRMS – Standardized root mean square residual

STV – Subjective task value

TLI – Tucker-Lewis index

UV – Utility value

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Outline of the thesis

The thesis consists of five chapters in addition to an abstract, acknowledgements, list of papers in the thesis, list of abbreviations, list of table and figures, references, appendices and papers I - VI.

Chapter one elaborates on the background for the research summarised in the present thesis, including a theoretical rationale. Chapter two introduces the methodological aspects and the methods used. Chapter three presents findings from the included papers in the present thesis, and those findings are synthesised and then further discussed in chapter four. Chapter five includes some concluding remarks, limitations and a call for further research.

Regarding the terms used in the following text, this work was initiated with two projects, the pilot and the main project, with both including an intervention. The data generated from the main project formed the basis for the included papers, the results of which are synthesised in the present thesis.

Chapter 1: Introduction

Background

Technology has transformed much of our modern society and has completely formed how we read, write, think and calculate. Collins and Halverson (2018) argue that these four actions constitute most of the activities in school, and yet technology has been kept in the periphery of schools, creating a deep incompatibility between schooling and technology. They further state that the next generation of public schooling must be able to adapt and incorporate technology-driven learning; if not, "students with the means and ability will pursue their learning outside of the public school" (Collins & Halverson, 2018, p. XV). Scholars like Fullan (2013) support this view, stating that technology has dramatically affected virtually every sector in society except education. In order to learn and develop new skills in school settings children must be motivated and engaged in activities (Reeve, 2012; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Sun & Chen, 2010), and both student motivation and student learning can benefit from the use of digital technology in an appropriate pedagogical manner (Casey, Goodyear, & Armour, 2017a; Gilje, 2017). A literature review by Danielsen (2019) looking into how the learning environment in school was affected when digital tools were implemented found several positive results. It was suggested that these implementations transformed the education to be more student-centred and organised in smaller groups, resulting in more collaboration between students and between student and teacher. Further, student motivation and attitude towards learning were affected in a positive direction. Nevertheless, it was emphasised that the teacher is still as important as before, as digital tools are only instruments in the students' learning process.

The discrepancy between suggested and observed levels of physical activity (PA) among adolescents is well documented in Norway (Norwegian Institute of Public Health, 2019) reflecting a global challenge (World Health Organization [WHO], 2016). Schools are vital in shaping children's lives and the subject physical education (PE) is an important arena for motivating young people to create and maintain a healthy and active lifestyle during and after adolescence. Nevertheless, there is a considerable amount of research demonstrating that this intention is not met in PE today (Arnesen, Nilsen, & Leirhaug, 2013; Dyson, 2014; Ennis, 2011; Gao, Lee, & Harrison, 2008; Kirk, 2010; Moen, Westlie, Bjørke, & Brattli, 2018; Oliver & Kirk, 2015; Säfvenbom, Haugen, & Bulie, 2014; Vlieghe, 2013). Digital technology

can give new perspectives and opportunities as new digital technologies are constantly emerging. But this is followed by a demand for new critical reflection and research into its potential benefits for PE (Koekoek & van Hilvoorde, 2018). While there is evidence of considerable growth in the availability and use of digital technology in PE, there is very little evidence on how these technologies are being used and if they optimise student learning (Armour, Casey, & Goodyear, 2017). PE teachers must understand how to select from all the digital information and technologies without losing sight of the main pedagogical and educational goals. As stated by van Hilvoorde and Koekoek (2018, p. 3): "physical educators, scholars and policy-makers increasingly face the challenge and need to create a digital pedagogy for physical education". New pedagogical frameworks and methods merging the use of digital technology with students' learning processes are being implemented in schools to (intentionally) optimise learning, and the motivation to engage in these learning processes. The present thesis suggests that a learning framework called flipped learning (FL) does just that.

Flipped learning

This thesis classifies flipped learning (FL) as a *learning framework* and not a method of teaching or learning, or a learning strategy. FL is not just another teaching tactic, but can function as a meta-instructional strategy (Hwang, Chen, Sung, & Lin, 2018; Shin, 2018) and this learning framework facilitates all other instructional strategies from project-based learning, inquiry learning, game-based learning, mastery learning, makerspaces, and myriad other active learning strategies into class-time. The updated definition of FL is:

> "Flipped Learning is a framework that enables educators to reach every student. The flipped approach inverts the traditional classroom model by introducing course concepts before class, allowing educators to use class time to guide each student through active, practical, innovative applications of the course principles" (Academy of Active Learning Arts and Sciences [AALAS], 2018).

This definition was ratified by international delegates from 49 countries in answer to the need for a globally understood definition due to the increase in international collaboration among FL practitioners. There has been a rapidly growing interest in FL, and the use and understanding of FL has developed simultaneously:

> "We believe that flipped learning is an important transition stage. It is moving both students and academic staff away from traditional lectures, an approach that has been in use since the middle ages. Classrooms are becoming places for activity rather than information transfer. Students can get information online, increasingly in video format, rather than text—the oral tradition, suppressed by the printing press since 1440, is re-emerging" (Reidsema, Kavanagh, Hadgraft, & Smith, 2017, p. 10).

The FL approach makes it possible to apply the time you have as a teacher with the students in a different way. Where the teacher formerly would spend time in class to 'deliver' basic knowledge and the students would construct the knowledge around the same topic at home, this process would invert in a FL approach. The FL approach advocates that basic knowledge is presented outside class, e.g., in form of a video, while students, together with peer students and the teacher, undergo more student-centred activities in class to understand, apply and reflect on this knowledge. The reflection in class is strengthened by the *preflection* which starts as students watch the prescribed homework videos, especially if they contain some sort of interaction like a quiz or a reflection question. Preflection allows the learners to prepare for learning through increasing their capabilities for focusing on learning during subsequent concrete learning experiences, and Jones and Bjelland (2004) proposed that preflection "increases the readiness capacity of students to learn from their experiences, thereby increasing their capacity to reflect upon the concrete experience and increasing the overall learning by the student" (p. 963).

The teacher's role changes from being a traditional 'deliverer' of knowledge to becoming a guide, a coach, part of a scaffold who helps and provides for reflection and critical thinking among the students. Prensky (2016) states that the future of education lies in teachers as 'empowerers' as the world needs children who have, through their own effort, as a result of their education, and with the help of teachers, peers, and technology, "figured out how to accomplish effectively and apply their passion to bettering the world" (p. 89-90). In order to motivate the next generation of people who seek out learning, learners need to be given more control over their own learning, and this runs counter to the institutional control over learning exercised by schools (Collins & Halverson, 2018). With the omnipresence of digital technology in modern society and education the teacher's role changes (Selander, 2017), and is described by Arstorp (2019) as changing into a parallel learning environment where the teacher and the students simultaneously enhance their knowledge. Kavanagh, Reidsema,

McCredden, and Smith (2017) stated that the role of the educator changes from lecturer to guide, and that not only requires that the teacher becomes a learner, but that we explicitly define learning as "mutually constructed meaning" (Baxter Magolda 2012)" (p. 17). This view can be recognised as a constructivist view on learning and a situated learning environment, and Kavanagh et al. (2017) further state that FL is constructivist by its very definition as "we require students to become actively involved in their learning rather than passively recipients of information. The focus is there for switched from the teacher to the learner…" (p. 17). Selander (2017) describes this view in a modified didactical triangle (see Figure 1.1.).

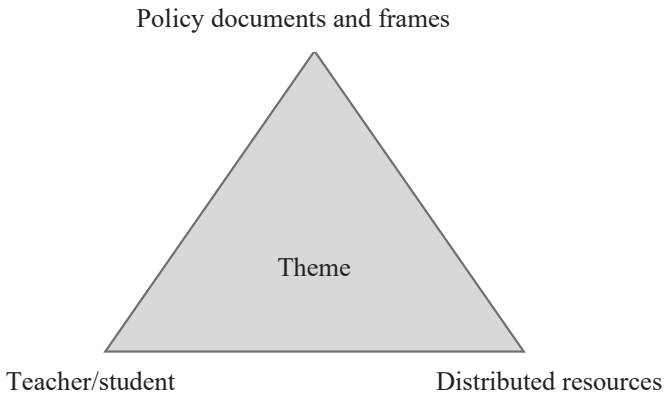

Figure 1.1. The design-oriented didactical triangle. Adapted from "Didaktiken efter Vygotskij: Design för lärande," by Selander (2017), freely translated from Swedish into English by the author.

This didactical view is in line with how young people act and interact in late modern (Held & Thompson, 1989) or liquid modern (see Bauman, 2000) society. FL promotes something of a change in the relationship between the teacher and the students as both have more time to interact, and the interactions between student-teachers and among students change due to the emphasis on student active and cooperative learning activities. This change is welcomed as

having a positive influence on the quality of classroom interactions and student engagement as found in recent research (Havik & Westergård, 2019).

There has been a massive growth in interest in applying the FL approach among a an ever broader set of disciplines, subjects and ages in our educational system. This is partly due to an increasing pressure on institutions to undergo change and develop an extended use of digital tools (O'Flaherty & Phillips, 2015). This growth in use has also resulted in an exponential growth in research, mostly at university level and in STEM subjects (Lundin, Rensfeldt, Hillman, Lantz-Andersson, & Peterson, 2018), trying to both explain the effects on factors like academic performance, motivation, social aspects and values, and how the approach can function as a meta-strategy in student learning. Although the number of studies is large, there is still an issue of trustworthiness, as the scope of how the FL approaches were formed and how they were applied makes a comparison and synthesising of results a difficult task with limited validity and opportunities for generalisation:

> "Academically and socially, the research is quite scattered, and only local evidence and experiences are available. The knowledge contributions within this field of interest seem to be anecdotal rather than systematically researched. To a large extent, the research lacks anchoring in, for example, learning theory or instructional design known from educational technology traditions and which would have helped much of the flipped classroom research to examine aspects of the flipped classroom approach more fully" (Lundin et al., 2018, p. 1).

Lundin et al. (2018) further argue that "research tends not to interact beyond the two clusters of general education/educational technology and subject-specific areas. This implies that knowledge contributions related to the flipped classroom approach are relatively siloed and fragmented and have yet to stabilise" (p. 16). Interest in research around the instructional approach and designs of FL frameworks is increasing (Song, Jong, Chang, & Chen, 2017; Stöhr & Adawi, 2018) as positive contributions to an expanding research field. Nevertheless, there are several large meta-studies synthesising results which demonstrate that FL can improve students' academic accomplishment, satisfaction and engagement, promote self-paced learning, and increase interactions between students and teachers (Akçayır & Akçayır, 2018; L. L. Chen, 2016; Cheng, Ritzhaupt, & Antonenko, 2018), and promote a more student-centred approach to education (Kim, Kim, Khera, & Getman, 2014; Y. Wang, Huang,

Schunn, Zou, & Ai, 2019). Further, FL positively affects the students' higher order thinking skills (Bergmann & Sams, 2014; Lee & Lai, 2017; Mas'ud & Surjono, 2018; Wølner & Horgen, 2019) and narrows the gap between how low- and high-performing students perform (Xiao, Thor, Zheng, Baek, & Kim, 2018). Kurban (2018) argues that teachers often flip instruction, but keep traditional curricula and assessment, and her study demonstrated a more successful FL approach to learning when also curricula and assessment were redesigned to support FL. While some studies have observed a negative attitude from students towards the perceived extra work load coming from a FL approach (Akçayır & Akçayır, 2018; Missildine, Fountain, Summers, & Gosselin, 2013), the observed negative aspects are far less than the observed advantages (Akçayır & Akçayır, 2018).

Flipped learning in physical education.

As the FL approach originated in science subjects like mathematics, chemistry and physics, the majority of both use and inquiry still today revolve around these subjects, both in elementary and high school and at university level. The increased interest in applying the FL approach to practical subjects like physical education (PE) brings a need for a different approach and understanding. Where a traditional science class, characterised by a static, non-student-involving, lecturing style learning environment would in a FL approach be inverted to a more student-active and student-centred environment, a PE class would not have this great transformation in class, as the classes are already quite student active. Nevertheless, by the very definition of FL, one cannot just assign preparation homework for students and give no thought to the in-class content if viewed through a social constructivist and situated learning lens. The FL framework relies on students constructing knowledge together in a cooperative fashion. The teacher's role would somehow change from taking an instructor role to a scaffold role, where peer students are included in the scaffold. In traditional PE there is seemingly a lot of cooperative activity going on, e.g., students conducting team activities like football, but this is not activity prompting autonomy nor promoting individualisation regarding levels, interests or aims. Cooperative work, where a group of students, with support from the teacher, define both the aims for the activity and the content would be more valuable, as such cooperative work increases the motivation to learn (Gillies & Boyle, 2005). Further, the transformation would also involve students preparing prior to class, as homework

has not traditionally been used in PE (Devrilmez, Dervent, Ward, & Ince, 2018; Mitchell, Stanne, & Barton, 2000; Smith & Claxton, 2003). How a general FL framework would be outlined in a practical subject like PE is later in the present thesis mentioned as called for research. This call is supported by the study of Chad M Killian, Kinder, and Woods (2019), who conclude that systematic research related to how online and blended instruction in PE is designed, adapted and implemented is needed to understand how they can support good teaching and encourage deep learning in PE.

Nevertheless, despite the scarce amount of research investigating FL in PE (Sargent & Casey, 2019) there are some studies that the present thesis can draw upon. There are studies suggesting that FL can affect student motivation both in primary school (Ferriz Valero, Sebastià Amat, & García Martínez, 2017) and at university level PE (Chiang, Yang, & Yin, 2018; Hinojo-Lucena, Mingorance-Estrada, Trujillo-Torres, Aznar-Díaz, & Cáceres, 2018). As the FL approach facilitates spending less time on instructions and more time dedicated to learning activities, FL can foster more learning in PE on all educational levels (Isidori, Chiva-Bartoll, Fazio, & Sandor, 2018; Chad M. Killian, Trendowski, & Woods, 2016; Lina, 2017; Sargent & Casey, 2019; Østerlie, 2016). Bing (2017) suggests that student interest in learning in PE is mediated by integration of the use of video in the learning process, producing a positive effect on students' self-study abilities in PE after attending PE classes in a FL fashion. Moreover, FL has been shown to be an effective approach to learning the rules of new games (Bergmann & Sams, 2014) and orientation skills (García, Lemus, & Morales, 2015) in secondary PE.

Implications for this study.

The major implication for this study was how the FL framework to be applied in the intervention was designed. Back in 2015, the lack of research was even more prominent, and many choices made were based on intuition and drawing upon the researcher's many years of experience as a PE teacher. The goal was to implement and merge knowledge about the activities, the context, and experiencing the activities, all based on the curriculum aims. A further elaboration of the FL intervention is to be found in the methods chapter.

Physical education

In Scandinavia there are many similarities regarding PE (Redelius & Larsson, 2010). This is supported by G. Ward and Griggs (2018), who state that "Physical Education is widespread across the world, yet despite its cultural variation it remains remarkably similar" (p. 400). This assumption further involves that the notions of 'Norway', 'Scandinavia', or 'international' are not always applied when referring to research where the implications referred to are assumed to apply to the present thesis and the Norwegian context regardless of the original national or cultural setting or contexts. Hence, a much used 'the Norwegian context' chapter is not included in the present thesis.

PE in Norwegian schools has a mandate to inspire physical activity in all aspects of life and inspire lifelong enjoyment of being physically active (Norwegian Directorate for Education and Training, 2015). In Norway, competitive sports and sport federations have had a strong influence on the curriculum as well on the general class content in secondary school PE (Borgen & Hjardemaal, 2017; Leirhaug & MacPhail, 2015), a discourse like in many countries, including Sweden (Lundvall & Meckbach, 2008) and others (Capel, 2007; Green, 2008; Kirk, 2010; Penney, 2013; G. Ward & Griggs, 2018). Unfortunately, the national curriculum aims for PE set out by the Norwegian Directorate for Education and Training (2015) are not reflected in what is conducted as curriculum content in gymnastics halls, out on fields and in other PE arenas (Arnesen et al., 2013; Moen et al., 2018) reflecting a global trend which has lasted for decades (Dyson, 2014; Ennis, 2011; Green, 2008). Barker, Aggerholm, Standal, and Larsson (2018) state that there is a "general need to think more about how embodied approaches to movement pedagogy can be implemented in PE contexts" (p. 211). This statement is supported by the statements of scholars like Dyson (2014) and Ennis (2011), who argue that the PE curriculum is too narrow and does not include the enhancing of students' social and cognitive skills, nor ensure that students develop a positive perception of their physical self-worth. A gender difference in final marks in Norwegian mandatory school PE is observed, where girls scores lower than boys, and this is the only school subject where this occurs (Statistics Norway, 2018). The exact same phenomenon is observed in Sweden (The Swedish National Agency for Education, 2018), but not in, e.g., Denmark (Ministry of Children and Education, 2019) and the UK (Joint Council for

Qualifications [JCQ], 2018), where girls receive higher final marks than boys in the last year of mandatory school PE.

As the aim of PE seems to be somewhat neglected, a change is both needed and called for. Green (2008) suggested, more than a decade ago, that new pedagogical methods should be adapted in PE as the subject is still dominated by a teacher-centred teaching style. Students do, in general, welcome innovative approaches and curricula in PE (Dyson, 2006), and the use of digital technology in PE provides opportunities and promotes learning that is less 'dispensed' and more 'built' (Parker et al., 2017).

New technologies in physical education.

There is a rapid increase of interventions in PE which are adapting a myriad of approaches using digital technologies. As an example, many studies use video to increase the levels of PA (Palao, Hastie, Cruz, & Ortega, 2015) and to enhance student learning, teaching and assessment (Koekoek & van Hilvoorde, 2018; Penney, Jones, Newhouse, & Cambell, 2012; Weir & Connor, 2009), or to enhance engagement in PE (Casey & Jones, 2011), all with positive outcomes. As we know that physical inactivity among adolescents strongly predict levels of inactivity in adulthood (Anderssen & Andersen, 2004), this use of information and communication technology (ICT) is a valuable addition in PE to fulfil its aim: "although ICT use affords the potential to enhance learners' educational experience, the lack of ICT use in PE is still apparent" (Tou, Kee, Koh, Camire, & Chow, 2019, p. 11). The omnipresence of digital technology can in many ways obstruct the aims of PE, but at the same time new approaches and alternative ways of planning, organising, conducting and assessing PE can arise as the technological development goes on. The demand for PE teachers to critically value how these technologies can be incorporated as effective pedagogical tools in PE learning processes is increasing at the same time (Koekoek & van Hilvoorde, 2018). Among Singapore PE teachers, Tou et al. (2019) found that the older group (above 40 years), and those with the longest experience as PE teachers demonstrated a more positive attitude towards ICT compared to their younger and more inexperienced counterparts. Furthermore, in the same study it was demonstrated that male teachers had a more positive attitude towards ICT than female teachers. The number of books describing, and reflecting upon, digital

technology in PE (e.g., Casey et al., 2017a; Koekoek & van Hilvoorde, 2018) demonstrates a growing interest in this field. These are also positive contributions to higher education, as we know that PE is the subject in teacher education lagging behind all other subjects in implementing ICT (Tearle & Golder, 2008). What worked yesterday will not work tomorrow, as "the pressure of research is hurting the university classroom, despite the fact that universities exist to provide the very education they are neglecting!" (Sahin & Kurban, 2019, p. 3).

No implementation of new approaches or ways of thinking in a school subject goes on without encountering some sort of problem. Villalba, González-Rivera, and Díaz-Pulido (2017) observed among 400 PE teachers in Spain that the most frequently perceived obstacles implementing ICT in PE were loss of time spent on PA, lack of resources, investment in time and training, unsuitable use, lack of knowledge, and technical problems. Further, unfamiliarity with technology and poor group cooperation were identified as initial barriers to pupil learning when integrating technology (Bodsworth & Goodyear, 2017). PE teachers also seem to be happy with things as they are, as a majority of teachers in the study by Kretschmann (2012) stated that their teaching in PE was successful without the use of any technology at all. These findings support the call from Kretschmann (2015), Casey, Goodyear, and Armour (2017b), and Chad M Killian et al. (2019) for further research focus on how to successfully implement ICT in PE.

Implications for this study.

Both the substantial evidence that PE is a subject not fulfilling its intentions of motivating all students to start and maintain a healthy and active style of life, and my perceived positive impact ICT can have in PE inspired me in the beginning to perform an intervention in school and to investigate the impact. After digging deeper into both the opportunities and obstacles related to ICT in PE, I was utterly convinced that this inquiry is both called upon, important, and can have an impact on how PE is conducted in the future.

Motivation in physical education

The main aim of PE is to motivate all students to engage in a lifelong physical active and healthy lifestyle (Kirk, 2010; Norwegian Directorate for Education and Training, 2015), but unfortunately, "many PE teachers report that motivating students is a significant challenge" (Bennie, Peralta, Gibbons, Lubans, & Rosenkranz, 2016, p. 1). PE is one of the most popular subjects in school (Goodlad, 2004; Moen et al., 2018) but a major decline in motivation to participate in PE has been observed, especially among girls, as students move from primary to secondary and upper secondary school (Gao et al., 2008; Mowling, Brock, Eiler, Rudisill, & Dance, 2004; Prochaska, Sallis, Slymen, & McKenzie, 2003; Säfvenbom et al., 2014; Xiang, McBride, & Guan, 2004). Further, Goodlad (2004) observed that although PE is highly liked by students, it has the lowest perceived value among students, school administrators and teaching staff. The decline in motivation is partly due to a 'sportified' PE favouring students, boys in particular, who conduct sports outside school (Andrews & Johansen, 2005; Dowling, 2016; Ennis, 1999; Green, 2008; Lundvall, 2016; Oliver & Kirk, 2015; Prochaska et al., 2003; Scraton, 2013; Säfvenbom et al., 2014; Vlieghe, 2013).

Two motivational theories were chosen as a framework in the present thesis. Both expectancy-value theory (EVT: Eccles, 1983; Eccles & Wigfield, 1995) and self-determination theory (SDT: Ryan & Deci, 2017) are broadly used as a theoretical framework when studying motivation in PE, and in general are acknowledged as major theories of motivation (Weiner, 2010). EVT was chosen over the associated theory of self-efficacy by Bandura (1997). Arguably, constructs rooted in EVT have a more direct impact on learning behaviour and achievement than other motivation constructs like self-efficacy (A. Chen, Martin, Ennis, & Sun, 2008). While self-efficacy theory ties one's beliefs about mastering to a specific task (Skaalvik & Skaalvik, 2015), e.g., in sports, where self-efficacy is a recognisable and valued attribute (Feltz, Short, & Sullivan, 2008), EVT includes beliefs about one's competence in a given domain, hence representing a broader area than a specific task (Gao et al., 2008; Wigfield, Tonks, & Klauda, 2009). This broader approach works well with the PE subject, acquiring a wide competence involving both students' cognitive knowledge, physical and social competence. SDT was chosen, as this theory is one of the few motivational theories that focuses on the role of choice and autonomy in human behaviour. As PE is a mandatory subject, at least in the setting of the present thesis, this is an important perspective to consider.

Different from other theoretical frameworks, SDT recognises the controlling nature of schools and suggests the use of strategies consistent with this nature to encourage the fundamental human needs for autonomy, competence and relatedness as motivation mediators (Sun & Chen, 2010). This has resulted in an extensive amount of inquiry using SDT to investigate student motivation in PE (Ntoumanis & Standage, 2009; Ryan & Deci, 2017), and hence SDT was found to be suitable as a framework in the present thesis.

Expectancy-value theory.

Expectancy beliefs (EB) and subjective task values (STV) are considered important predictors of students' performance and behaviour choices in educational research (Eccles, 1983; Eccles & Wigfield, 1995), and they directly predict students' achievement-related choices and performance in a domain (Eccles, 1983; Fredricks & Eccles, 2002; Wigfield & Eccles, 2000). Expectancy beliefs refer to one's broad beliefs about one's competence in a given domain (Zhu, Sun, Chen, & Ennis, 2012). The motivational factor STV, which is independent of the motivational factor EB (Eccles & Wigfield, 1995), consists of four constructs (see Figure 1.2.). According to Eccles (1983), these four constructs are attainment value (AV), intrinsic value (IV), utility value (UV) and cost. AV is a person's perceived importance of doing well on a task; IV is the level of enjoyment that a person perceives doing a task will offer; UV is how the perceived usefulness in doing a task relates to current and future personal goals (Eccles & Wigfield, 2002); and cost refers to the negative aspects of engaging in a task, such as the fear of failure or lost opportunities due to choosing one task over another (Wigfield, 1994). Hence, EBs and the three STVs; AV, IV and UV can motivate students to engage in a school subject, while costs can demotivate students.

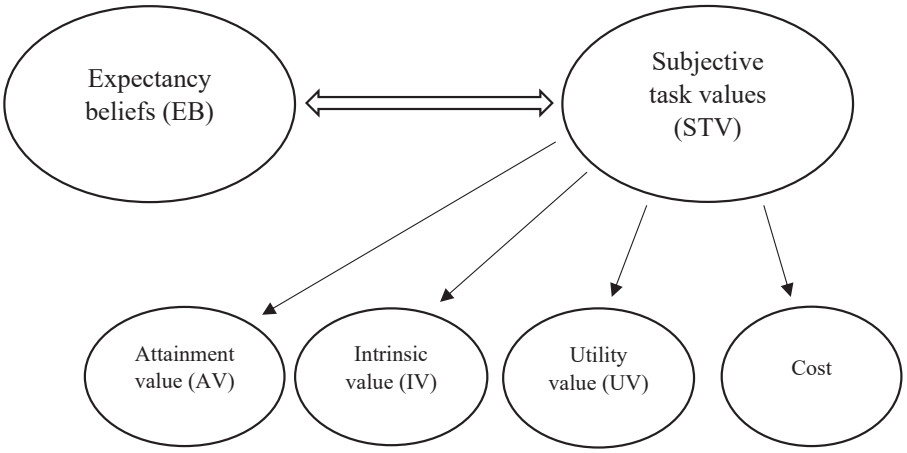

Figure 1.2. Expectancy-value theory. Expressed by types of motivational factors with their aspects. Adapted from Eccles (1983) and Eccles and Wigfield (2002).

Scholars like Gao (2009) and Zhu et al. (2012) have argued EVT to be an important theoretical lens with which to examine and understand student learning and motivation in PE. This motivation is related to students' intentions to participate, engage and perform in PE (Xiang, McBride, & Bruene, 2004; 2006), but not necessarily with PE learning achievement (Zhu & Chen, 2010). Among those factors that seem to affect students' expectancy-beliefs and values in PE, age and gender are argued to be two of the most important. Research has shown that students' general expectancy–value motivation declines with age among both genders (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Xiang et al., 2006; Xiang, McBride, & Guan, 2004), although age has recently been observed to explain STVs, and it has not been shown to affect EBs (Zhu & Chen, 2010; Zhu et al., 2012). Boys tend to have higher EBs than girls, although the same differences do not characterise their STVs (Gao, 2009; Xiang, McBride, & Bruene, 2004; Xiang et al., 2006; Xiang, McBride, Guan, & Solmon, 2003). Expectancy-value motivation is also connected to fitness knowledge learning in PE. S. Chen, Chen, Sun, and Zhu (2013) found AV, as the only expectancy-value construct, to predict fitness knowledge learning when PA levels were held constant but moderate. Researchers have theorised that costs, which refer to the negative aspects of engaging in a task, such as the fear of failure or lost opportunities

due to choosing one task over another (Wigfield, 1994), negatively affect students' achievement behaviour (Eccles, 1983). Facets of PE that seem to affect elementary-school students' perceived cost of attending include content, peer behaviour, physical discomfort and teacher behaviour (A. Chen et al., 2008), reflecting the finding also among middle-school (Zhu & Chen, 2013) and college (A. Chen & Liu, 2009) students. Nevertheless, all these studies revealed that most students would choose to attend PE if given the choice, despite the costs they perceived in attending. The lack of evidence regarding the role of costs in the motivation process may hinder our understanding of the full function of expectancy beliefs and perceived task values in PE, and Gao (2009) calls for further inquiry due to inconclusive findings. A critique of EVT has been its lack of power to include social phenomena in situations where students learn. Light has also been shed on issues with the methodology used in studies applying EVT to self-reporting among young individuals, the extended use of statistical tests, not including qualitative approaches, and the theory's lack of counting for the complexity of students' choice processes (Lykkegaard & Ulriksen, 2016).

Self-determination theory.

Self-determination theory (SDT) is an empirically based, organismic theory of human behaviour and personality development. Analysis in light of SDT is focused primarily at the psychological level, and it differentiates types of motivation along a continuum from controlled to autonomous (see Figure 1.3.) based on the different reasons or goals that give rise to an action (Ryan & Deci, 2017). Broadly speaking, the types of motivation that reflect behavioural engagement as a result of enjoyment/task interest (intrinsic motivation) or integration of a behaviour into one's core self and value system (integrated regulation) or due to the perceived personal utility and benefits of the behaviour (identified regulation) are named autonomous or self-determined motivation. In contrast, motivations that reflect behavioural engagement stemming from internal pressures such as guilt or ego contingencies (introjected regulation), or external burdens such as rewards or castigations (external regulation), are named controlled forms of motivation. In a school context it is desirable for all students to achieve a high level of engagement in learning activities that can result in a high learning outcome. Ryan and Deci (2017) argue that self-determined motivation is high-quality motivation and results in the desirable outcome of engagement.

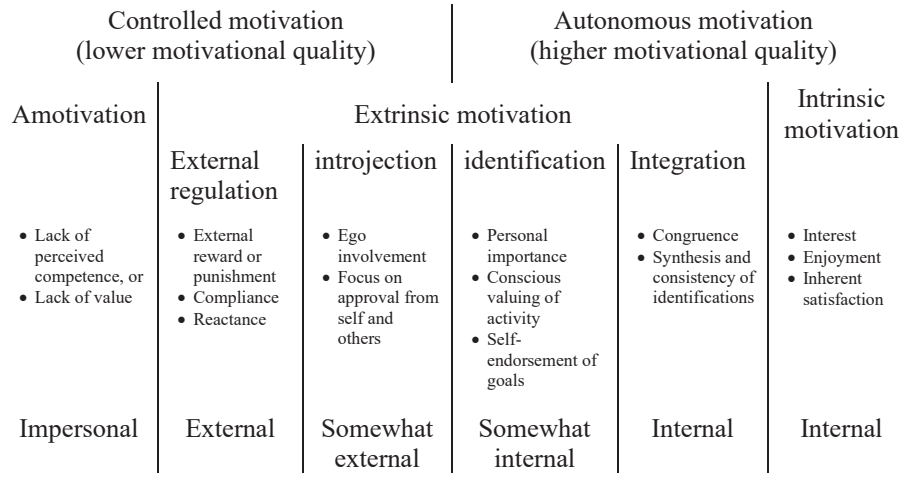

Figure 1.3. The self-determination continuum. Expressed by types of motivation with their regulatory style, corresponding processes and loci of causality. Adapted from Ryan and Deci (2000).

During the last decades a large number of studies have applied STD as a theoretical lens in investigating student motivation in PE (Ulstad, 2019) and in the exercise context (Guérin, Bales, Sweet, & Fortier, 2012). van Aart, Hartman, Elferink-Gemser, Mombarg, and Visscher (2017) confirmed the importance of the basic psychological needs in the prediction of autonomous motivation in PE in primary school. Although all needs should be supported by the PE teacher, it is important to be aware of the different impact of the needs for autonomous motivation for boys and girls in PE. Students' autonomous motivation for participating in PE is important because of its influence on PA in PE (Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009), but also, and perhaps more importantly, because students' experiences during PE lessons may influence their PA habits outside school and later in life (Chatzisarantis & Hagger, 2009). Further, numerous studies in secondary PE have described associations between perceived competence, autonomy and relatedness, and autonomous motivation in PE (Cox, Smith, & Williams, 2008; Ntoumanis, 2001; 2005; Standage, Duda, & Ntoumanis, 2003; 2005; 2006), and a study from Bagøien, Halvari, and Nesheim (2010) linked how students perceived the PE teacher to be more autonomous-supportive to a general greater well-being and increased effort in PE. A recent doctoral thesis by Ulstad (2019) concluded that applying SDT in PE can lead students from a psychological state of 'having to' to one of

‘wanting to’, leading to a more effective use of learning strategies and a more physical active lifestyle. Roure (2019) examined the impact of a student-centred teaching style, coupled with digital technologies and preliminary results, which showed that students in the experimental group reported stable scores for their contextual motivation, whereas the control group showed a decline. In addition, the situational motivation of the experimental group evolved more than those of the control group, indicating a stronger interest for PE when using ICT.

These few examples of inquiries applying SDT to PE demonstrate that obtaining a high-quality motivation like autonomous motivation can both enhance the learning outcome from PE and lead to a lifelong healthy lifestyle. In addition, the use of ICT in PE seems to further support the perception of autonomous motivation in PE.

Implications for this study.

Theories of motivation are, as the name implies, theories. This view embraces the idea that these theories might have facets not accounted for, or weaknesses pointed out by scholars, and there is to date no single grand motivation theory one can rely on to understand human motivation (Reeve, 2016), including in PE (A. Chen & Ennis, 2004; Shen, Chen, & Guan, 2007). The term ‘theory’ is best understood as an over-arching term that often holds different interpretations among qualitative and quantitative researchers (Gleeson, 2010), and is outlined by Thomas (1997) as having four uses: as thinking and reflection; as tighter or looser hypotheses or hunches; as explanations for adding to knowledge in different fields; and as formally expressed statements of science. This view regarding the use of theory in educational research is compatible with understanding theory as a lens through which the researcher plays with ideas, hunches and hypotheses or ways of looking that are the precursors of research design.

One implication regarding this in the present thesis was that two different theoretical lenses were selected as the framework to best examine the research questions, since two eyes see better than one. The two chosen approaches provide alternative explanations of why people engage in behaviour of varied types:

> “In brief, the SDT proposes that the triggering factors originate from the degree to which one can make volitional choices while meeting the needs of autonomy,

competence and relatedness. EVTs suggest that the triggering factors are constituted by one's beliefs about his or her ability to perform a task at hand in relation to the expected utility value of the outcome of task performance" (Savolainen, 2018, p. 124).

This methodological choice found support in scholars like Hidi and Harackiewicz (2000) and Pintrich (2003), who emphasise the significance of using an inclusive, multidimensional theoretical approach in the investigation of motivation and learning achievement in PE.

While theory is often seen as irrelevant to practice, the approach taken in the present thesis is one of viewing theory as a form of practice, with the two being inseparable. Both SDT and EVT provide the foundation for thoughts and tools for understanding and developing PE, and PE on the other hand has played a major role in forming and understanding student motivation by those same theories. Further, the nature of the FL framework, shifting from a teacher-centred to a more student-centred style, where the students are more actively involved in their learning processes, encourages students to act more autonomously. Further, the present thesis considers motivation in PE a state more than a trait, a view supported by Reeve (2016), who states that "motivation is always a state" (p. 32), but somewhat contradictory to the view of Baumeister (2016) recognising that motivation comes in both state and trait forms. A motivational state is more likely to be formed, mediated or changed by new experiences, while a motivational trait has no way of activating itself (Reeve, 2016). The assumption of motivation in PE is that it is a state, implying that the present thesis not only seeks to measure change in motivation over time but also seeks to discover the underlying mechanisms which drive these changes: in other words, not only *how* but equally important *why* motivation in PE acts when FL is applied.

Learning in physical education

The national curriculum in Norwegian PE is open for a broad approach, both regarding class content, pedagogical methods and assessment in a local context as long as the students achieve the aims and knowledge requirements. Recently, PE has been recognised as a subject of knowledge (Larsson, 2016), and "physical education teachers are being held accountable for student learning in the same way as their classroom peers" (P. Ward, 2013, p. 431). Nevertheless, teachers and students find it difficult to express what should actually be learned

in PE both in Norway (Arnesen et al., 2013; Leirhaug & Annerstedt, 2016; Leirhaug, MacPhail, & Annerstedt, 2016; Moen et al., 2018; Prøitz & Borgen, 2010), Sweden (Redelius & Larsson, 2010; Svennberg, 2017), and globally (Penney & Chandler, 2000; Siedentop, 2002; Tinning, 2002). This trend has resulted in a narrower approach to PE focusing on (sport-like) content more than learning of content (Andrews & Johansen, 2005; Annerstedt, 2008; Dowling, 2016; Kirk, MacDonald, & O'Sullivan, 2006; Larsson & Karlefors, 2015; Lund & Tannehill, 2014; Lundvall & Meckbach, 2008; Redelius, Quennerstedt, & Öhman, 2015; Säfvenbom et al., 2014; Vlieghe, 2013). This phenomenon is partly a result of a PE teacher education that is "not adequately preparing future PE teachers to promote healthy, active lifestyles and is not addressing previously identified issues in health-related teaching and learning" (Harris, 2014, p. 466).

Recent studies conclude with a student view of PE as a break from other subjects and more non-educational than a subject of learning (Lyngstad, Bjerke, & Lagestad, 2019; Moen et al., 2018; Røset, Green, & Thurston, 2019; Woods, Tannehill, & Walsh, 2012). Learning in PE is an under-researched topic (Quennerstedt et al., 2014; Quennerstedt, Öhman, & Öhman, 2011; Rovegno, 2006), whereas research has focused more on the curriculum, content, and the teaching of PE (Kirk et al., 2006). Scholars like Larsson and Redelius (2008) call on researchers to change focus from studying activities to studying learning outcomes grounded in the uncertainty about the subject's educational purpose. The scarce research examining a possible connection between cognitive knowledge learning, measured as health-related fitness knowledge (HRFK) and PA behaviours in PE finds that there is no connection in the form of prediction (Haslem, Wilkinson, Prusak, Christensen, & Pennington, 2016; Shen et al., 2007). This further supports the assumption that PE is merely a place for activity disconnected from the concept of learning. Further, Placek (1983) found that keeping students 'busy, happy and good' superseded all other learning outcomes in PE. This reality is still today reflected in PE both in Norway (Moen et al., 2018), Sweden (Henninger & Coleman, 2008; Larsson & Nyberg, 2017; Larsson & Redelius, 2008; Quennerstedt, Öhman, & Eriksson, 2008), and other countries like the UK (G. Ward & Griggs, 2018).

Situated learning.

Students learn together in PE. Most activities are based on cooperation, and how and what the students learn must be seen in a social context where students' learning depends on their peers' actions, attitudes and support. Imagine practicing tennis where your learning partner only obstructs you, shows a bad attitude and gives you no support. This learning environment will definitely affect your learning outcome in tennis and your motivation to continue practising tennis. *Situated learning* (Lave & Wenger, 1991) contributes to a growing body of research in human sciences that explores the situated character of human learning and communication. The roots of situated learning lie in the work of activity theorists such as Vygotsky, and ideas proposed by Dewey, Piaget, and Gibson (Brown, Collins, & Duguid, 1989; Clancey, 1997; Greeno, 1997). Lave and Wenger (1991) with the theory of situated learning focus on the relationship between learning and the social situations in which the learning occurs. Rather than asking what kinds of cognitive processes and conceptual structures are involved, they ask what kinds of social engagements provide the proper context for learning to take place. This shift in thinking about teaching and learning is embraced and applied to PE by scholars like Kirk and Macdonald (1998) and Rovegno (2006) as a constructivist perspective on learning. "Constructivist perspectives have in the past and continue today to be a basis for research in physical education that addresses the curriculum, student learning and knowledge, teacher learning and knowledge as well as content" (Rovegno & Dolly, 2006, p. 257). Constructivist approaches emphasise that learning is an active process in which the individual seeks out information in relation to the task at hand (Kirk & Macdonald, 1998). In concert with constructivist perspectives, situated perspectives consider it very important for researchers and teachers to understand how students learn in school settings by understanding how students' pre-existing knowledge facilitates and impedes learning (Rovegno, 2006).

The situated perspectives have illustrated the need to understand the multiple cultures of the learner, teacher, school and society: how these impact learners, and how to plan a curriculum and teaching in PE that leads to "robust, meaningful knowledge useful in multiple contexts" (Rovegno, 2006, p. 271). Robust, meaningful knowledge useful in multiple contexts is in the currently political educational debate in Norway named 'deep learning'. This terminology

seems to have a great impact on the ongoing revision of the national curriculum in Norwegian primary, lower secondary and upper secondary school, including the subject of PE.

Deep learning.

Deep learning is in Norwegian school-policy documents a key concept in describing how to obtain the knowledge, skills, attitudes and values that today's students need to thrive and shape their world (Meld. St. 28 (2015-2016), 2016; NOU 2014:7, 2014; NOU 2015:8, 2015; NOU 2019:2, 2019; OECD, 2018). Pellegrino and Hilton (2012) describe deep learning as recognised by an individual's capability to transfer knowledge from one situation to another. In other words, if a student demonstrates that knowledge learned in one context can be used to learn in another context, then deep learning is happening. Frey, Fisher, and Hattie (2016) differentiate between the deep and transfer learning phases, where the deep learning phase is defined as "interaction with skills and concepts", with the driving question being "how do these facts and principles fit together?" recognised by the processes of "planning, organization, elaboration, and reflection". The transfer learning phase, on the other hand, is defined as "organizing, synthesizing and extending conceptual knowledge", with the driving question being "how and when do I use this for my own purposes?" recognised by the processes of "making associations across knowledge bases and application to novel situations" (p. 570). Deep learning is conditioned on surface learning (Frey et al., 2016), and seems to be mediated by intrinsic motivation and engagement, and supported by relevant learning approaches (M. Wang, Derry, & Ge, 2017). Nevertheless, these perspectives on deep learning have received critique and been met with scepticism. Dahl and Østern (2019) argue that they are too 'cognitive' oriented, and do not acknowledge learning processes in a practical subject like PE, where the body is the main 'learning tool'. They describe deep learning to be a process of creation, where body, relations, creative, affective and cognitive processes together give depth to the learning, as no part is unaffected by another. Further, Tochon (2010) argues that the deep learning process among students is mediated by the teacher. With that, he argues that deep teaching not only builds on intrinsic motivation, but is also learner-centred, and the approach is contextualised, situated, and is based on meaningfulness for the learner, as "meanings are embodied in action" (p. 6).

When can a teacher observe that deep learning is happening in PE? What is deep learning in PE? These questions are too recent to have answers. First of all, there must be a recognition of *learning* happening in PE before we start looking for and facilitating *deep learning*. Fu (1999) stated that how students employ learning strategies in PE, whether at a surface or deep level, hinges on how the students value the task to be learned. Scholars like Ennis (2015) and Vinje (2016) argue that the very future of PE depends on how teachers implement terms like self-paced learning, reflection, meta cognition and deep learning in their practice. One obstacle to deep learning in PE is the fact that students too often do not have any insight or understanding of the learning objectives in the activities conducted (Borgen & Hjardemaal, 2017). Birch, Vinje, Moser, and Skrede (2019) have outlined a way of understanding deep learning in PE, recognising that an acceptance of a dual view on knowledge includes both 'learning that' and 'learning how'. In a PE context this might be visible as students learn different strength exercises, how to train different modes of strengths and what happens inside one's body when strength is gained. To support deep learning in PE the concept of scaffolding plays an important role. Scaffolding is described by Wood, Bruner, and Ross (1976) as a process that enables students to solve a task or achieve a goal beyond their unassisted efforts. Jumaat and Tasir (2014) stated that technology mediates how teachers and students interact, and this calls for a new understanding of how scaffolding happens in school, supporting the findings of Yelland and Masters (2007) in finding that in the information age, the traditional form of scaffolding, based on the 'expert's' view on how a problem should be solved, should further be conceptualized as cognitive, technical and affective scaffolding. To achieve that, both the teacher and peer students must take part in this scaffold, as this concept is related to the concept of 'zone of proximal development' (ZPD) rooted in social constructivist theory. The concept of ZPD was introduced, but not fully developed, by Vygotsky (1978) and refers to the difference between what a learner can do without help and what she or he can achieve with guidance and encouragement from peers: "What the child is able to do in collaboration today he will be able to do independently tomorrow" (Vygotsky, 1987, p. 211). The social constructivist idea also includes a focus on students working together in a fashion called cooperative learning or guided learning (Gillies & Boyle, 2005), where, throughout the learning process, "an individual's ZPD is satisfied through internalizing knowledge acquired through communicating with the others" (Sun & Chen, 2010, pp. 370-371).

Implications for this study.

As the concept of ´deep learning´ in the subject of PE is in its infancy regarding meaning, implications and use, I did not therefore dare to use this word in the title without a parenthesis. Further, in the light of the challenges PE is facing, it is appropriate to begin to explore new approaches to teaching and learning in PE. 'The design-oriented didactical triangle' (see Figure 1.1.) in the light of a constructivist approach like situated learning might be one way to think about how students learn in PE. Finally, FL, as applied in this thesis, seems, theoretically, to fit well as part of a scaffold to enable deep learning in PE.

Aim of the study

The aim of this thesis was to obtain insight into how students experienced the application of the learning framework FL in PE. Hence, the main research question was:

1. How do PE students in secondary, and upper secondary school experience an intervention where the learning framework is FL?

The main aim was further refined into two sub research questions:

1.1 How does FL impact student motivation for PE?

1.2 How does FL impact student (deep) learning in PE?

The methodological considerations that follow led to the choice in this study of combining both qualitative and quantitative approaches to best answer the study aim and research questions.

There further follows a description of the research design, the instruments and methods used to generate and analyse the data, a discussion of ethical considerations, and the trustworthiness of the presented and discussed results.

Chapter 2: Methodology and methods

Methodological considerations

Before outlining the methods used in the present thesis it would be useful to rehearse some of the fundamental methodological issues related to reality and knowledge in social and educational research and by this describe how the present thesis is positioned.

Ontological and epistemological considerations.

The process of constructing knowledge through research is guided by frameworks that enable researchers and communities of practice to ask questions about ontology (what it is, what is there to be known, what the object of research is) and epistemology (questions about the nature of knowledge, such as what does it mean to know?) (Hartas, 2010a). In Norway, PE had in its infancy, almost two decades ago, a strong connection to the army with the purpose of teaching army skills to young boys preparing for military service (Augestad, 2003; Husby & Naadland, 1976). Today, army skills are no longer central to the practice of PE in Norway. The subject is applied in school on the legitimation of health, the training of movement and outdoor-life skills, and as a general *Bildung*-subject supposed to inspire students to maintain a life-long healthy lifestyle (Norwegian Directorate for Education and Training, 2015; Vinje, 2016), reflecting a global view of PE (Green, 2008; Laker, 2003; Phillips & Roper, 2006; Vasile-Liviu, 2013). As observed, PE develops over time in relation to its environment's social development and processes. Hence, PE is, in ontological terms, socially constructed.

The main aim of the present thesis was to develop original knowledge about the school subject PE, and more precisely knowledge about how students' encounter with a learning framework called flipped learning affected their motivation for and (deep) learning in PE. This involved addressing fundamental ontological and epistemological issues in social science. The term epistemological refers to the study of knowledge, or the philosophy of knowledge (Hartas, 2010a). Questions of what is, or should be, regarded as acceptable knowledge in a discipline, are raised by scholars like Bryman (2008) in questioning whether the social world can or should be studied according to the same principles, procedures, and ethos as the natural sciences. In other words, can research questions in educational inquiry

best be answered based in an epistemological position known as positivism? To construct knowledge and reflect on its nature, the researcher must use a lens, a worldview, which offers theories, models, exemplars, values and methods shared by a community of scholars. This worldview is called a paradigm, and is deeply embedded in the socialisation of advocates and practitioners (Hartas, 2010a).

The present thesis combined, or triangulated, data generated for analysis rooted in both quantitative and qualitative traditions. This forced a bridging of diverse worldviews. More and more in educational research, an eclectic approach to diverse worldviews is taken, combining both quantitative and qualitative strategies of inquiry (e.g., mixed-method designs) (Hartas, 2010b), and scholars like Salomon (1991) argue for a combination of an analytic and a systematic approach in educational research, stating: "As with the case of quantitative and qualitative research in education, cohabitation is not a luxury; it is a necessity if any fruitful outcomes are ever expected to emerge." (p. 17). There has been a debate on the polarisation of qualitative and quantitative educational research (e.g., Ercikan & Roth, 2009) ongoing since the second half of the twentieth century, but in the present thesis a combination was preferred since "educational scientists deal with contexts and human variations, as well as unpredictability and continually changing political, ideological and cultural landscapes and networks of social interactions" (Hartas, 2010a, p. 26). Education is described by Berliner (2002) as the "hardest-to-do science" (p. 18) as realities are shifting, local conditions limit generalisation and theory building, and due to the ubiquity of interactions and the short-life of findings. Educational research involves elements that are simultaneously particular and universal, concrete and abstract, or specific and general, suggesting that the involvement of both qualitative and quantitative dimensions is needed to understand educational phenomena and the construction of knowledge about them (Hartas, 2010a). Hence, a combination of qualitative and quantitative approaches was chosen in the present thesis, as such a combination is needed to ask questions about "what works" and also to establish "what it is", supporting the view of Erickson and Gutierrez (2002), who state that the dichotomy between qualitative and quantitative research is artificial. If the purpose of research is to understand complex educational phenomena, then multiplicity and polyphony in the modes of inquiry are required to respond to the different needs of individuals and groups in society (Hartas, 2010a). Combining different paradigms and philosophical positions might challenge dichotomies and

perceived incompatibilities, taking the view that "social reality is both casual and contextual, and social knowledge is both propositional and constructed … multiple methods are not only welcomed but required" (Greene & Caracelli, 2003, p. 99). To construct knowledge on how students' encounter with a learning framework called flipped learning affected their motivation for and (deep)learning in PE, the researcher blended critical realism from quantitative research with social constructivism from qualitative research to create a lens through which the generated data were analysed and presented. This lens can be labelled a pragmatic approach as described by Morgan (2007) as "a version of abductive reasoning that moves back and forth between induction and deduction – first converting observations into theories and then assessing those theories through action" (p. 71). This pragmatic approach is further argued to view the forced dichotomy between subject and object as artificial. Any practical researcher must move between various frames of reference, which implies emphasis on an intersubjective approach to capture this duality. Morgan (2007) further argues that the pragmatic approach rejects the need to choose between a pair of extremes where research results are either completely specific to a context or an instance of some more generalised set of principles. In other words, we cannot simply assume that our methods and our approach to research makes our results either context-bound or generalisable; instead, we need to investigate the factors that affect whether the knowledge we gain can be transferred to other settings.

Critical realism is critical because researchers accept that their investigations are fallible and stress the importance of a critical examination of values and facts. As knowledge is gained, previous knowledge and understandings is revised (Patomäki & Wight, 2000). As in critical realism, in pragmatism the truth is not seen to be absolute, but relative to the time, place and purpose of an inquiry, and verifiable as discoveries are made (Hartas, 2010b). Hence, a pragmatic researcher accepts that inquiry does not offer guaranteed knowledge based on past experience, but rather a sufficient knowledge to make predictions regarding present action. Olsen and Morgan (2005) argue that through a statistical analysis one cannot achieve absolute representations of reality, as it is not "how do analytical statistics do what they do", but rather "how can we interpret what we do with analytical statistics, and how can we (if we should at all) incorporate them into research" (p. 257).

In the paradigm, or worldview, of social constructivism, individuals seek understanding of the world in which they live, and they develop meanings of their experiences, meanings directed toward certain objects or things, advocating a research practice of relaying as much as possible on the participants' view of the situation (Creswell & Poth, 2018; Hartas, 2010b). As this worldview formed part of the research lens used in the present thesis, the interpretations of the generated data accounted for the fact that these subjective meanings of the participants not were simply imprinted on them as individuals, but were formed through interactions with others (hence, social construction) and through historical and cultural norms that operate in the participants' lives.

These ontological and epistemological considerations fall in line with a view of the socially constructed nature of PE emphasised by scholars like Green (2008), who state about PE that "it is simply what it has become" (p. 21), and that there is no timeless essence to PE in the sense of something immutable that the subject is and must always be if it is to count as PE (Kirk, 1992). "Constructivist perspectives have in the past and continue today to be a basis for research in physical education that address the curriculum, student learning and knowledge, teacher learning and knowledge as well" (Rovegno & Dolly, 2006, p. 257). The present thesis can be named a mixed-methods study, and Shannon-Baker (2016) argues that scholars should not argue for a single 'best' paradigm for mixed-methods research, but rather the legitimation for and operationalization of the one chosen.

Methods

Based on the pragmatic approach described in the last section, the present thesis took on an inquiry approach belonging to the genre of educational design research (e.g., McKenney & Reeves, 2012) rooted in pragmatism and mixed methods research. The analytic part of the present inquiry was based on a convergent design.

Design.

Educational design research is concerned with developing what Lagemann (2002) referred to as usable knowledge or solutions to practical and complex educational problems, often using

multiple methods (McKenney & Reeves, 2012). Convergent research design is described by Creswell (2015) as merging collected and analysed, qualitative and quantitative data, followed by an interpretation. (see Figure 2.1)

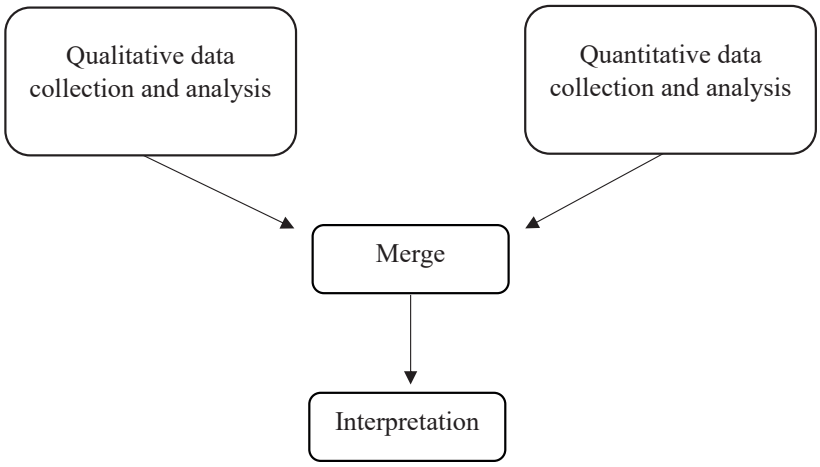

Figure 2.1. Description of the converged design. Adapted from "A concise introduction to mixed methods research," by Creswell (2015, p. 37).

The logic behind convergent design is that quantitative results yield general trends and relationships, which are often needed, while qualitative results provide in-depth personal perspectives of individuals (Creswell, 2015). Both quantitative and qualitative approaches are useful in gathering data and creating a more complete understanding than what would have been provided by each database alone. This parallel construction of knowledge is essential to gain multiple pictures of a problem from different angles. The results from the two databases were merged, developing a 'joint display' table that compares the quantitative against the qualitative results (see Table 3.1.). The interpretation (the side-by-side comparison) of the results was then discussed to get an understanding of how the qualitative and quantitative results converged or diverged.

To get an overview on the different phases in the two projects, Figure 2.2 outlines the phases and key actions regarding data generation.

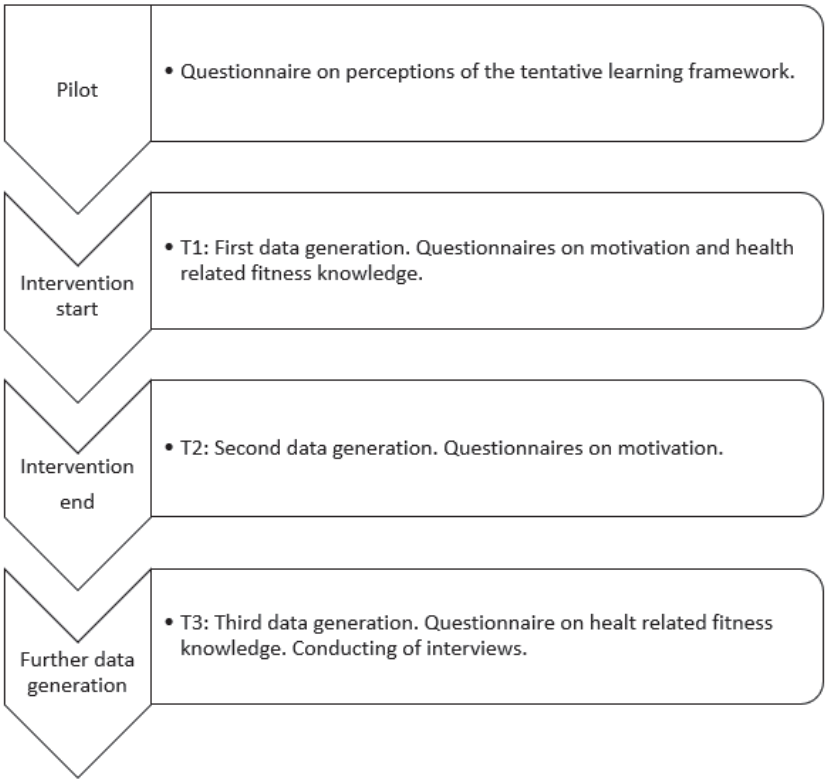

Figure 2.2. Timeline of the two projects with key actions.

The pilot study.

Prior to the main study, a pilot study was conducted. In educational research design pilots can help researchers get a sense of how the intervention will perform in various contexts and what kind of realities need to be addressed for the design to have the best chance of success (McKenney & Reeves, 2012). The pilot was both to test the learning resources later applied in the main study and to get an initial insight on the influence a FL learning framework in PE could have, so that the focus on the main study could be mapped out. The learning resources were developed by the researcher in cooperation with the National Center for Food, Health and PA[1] as they could offer support on technical and multimedia issues and matters regarding

[1] https://mhfa.no/

PE. This process is named an 'external expert appraisal' and was conducted as suggested in educational design research (McKenney & Reeves, 2012).

Participants.

169 lower secondary school students and eight PE teachers, belonging to three different schools in two different regions in Norway, were recruited for the pilot intervention. The inclusion criteria were schools from lower and upper secondary schools, that in total could represent a normal distribution of ethnic and socio-economic backgrounds, and schools situated in both rural and urban surroundings. In total, seven schools were contacted by the researcher, and four were initially positive about participating. The information letter given to the participating PE teachers is enclosed as Appendix I. One school had to withdraw its consent, resulting in three participating schools. The final cohort of students and their parents were informed by a written letter (Appendix II). The letter explained the objectives of the intervention and what was expected of the students in terms of preparation (seeing the videos before class), participation in PE and answering the questionnaire. There was an emphasis on anonymity in answering the questionnaire, but no written consent was collected as no personal data were collected like names or date of birth. This is approved by NSD as good practice[2].

Data generation.

The participating students answered three questionnaires made by the researcher (Appendix III), one after each practical lesson. The questionnaires consisted of questions about gender, academic year and if they had seen the video assigned as homework, followed by eight statements on which the participants could mark on a 5-point Likert scale their degree of agreement. Among the statements, which included assumptions on FL vs traditional education, the students had to make a statement on whether they got more motivated, learned more, were more physically active, mastered more, increased their skills and if they thought theory was interesting to learn and if they thought it was a good idea to apply FL in PE.

[2] https://nsd.no/personvernombud/en/notify/index.html

The teachers also answered a similar questionnaire (Appendix IV) to the one given to the students, and they were encouraged to write a narrative on their experiences of applying these three resources. These narratives could help in the further revision of the learning resources, constituting a part of the earlier mentioned 'external expert appraisal'.

Results and implications for the main study.

The results from the pilot student questionnaire revealed that about 70 % saw parts or the whole of the videos. Further, the topics of motivation (M = 3.50, SD = 1.102), learning (M = 4.04, SD = 1.125) and the experience of mastery (M = 3.30, SD = 1.221) were among the most highly scored statements and this led to the aims of the present thesis. The question about whether the students preferred more classes conducted in a FL manner also scored highly (M = 3.28, SD = 1.3).

Reflecting on the student responses, the analysis of the teachers' answers on the questionnaires revealed that they became more motivated to teach (M = 4.29, SD = .73) and the students seemed to have interest in learned theory in PE (M = 4.36, SD = .75). The question about whether the teachers would conduct classes in a FL manner later also scored highly (M = 4.79, SD = .43).

The narratives from the teachers resulted in some adjustments in the practical lessons, where some start-up activities were reported to be too intensive. Nevertheless, the teachers reported a positive perception of both the videos assigned as homework and the practical classes, stating that they would use these learning resources at a later point if they were made available. During the practical classes the teachers observed their students completing the activities with joy and involvement, expressing high levels of mastery, motivation and PA. The experience of using a model where some theory can be applied outside of the gym was appreciated as the teachers wanted to dedicate as much time as possible to PA in PE classes.

The main study.

The main study consisted of applying the learning framework FL in PE classes, named 'the intervention', in the spring of 2016 (see Figure 2.2). Three learning resources were allocated

over three weeks, each including a video to be watched as homework prior to participating in a practical PE lesson. The participants were asked to self-report through different measurement instruments on their motivation for PE and health-related fitness knowledge (HRFK) before and after the intervention. In addition, ten students participated in semi-structured interviews.

Participants.

From the pilot study, two schools agreed to continue into the main intervention. This included the same teachers but with different classes of students. In addition, one school requested to participate after hearing about the project. A further twenty schools were asked to participate by e-mail directly to the PE teacher, or by e-mail to the principal's office. The inclusion criteria were, again, schools from lower and upper secondary schools, which in total could represent a normal distribution of ethnic and socio-economic backgrounds, and schools situated in both rural and urban surroundings. The final cohort consisted of six schools belonging to three different regions of Norway totalling 364 students. Of these, 338 gave their written consent to participate, themselves or through their parents, depending on age. If the student had completed fifteen years by the start of the intervention, they could grant this permission themselves according to the standard of the Norwegian Centre for Research Data (NSD)[3]. Papers III and VI include 206 and 318 of these students as the analysis included listwise exclusion, and some students did not complete one or both questionnaires associated with these papers.

Self-reported information on sex, date of birth and name was obtained to characterise the whole sample (N = 338). Girls (n = 153) had a mean age of 15.26 years (SD = 1.3), and boys (n = 185) a mean age of 15.01 years (SD = 1.12). The participants were from four different levels in the Norwegian school system: the three grades of lower secondary school and the initial grade in upper secondary school - that is, Grade 8 (n = 114), Grade 9 (n = 101), Grade 10 (n = 38) and VG1[4] (n = 85). The students' academic marks (girls: 4.45; boys: 4.48) during

[3] https://nsd.no/personvernombud/en/help/research_topics/schools_kindergartens.html
[4] VG1 is the abbreviation for "Videregående 1", meaning the first year in upper secondary school.

the same semester reflected the national average for Grade 10 (girls: 4.5; boys: 4.6), according to Statistics Norway (2016).

Measurement tools.

This section elaborates on the measurement tools used in the main intervention for data generation.

EVQ.

The Expectancy-Value Questionnaire (EVQ) (Appendix V) measures expectancy-related beliefs and subjective task values in PE. The EVQ consists of 11 items on four sub-scales. Five items measure expectancy beliefs (EB) and six measure subjective task values (STV) on three sub-scales: attainment value (AV), intrinsic value (IV) and utility value (UV). Responses to all items are submitted on a 5-point Likert scale (1 = not important, 5 = very important). A sample item used to measure student AV is, 'Compared to math, reading, and science, how important is it for you to learn PE content?' The EVQ measures students' EBs and STVs of the domain content and can be used to measure expectancy–value constructs in PE for both middle-school and elementary students with good construct validity and internal reliability (Zhu et al., 2012). Paper V in the present thesis revealed that the EVQ translated into Norwegian also demonstrated satisfactory validity and reliability in measuring EBs and STVs for PE among adolescents.

Motivational cost, the fourth STV construct, has been under-researched, and there are no specific quantitative tools to measure it (Zhu & Chen, 2013). To measure the costs of attending PE, the EVQ in the present thesis included four open-ended questions, as was also done in studies by A. Chen and Liu (2009) and Zhu and Chen (2013). The four questions were consolidated into the following two questions: "If there is anything that you do not like in PE, what would that be? Why?" (Q1) and "If you had a choice, would you rather not come to PE? Why?" (Q2). Q1 addressed what aspects of PE the students did not like and thus identified the costs of attending PE. Q2 revealed whether the students experienced opportunity cost by attending PE because PE was a mandatory subject, and the students were

asked a hypothetical question regarding if they would or would not attend PE if the subject was not mandatory.

SIMS.

The situational motivational scale (SIMS) (Appendix VI) was applied to the participants to measure their motivation for PE by assessing the constructs of intrinsic motivation, identified regulation, external regulation, and amotivation for PE. In paper VI in the present thesis the SIMS was demonstrated to be appropriate to measure situational motivation among adolescents.

The health-related fitness knowledge test.

Health-related fitness knowledge (HRFK) refers to the ideas and principles about the body's ability to move effectively and efficiently for health promotion and the prevention of disease (Corbin, Welk, Corbin, & Welk, 2012). The HRFK test applied in the conducted intervention (Appendix VII) was constructed by the researcher as a multiple-choice test measuring knowledge of the three topics endurance, strength and coordination. Example questions included "Why is good strength important for your health?" and "What is coordination?" with one or more options indicating the right answers. The twenty questions emerged from two curriculum aims for 10th grade[5]: "practice and explain the basic principles of exercise and training" and "elaborate on the relationship between different physical activities, lifestyles and health" (Norwegian Directorate for Education and Training, 2015). As students from the initial grade in upper secondary school were also included in the intervention, the HRFK test was checked to align with the curriculum aims for PE in VG1 on the topic of exercise, training and health. The aim reflecting the HRFK test, and the learning resources, in VG1 were "practice training methods and exercises relating to training stamina, strength and coordination to develop one's own body and care for one's health". All participants answered the same HRFK test, regardless of school level, and the same test was allocated at both measuring times (T1 and T3, about seven weeks apart).

[5] These aims are assigned for 8th, 9th, and 10th grade in Norwegian school.

A group of 30 students from 9th grade and their teacher, who belonged to one of the pilot schools, tested the instrument to ensure that the questions were understood and that the level of difficulty was appropriate for the given ages, which resulted in some small modifications. After the researcher received all the HRFK tests, they were scored as suggested in multiple-choice tests of the type where more than one answer may be correct (Lesage, Valcke, & Sabbe, 2013).

The interview

The chosen form of interview was semi-structured focus group interview. There are numerous advantages to interviewing in groups in terms of saving both time and the financial costs of travelling to research sites, as well as potential benefits associated with the 'participants-to-participants' dynamic:

> "In focus groups in particular, participants often probe each other's reasons for holding certain views in ways that one might be reluctant to do as an interviewer, which can help the researcher to develop a fuller understanding of *why* people feel or behave the way they do" (Hobson & Townsend, 2010, p. 234).

One of the benefits of a partly structured interview is providing opportunities for the interviewees to talk about what is important to them, while also helping the researcher to cover an agenda, achieving both breadth and depth in the data (Hobson & Townsend, 2010). An interview guide (Appendix VIII) was used to ensure certain key topics, rooted in the research aim, were included in the conversations. The mentioned key topics were motivation and learning in PE. Following the concept of "sensitizing" (Rennstam & Wästerfors, 2015, p. 34) the researcher was open to new topics, basing the interview more on discovering rather than merely asking questions (Charmaz, 2006). The whole class was asked to voluntarily participate in the interview by their own PE teacher, and the teachers were instructed to choose from among those who gave their consent five students to represent major diversity based on gender, grades and involvement in PE. The interviews were conducted by the researchers, but in familiar surroundings at the students' own school within normal school hours. The data were later transcribed to a written document and imported to NVivo 12 for further analysis.

The intervention.

When conducting the main intervention, all the participating classes were divided into belonging to either an intervention group or a control group. There were two different types of control group to best reflect the conventional methods of conducting PE in Norway. Students belonging to control group A were given a short summary of the theoretical concepts presented in the video lasting about five minutes, while students belonging to control group B were given no such oral explication of the class topic. Both types of control groups carried out the same practical classes as the intervention group, but the students had no access to the videos prescribed as homework for the students belonging to the intervention group. This ensured that the sole difference between the intervention and control groups was that the students belonging to the intervention group was given access to the videos for preparation before class. Here arises a methodological question as to whether the control group really functioned as a control as they received the same practical classes, and the sole difference was that the intervention classes had access to the preparation videos. As mentioned in the theoretical section, a FL framework also includes the activities in school, not merely the preparation content. This is further discussed in the 'limitations' section.

The intervention took place in the spring of 2016 and lasted over a period of three weeks. The three learning resources regarding endurance, strength and coordination were applied to the PE classes. Each resource consisted of a video (see Figures 2.3. -2.5.) that was assigned for viewing as homework before class, one in-class lesson plan (Appendix IX) that the PE teachers performed, and a teacher's guide (Appendix X).

Figure 2.3. QR code to video assigned for homework on the topic 'endurance'.

Figure 2.4. QR code to video assigned for homework on the topic ‘strength’.

Figure 2.5. QR code to video assigned for homework on the topic ‘coordination’.

The videos were about 12 minutes long, which was well within the suggested length for such videos (Lagerstrom, Johanes, & Ponsukcharoen, 2015; Long, Logan, & Waugh, 2016), and were published on a digital learning platform. Each video gave a thorough but easily understandable introduction to the in-class content topic. E.g., when endurance was the weekly topic, the video explained endurance in an age-appropriate way by discussing why endurance improves health, what happens in the body when endurance is gained, and how to increase endurance. At the end of the video, a summary of the upcoming class content was given. Short quizzes embedded in the videos were used to enhance the students’ motivation to continue watching and to develop a deeper understanding of the content, as suggested by Geri, Winer, and Zaks (2017), Long et al. (2016) and Frydenberg (2012).

The in-class lesson was strongly linked to the video content and consisted of play-based activities focusing on one of the three topics in the intervention. As the content of PE has traditionally been focused on ball games and fitness training, something affirmed by Moen et al. (2018), the activities were based in a play-like manner to best fit all the participating students. Both the intervention and the control group performed the same activities. Further, the activities were grounded in a student-centred approach with an emphasis on cooperative learning, as this approach is shown to produce high levels of student engagement and

empowerment so that students become central to the learning process, thus facilitating learning in all three of the psychomotor, cognitive and affective learning domains (Wallhead & Dyson, 2017). As parts of the instructions of the activities were given in the videos, the teacher could take a role as more of a guide and co-learner than the role of an instructor.

All video and class content was based on relevant aims in the Norwegian national curriculum for secondary school physical education (Norwegian Directorate for Education and Training, 2015). The intervention was grounded on constructivist approaches, emphasising that learning is an active process in which the individual seeks out information in relation to the task at hand, as suggested by Kirk and Macdonald (1998). This approach is argued by Lave and Wenger (1991) to form a framework for each student's learning, where the social and cultural context have a significant influence on what is learned and how learning takes place.

All the practical classes were conducted by the students' PE teachers. To ensure that the classes were conducted in a similar fashion across class levels, schools and intervention or control group, all the teachers had a thorough introduction to the activities through the teacher guide, the in-class plan and the intervention and its aims. All the teachers were also able to contact the researcher at any time to clarify uncertainties. All the teachers but one conducted classes with students belonging to both intervention and control group to lower the possibilities of bias. One teacher only conducted classes among students belonging to the intervention group due to the low number of PE classes at that school, and this teacher had only this one class.

Data generation.

Data generation 1. T1 (Papers I, II, III, V and VI).

In the beginning of the first week of the intervention the students were asked to fill out three questionnaires: the EVQ, SIMS and HRFK test. Students belonging to both the intervention and control groups completed all three questionnaires except those who had not given written consent to participate. The questionnaires were handed out by the PE teachers after instructions from the researcher. The students were asked to take their time and their anonymity was again ensured. After completing the questionnaires, the responses were mailed

in closed envelopes to the researcher. Before analysing the data, student names were coded, and the names removed.

Data generation 2. T2 (Papers I, II, III, V and VI).

Right after the third practical class the EVQ and SIMS were filled out for a second time. Students belonging to both the intervention and control groups completed all three questionnaires except students who had not given written consent to participate. The questionnaires were handed out by the PE teachers after instructions from the researcher. The students were asked to take their time and their anonymity was again assured. After completing the questionnaires, the responses were mailed in closed envelopes to the researcher. Before analysing the data, student names were coded, and the names removed.

Data generation 3. T3 (Paper III and IV).

About four weeks after the intervention end, the last questionnaire, the HRFK test, was conducted for a second time. Additionally, ten students participated in a semi-structured interview. The interview participants comprised ten students from 13 to 17 years of age: seven girls and three boys. They were students from two schools, purposely chosen from the six schools that participated in the intervention, forming two groups of five participants. Group A consisted of five girls ranging from 16 to 17 years of age belonging to an upper secondary school, level VG1. Among group A only girls responded positively to participation. Group B consisted of two girls and three boys ranging from 13 to 14 years of age belonging to a secondary school, year 8. The two interviews lasted 23 and 16 minutes. By selecting participants from both the youngest and oldest parts of the cohort a diversity of perceptions could be generated following the principles of maximum variation among the participants (Creswell & Poth, 2018).

Data analysis

This section provides an overview and a description of the analysis used in the different papers.

Paper I.

Reflecting on the study aim, the first paper investigated the first research question: "How does FL affect the student motivation for PE?", focusing on students' expectancy-beliefs and subjective task values regarding participation in PE. EVT theorises motivation to be influenced by two factors: EB and STV, whereas STV consists of the four constructs AV, IV, UV and cost. Part one of the EVQ measures EB and STV minus the fourth construct, cost, and this compromised the research data in Paper I in the present thesis. Initially, the dataset was cleaned and screened for missing data, out-of-range values, outliers and sample distribution normality. Since data were assumed to be missing completely at random by Little's MCAR test, analysis was continued. Formal normality tests then showed values of skewness and kurtosis within the normal range for all constructs, therefore, the data were regarded fit for testing and comparing means. A paired samples *t* test, with list-wise exclusion, was used to identify any significant change in mean score from T1 to T2 for both the intervention and control groups and between genders in the intervention group. A *t* test was used to identify any significant differences between the intervention and control groups at either T1 or at T2 for any dimension of the EVQ. Pearson's correlation coefficient was computed to assess the relationship between EB, STV and age.

Paper II.

Reflecting on the study aim, the second paper investigated the first research question; "How does FL affect the student motivation for PE?", focusing on the perceived motivational cost among students to participate in PE. The data collected and analysed in Paper II were based on the four open-ended questions added to the EVQ to measure students' perceived cost of attending PE. Students' responses to the open-ended questions were analysed using an open-coding approach to analyse a whole sentence or paragraph, which was especially useful when the researcher already had several categories and wanted to code specifically in relation to

those categories (Strauss & Corbin, 1998). Analyses of the coded, open-ended questions were conducted with Friedman's test, as non-parametric distributions across the two test attempts were examined. A Pearson correlation coefficient was computed to assess the relationship between perceived costs and age, and a chi-square test was used to determine whether there was an association between the questions.

Paper III.

Reflecting on the study aim, the third paper investigated both research questions in the present thesis; "How does FL affect the student motivation for PE?", and "How does FL affect the student learning in PE?". The purpose of Paper III was to examine if and how the introduction of a flipped learning framework in PE could affect student situational motivation and health-related fitness knowledge (HRFK). The responses to the items on the SIMS were entered in SPSS and reduced by the constructs IM, IR, EM and AM. Before conducting the hypothesis testing, the data were cleaned and screened for out-of-range values, outliers, and sample distribution normality. The formal normality tests showed values of skewness and kurtosis within the normal range. Considering this, the data were regarded as fit for conducting tests for comparing means. The one-way repeated measures ANOVA test, with an alpha level of .05, was used to determine whether male and female student motivation and knowledge had changed over time, and to what extent the introduction of FL would impact student motivation and HRFK. The HRFK test was scored as suggested for multiple choice tests, where more than one answer may be correct involving that "every choice option becomes a true/false item" (Lesage et al., 2013, p. 192). Three constructs were computed from the twenty questions: endurance, strength and coordination. The three constructs combined would represent the students' HRFK. The Pearson correlational coefficients were computed to discover possible correlations between any types of motivation and HRFK.

Paper IV.

Reflecting on the study aim, the fourth paper investigated both research questions in the present thesis: "How does FL affect the student motivation for PE?", and "How does FL affect the student learning in PE?". The purpose of Paper IV was to examine adolescents'

perceptions of a flipped learning (FL) framework, applied to enhance student motivation and learning, in PE. Constructivist grounded theory (GT: Charmaz, 2014) and stepwise-deductive induction (SDI: Tjora, 2018) framed the analysis. SDI is argued to produce a more linear and inductive approach to analysing data from interviews compared to a more traditional GT-approach (Tjora, 2018). The researcher's analysis starts already the moment he or she meets the informant (Kvale & Brinkmann, 2009), so the researcher was open to other topics occurring, and one specific topic did occur: the view and value of PE. Coding is the core process in classic grounded theory methodology, and through the coding done in Paper IV and a constant comparison of incidents (indicators) in the data, a 'theoretical saturation' was achieved. "This constant comparing of incidents continues until the process yields the interchangeability of indicators, meaning that no new properties or dimensions emerging from continued coding and comparison" (Holton, 2007, p. 265). Initial codes were counted as 113, then reduced to ten focus codes, and further to six empirical themes. In an attempt not to be concerned about missing something while analysing and delimiting data collection and coding to get to the core concepts and those related to the core, the authors found support in the words of Holton (2007), who reminds researchers that "it is important to remember that grounded theory is about concepts that emerge from the data, not the data per se" (p. 266).

Paper V.

The main aim of Paper V was to evaluate the EVQ by answering two important questions: (1) the underlying dimensionality of the data, and (2) the adequacy of individual items. The implicit assumption underlying the use of explorative factor analysis (EFA) in the present paper is insecurity with respect to the dimensionality of the EVQ, which has not previously been tested in Norway among adolescents. Therefore, this paper intended to gain insight into a potential factor structure of the EVQ and provide a broad perspective on the observed data using EFA, followed by the confirmation procedure by means of confirmatory factor analysis (CFA). The data were analysed by descriptive statistics and EFA using IBM SPSS version 24, and CFA by means of Stata 14.1 (StataCorp, 2015).

A substantial body of research has indicated that Cronbach's alpha cannot be generally relied on as an estimator of reliability (Raykov, 2001). Thus, inter-item consistency was assessed by

Cronbach's alpha (α), as well as the composite reliability (ρc) coefficients (Hair, Black, Babin, & Anderson, 2010). Paper V assessed model fit adequacy by χ2-statistics and various fit indices. In line with the ´rules of thumb´ given as conventional cut-off criteria (Mehmetoglu & Jakobsen, 2017), the following fit indices were used: the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMS), with values below .05 indicating good fit, and values smaller than .10 interpreted as acceptable (Mehmetoglu & Jakobsen, 2017). Further, the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), with acceptable fit set at .90 (Mehmetoglu & Jakobsen, 2017), were used. The frequency distribution of the measurements was examined to assess deviation from normality: both skewness and kurtosis were significant, thus the Robust Maximum Likelihood (RML) estimate procedure was applied.

Paper VI.

The main aim of Paper VI was to gain insight into a potential factor structure of the SIMS and provide a broad perspective on the observed data, again using EFA followed by the confirmation procedure by means of CFA. As in Paper V, the data were analysed by descriptive statistics and EFA, using IBM SPSS version 24 and CFA by means of Stata 14.1 (StataCorp, 2015). The implicit assumption underlying the use of EFA in Paper VI was insecurity with respect to the dimensionality of the SIMS, which has not previously been tested in Norway, nor among adolescents.

The present paper assessed model fit adequacy by χ2-statistics and various fit indices. In line with the "rules of thumb" given as conventional cut-off criteria (Mehmetoglu & Jakobsen, 2017), the following fit indices were used: the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMS), with values below .05 indicating good fit, and values smaller than 0.10 interpreted as acceptable (Mehmetoglu & Jakobsen, 2017). Further, the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), with acceptable fit set at .90 (Mehmetoglu & Jakobsen, 2017), were used. The frequency distribution of the measurements was examined to assess deviation from normality: both skewness and kurtosis were significant, thus the Robust Maximum Likelihood (RML) estimate procedure was applied.

Ethics

From several violations of the treatment of participants in research such as the treatment of individuals in Nazi Germany and the inappropriate Tuskegee syphilis studies (Mark & Gamble, 2009), a need for federal ethical guidelines in research arose. This resulted in reports like the Belmont Report (Department of Health Education and Welfare, 1978), which included three basic principles: "beneficence of treatment of participants (maximising good outcome and minimising risk), respect for participants (protecting autonomy and ensuring well-informed, voluntary participation), and justice (a fair distribution of risk and benefits)" (Creswell, 2014, p. 36). When analysing inquiry data, the researcher is responsible to a lot of people: the participants, funders, commissioners, supervisors, examiners, and so on, and this applies whether there is primary or secondary data, or both, being analysed (Kara, 2015). The ubiquity of digital tools has in present times constrained personal privacy, resulting in new law on, among other things, protecting personal data: 'The General Data Protection Regulation (GDPR)'[6]. This strong focus on the protection of personal data has also resulted in a stronger focus on research ethics in general (Krumsvik, 2019).

Tangen (2014) foregrounded three main domains regarding research ethics: (A) ethics within the research community; (B) ethics concerning relationships with individuals and groups directly affected by the research, and (C) ethics related to the external value and role of educational research for various user groups and for the quality of education. These domains are rooted in the 'general guidelines for research ethics' published by The Norwegian National Research Ethics Committees (2014). These domains are operationalised by Tangen (2014, p. 682) into a "general ethics matrix" used in the present thesis as a framework for identifying, reflecting on, analysing, and discussing ethical issues and balancing ethical dilemmas. This matrix includes all stages in the research process, from planning to reporting with key questions, belonging to domain C, like "consider how the research may be relevant for users. Listen to users' voices?". Responding to this question, in the present thesis teachers and students were consulted in both the testing of learning resources applied in the intervention, and on questionnaires and procedures. Further, belonging to domain A, in quantitative analysis one can run all tests possible in SPSS, and by a 5% level of probability, five from 100 analyses will turn out statistically significant just by chance. This kind of

[6] https://eur-lex.europa.eu/eli/reg/2016/679/oj

'fishing' is highly unethical, as the key is to know which statistical test or tests are appropriate to apply for each research setting (Davis, 2013). An elaboration on which statistical tests were used in the present thesis is to be found in Papers I, II and III. Belonging to domain B, interview research is permeated with ethical issues, as the pursuit of interesting knowledge must be mediated by respect for the integrity of the interview subject:

> "The knowledge produced by such research depends on the social relationship of interviewer and interviewee, which rests on the interviewer's ability to create a stage where the subject is free and safe to talk of private events recorded for later public use." (Kvale & Brinkmann, 2009, p. 16)

The interviewer might find himself or herself offending the subject, in transgressing a line that only friends or intimates can cross. The key lies in "calibrating social distance without making the subject feel like an insect under the microscope" (Sennett, 2004, p. 38). Paper IV demonstrates how the data generated by interviews upholds a strong ethical standard by, e.g., conducting the interviews in familiar settings at the students' school and within school hours.

Prior to the pilot study, the Regional Committees for Medical and Health Research Ethics (REC) gave their assent after being informed of the intervention (Appendix XI). Further, between the pilot study and the main study, both REC and Norwegian Centre for Research Data (NSD) were informed and gave their assent (Appendix XII). In cooperation with NSD, the information and consent forms (Appendix XIII) to the schools, teachers, and pupils (and parents) were revised and approved according to proposed ethical guidelines (Project #47604). These guidelines include that the written information should be given in an age-appropriate way, emphasising the students' choice to withdraw their consent at any time, the duration of the storage of data, and assurance of anonymity. The names of the research participants, as well as the names of organisations and locations such as towns and schools were made anonymous to preserve participant confidentiality, study- and personal integrity, and trustworthiness in accordance with the guidelines for research ethics proposed by The National Committee for Research Ethics in the Social Sciences and the Humanities [NESH] (2016).

Trustworthiness of the present thesis

The present thesis includes both qualitative and quantitative data to answer the research questions. Hence, a description of the trustworthiness of the present thesis must include an elaboration, and comparison, of both qualitative and quantitative traditions regarding validity and reliability. The trustworthiness of the present thesis is a product of the interpreted and presented validity, reliability and transparency in Papers I - VI.

"Doing quantitative research bring many challenges, and employing appropriate statistical techniques is one of them" (Hartas, 2010d). The key concept of statistical analysis in quantitative research is comparing different sizes that can be expressed by numbers (Medbø, 2018), and the trustworthiness of the results are henceforward expressed through statistical tests and interpretations with a set probability level or significance (Hartas, 2010d). How trustworthiness is understood in quantitative research differs from the understandings in qualitative research traditions.

There has been an evolution from writers searching for, and finding, qualitative equivalents that parallel traditional quantitative approaches to validation and terms (LeCompte & Goetz, 1982), to perspectives seen through postmodern and interpretive lenses, syntheses of different perspectives, descriptions based on metaphorical images, or some combinations of these perspectives on validity (Creswell & Poth, 2018). We can go almost a decade back in time and find scholars like Gordon Allport (see Allport, 1942) "voicing a passionate, critical-minded, and courageous claim of the highest scientific legitimacy for qualitative research" (Wertz et al., 2011, p. 43). Allport advocated the using of many different perspectives in research on personal experience and argued that multiple different knowledge claims may achieve greater truth (Wertz et al., 2011). A term like *triangulation of methods*, which is rooted in the ideas of Allport, is widely used and recognised among scholars to gain a holistic understanding of social complexity (e.g., Lincoln & Guba, 1985; Wyness, 2010), and also in educational research and inquiry (Hartas, 2010c) in terms of re-conceptualizing validation with a postmodern sensibility (Lather, 1991). The triangulation of methods and the generation of data from multiple sources in the present thesis generally strengthens the trustworthiness of the findings, as reliability, and internal and external validity are assured (Cho & Trent, 2006; Denzin & Lincoln, 2013; Maxwell, 2013; Merriam & Tisdell, 2016).

Literature describing validity and reliability in research has been operating with a range of different terms, so the next section will be a clarification of the terms chosen in the present thesis to describe the trustworthiness of the findings.

Internal validity.

Internal validity relates mainly to the issue of causality (Bryman, 2008). Credibility and authenticity (Lincoln & Guba, 1985) are other terms linked to questions related to whether a conclusion that incorporates a causal relationship between two or more variables is valid. To establish credibility, the triangulation of data, sources, methods and investigators is proposed (Lincoln & Guba, 1985). The response of the present thesis to this proposal was the following: (1) Triangulation of data, including data sourced from both quantitative and qualitative data-generation traditions, and hence analysed from both perspectives regarding methods; (2) In Papers III, IV, V and VI more than one investigator conducted the inquiry in a cooperative fashion, and the researchers were from different fields of research. This encouraged a form of reflection, in educational design research described as "organic reflection" (McKenney & Reeves, 2012, p. 152), drawing on ideas that are not just new, but foreign, to establish credibility. While organic reflection (for many people the kind of reflection that takes place under the shower) it not typically associated with professional research, this reflection can certainly serve the work of educational design research (McKenney & Reeves, 2012). (3) As the present thesis used the convergent design proposed by Creswell (2015), the researcher could advance multiple perspectives and by this one database validate the other one.

As the present thesis includes both qualitative and quantitative parts, there must also be an acknowledgment that there are many types of validation, and that each researcher or study must find and describe the type they find comfortable in using (Creswell & Poth, 2018). Papers I, II and III include the use of questionnaires to generate data and papers I and II use the Norwegian version of the EVQ. Paper V discloses the validity of this questionnaire to be good, as construct validity, both by convergent and discriminant validity, was confirmed to be good by way of significant correlations in the predicted directions. Paper III used SIMS, and the validity in this questionnaire was demonstrated in a similar fashion as in Paper V, and disclosed in Paper VI. The internal validity in Paper IV, the qualitative study, was constituted

by craftsmanship, as communication, and as pragmatic action, as suggested by Kvale and Brinkmann (2009). Through the transparency of the research reported in Paper IV, the quality of the researchers' craftsmanship can be assessed. A communicative validity was constituted through the two researchers' conflicting knowledge claims argued in a conversation. With an emphasis on instigating change, based on the researcher's observations and interpretations, the pragmatic validity and the trustworthiness of the study were strengthened.

To ensure internal validity in the HRFK test used in Paper III, T1 and T2 scores were assessed. For two tests to be truly parallel, the observed variance must be equivalent (D'Agostino, 2005). The observed values (SD) were assessed to be inside a tolerable variance when scored at T1 were compared to scores at T2.

External validity.

In quantitative tradition, external validity is a measure of generalisability, while in qualitative traditions external validity is named, among other terms, transferability (Lincoln & Guba, 1985) or fittingness (Beck, 1993). Both traditions seek to reflect on how a study is transferable to other contexts, but where "quantitative research methods have employed a statistical form of generalization that consider features of the sample in relation to features of the entire population, generalization must be thought of differently within a qualitative research framework" (Tjora, 2018, p. 147). Tjora (2018) emphasises the importance of not trading generalisation for transferability, as generalisation is well established as a quality indicator in qualitative research *per se*. Ercikan and Roth (2009) argue that in educational research one form of research is not superior to another and that it is not question of the presence or absence of generalisability, but rather a continuum instead of a dichotomy of generalisability, removing the polarisation of qualitative and quantitative research.

The present thesis represents the voices of 338 adolescents from three different regions in Norway. This is an extensive number, both in terms of the number of participants and regions, but still there are many voices that have not been heard. Nevertheless, according to Miles and Huberman (1994), allowing the readers to evaluate the potential transferability to and fittingness of the findings for their own settings requires thorough descriptions of the

characteristics of the original sample of persons, the surroundings and the outcomes. In the present thesis, this is accounted for in the method section in Papers I - IV.

The conclusions from the present thesis can be transferred or generalised to a wider population in Norway since all schools, teachers and pupils are bound by the same national curriculum in PE which describes what competences the pupils should possess when finishing lower and upper secondary school. The national curriculum also includes to some extent which methods should be used by teachers in PE. The generalisation can also extend beyond Norway, as the subject of PE is demonstrated to be similar among the Scandinavian countries (Redelius & Larsson, 2010). Nevertheless, in a school context, the researcher must also be aware of local culture and its role in constructing knowledge. In Paper IV, the participants were from two different schools, and the concept of "analytic bracketing" (Rennstam & Wästerfors, 2015, p. 53) was applied. Analytic bracketing is about accepting duality in social reality, and hence, trying to account for the influence local culture could have on the participants' responses through the researchers constantly shifting between analysing what the participants are talking about and how they talk about it.

This thesis is not limited to a statistical form of transferability that consider features of the sample in relation to features of the entire population. The present thesis is considering another kind of transferability that represents a quality of quantitative research named theoretical or conceptual generalization. This is where expanding and generalizing theories and not enumerate frequencies matters, and where the goal for research is to foster conceptual, typological, and theoretical development that will have relevance for cases other than the one(s) studied (Tjora, 2018). This thesis draws upon prior theories and research and presents findings in accordance with them and adds to these theories and prior research in a way that leads to new theorising and a theoretical understanding of the phenomenon FL in PE.

Reliability.

In quantitative research, reliability measures how consistently an instrument obtains similar results over repeated measurement periods (Beck, 1993). Within the qualitative tradition reliability is referred to, among other terms, as dependability, confirmability (Lincoln & Guba, 1985) or auditability (Guba & Lincoln, 1981). The reliability of the quantitative data in

the present thesis was thoroughly tested and found to be sound, as demonstrated by the conclusions in Papers V and VI. The qualitative data in the present thesis must be assessed according to how the reader can follow the decision or audit trail to determine the reliability. The decision trail encompasses all the decisions made by the author at every stage of the research process (Beck, 1993). The method section of Paper IV demonstrates a transparent research process which forms reliable results.

Transparency.

One important requirement for trustworthiness in research, or in the presentation of research, is transparency. How a study is carried out, what choices were made at what times, how persons were recruited, what problems occurred, what theories were applied, and how they contributed analytically, are some among several questions that must be put forward and discussed. “To make sure that the findings are transferable between the researcher and those being studied, thick description is necessary.” (Creswell & Poth, 2018, p. 256). While reliability and validity reflect how suitable choices in the research process are made, transparency deals with how comprehensively these choices are explained in the research reporting. “The purpose is that readers obtain such a good insight of the research that they can assess the quality of the research of their own” (Tjora, 2018, p. 154). The methods section in the present thesis combined with the method sections in Paper I - VI ensure a good insight into the conducted research so that the trustworthiness of the following findings can be assessed.

Chapter 3: Findings

The aims, findings and conclusions of Papers I - IV are presented here by a short summary and a 'side-by-side joint display' table. As Papers V and VI are validations of the measurement tools used in Papers I, II and III, a summary of these papers is not included in this section.

Paper I: Can flipped learning enhance adolescents' motivation in physical education? An intervention study.

Paper I claimed that identifying adolescents' motivational dynamics in relation to their participation in PE might be a vital resource for facilitating PE learning and preventing further decline in students' motivation. The main goal of the paper was to determine whether using FL as a learning framework impacted student motivation to participate in PE based on their expectancy-beliefs and subjective task values for the subject. To that end, two research questions emerged: Q1: Can flipped learning enhance adolescents' expectancy beliefs in physical education? Q2: Can flipped learning enhance adolescents' subjective task values in physical education?

The main conclusions of the paper were that FL has a significant impact on adolescents' expectancy beliefs and attainment values regarding participation in PE. All significant changes in the intervention group were explained by gender. In an expectancy-value perspective, FL positively influences the motivation of adolescents, especially that of girls, to participate in PE. Therefore, FL can be used to enhance adolescents' motivation to participate in PE.

Paper II: Adolescents' perceived cost of attending physical education: A flipped learning intervention

The purpose of Paper II was to examine how the costs perceived by adolescents in attending PE impacted their motivation to participate when FL was applied as the learning framework. From this, two research questions were investigated: Q1: Can flipped learning decrease the

costs that students perceive of participating in PE? Q2: Can flipped learning positively affect students' intentions to participate in PE?

The main conclusions of the paper were that FL positively impacted the adolescents' motivation to participate in PE, as their perceived costs of attending PE were significantly reduced, and their intention to participate was significantly increased. All the significant changes within the intervention group were explained by gender. The adolescents who reported perceived costs in attending PE were more likely to be unmotivated to attend. The perceived costs of attending PE increased with age, and the intention to participate in turn declined. Depending on adolescents' perceived costs of attending PE, FL has a positive impact on their motivation to participate, especially among girls. Thus, FL can be used to enhance adolescents' motivation to participate in PE in secondary and upper secondary schools.

Paper III: Increasing knowledge and intrinsic motivation in physical education through flipped learning

The purpose of Paper III was to examine if and how the introduction of a flipped learning framework in PE could affect student situational motivation and HRFK. The study demonstrated that girls benefit from a change in PE, where more play-like activities dominate, but that the IM of boys is susceptible to negative development when experiencing the same change. However, when a FL framework was applied, the fall in IM among the boys was significantly reduced compared to the control group, emphasising the importance of providing context and meaning to activity changes in PE, in an autonomy supportive way. Among both girls and boys, the application of a FL framework caused more cognitive knowledge learning, resulting in higher levels of HRFK when compared to the control group.

Paper IV: The perception of adolescents' encounter with a flipped learning intervention in Norwegian physical education

The purpose of Paper IV was to examine adolescents' perceptions of a FL learning framework, applied to enhance student motivation and learning in PE. It was demonstrated that the video format was preferred as preparation material over text material; that instructions

on class activities were preferably given in the preparation material and not in class, and that students did not report any negative aspects of FL. The students showed a positive perception of preparing for PE classes if the preparation material was in the form of a video and if it had a clear connection to the upcoming class content and outcome aim(s). FL had a positive impact on student understanding and learning in PE, and FL produced a positive change in how students valued PE. A clearly positive perception of FL in PE was demonstrated. FL seemed to promote deep learning in PE facilitated by motivation, knowledge, and the nature of the learning framework.

Short synthesis of the findings

Here follows a short synthesis of the main findings in Papers I, II, III and IV presented in a 'side-by-side joint display' table, as suggested by Creswell (2015) in convergent design studies.

Table 3.1. 'Side-by-side joint display' table of the results in the present thesis.

Quantitative results	Qualitative results	Differences and similarities
Paper I: Significant impact on expectancy beliefs and attainment values in PE among girls Paper II: Perceived costs of attending PE significantly reduced, and intention to participate in PE significantly increased, among girls. Paper III: Stable intrinsic motivation in PE, and better cognitive knowledge learning outcome, resulting in higher health related fitness knowledge (HRFK) among both girls and boys.	Paper IV: FL has a positive effect on student understanding and learning in PE, and FL produces a positive change in how students value PE. A clearly positive perception of FL in PE was demonstrated. FL seems to promote deep learning in PE facilitated by motivation, knowledge, and the nature of the learning framework.	Similarities: FL has a positive effect on student cognitive knowledge learning in PE, and motivation to participate. Paper I and IV demonstrated a positive change in how students value PE Differences: Papers III and IV demonstrate positive effect on student motivation among both girls and boys, contrary to Papers I and II.

From this table the convergence or divergence of the statistical results from Papers I, II, and III and empirical themes from Paper IV can be understood, and this forms the basis for the following discussion.

Chapter 4: Discussion

This section elaborates on the findings in Papers I-IV, considering the presented theory, through organic and structured reflection. In educational design research, reflection involves active and thoughtful consideration of what has come together in both research and development, with the aim of producing new understanding (McKenney & Reeves, 2012).

The aim of this thesis was to obtain insight into how students experienced the intervention of the learning framework FL in PE. Hence, the main research question was:

1. How do PE students in secondary and upper secondary school experience an intervention where the learning framework is FL?

The main aim was further refined into two sub research questions:

1.1 How does FL impact the student motivation for PE?

1.2 How does FL impact the student (deep)learning in PE?

The following discussion will consider some of the important questions that were raised by the suggestion that flipped learning has a positive influence on student motivation and learning in physical education. The similarities and differences displayed in Table 3.1. point out where the findings in Papers I - IV converged or diverged, and this is considered during the discussion. Reflecting the two research questions in the present thesis, this section is divided in two sub-chapters, each named with a statement of desired direction for the subject of PE. Finally, this chapter is followed by some concluding remarks, limitations, and a call for further research.

Decrease the decline in motivation for PE

The present thesis demonstrated that motivation for participating in PE changed in a positive direction when a FL framework was applied. This assumption is based on the findings of a positive development of four different statistically analysed motivational constructs and qualitatively analysed interview responses, as displayed in Table 3.1. Expectancy-beliefs (EB), which Zhu et al. (2012) refer to as one's broad beliefs about one's competence in a

given domain, was shown in Paper I to increase among girls. Attainment value (AV), which Eccles and Wigfield (2002) refer to as a person's perceived importance of doing well on a task, was in shown Paper I to increase among girls. Motivational cost, which Wigfield (1994) refers to as the negative aspects of engaging in a task, such as the fear of failure or lost opportunities due to choosing one task over another, was demonstrated in Paper II to change in a positive direction among girls. Intrinsic motivation (IM), which Deci and Ryan (1985) suggest exists when individuals participate because of an inherent enjoyment or interest in the activity, was shown in Paper III not to decrease among the boys as happened among the boys in the control group. Paper IV demonstrated a positive perception of FL in PE by students, both boys and girls, who reported a positive attitude towards preparing prior to class, a rise in motivation due to an increased valuation of PE, and a perceived positive effect on understanding and learning in PE.

When combined, this represents substantial empiric evidence for the assumptions made in the present thesis regarding FL and motivation. There now follows a discussion on the positive impact FL seems to have on student motivation to participate in PE considering gender, contextualisation and autonomy.

Motivation and gender

As the 'Side-by-side joint display' (Table 3.1.) displayed divergent results regarding gender, one must try to understand the results both divided and merged. There might be characteristics in the two different motivational theories used in the present thesis that cause the measurement instrument based on one theory to observe a gender difference and the other not. The EVQ, and the open-ended questions on cost, based on the EVT, revealed girls to experience a rise in motivation, while this rise was not found among boys. The SIMS based on the SDT found the boys to benefit from FL more than the girls regarding motivation. When interviewed, both genders expressed a positive attitude and a positive change in motivation towards FL in PE.

If there are gender differences, then the following discussion might shed some light on the causes. One reason why FL in PE seems to benefit girls more than boys regarding motivation can be found in the fact that PE traditionally is more beneficial for boys than for girls. This is

shown to apply in many countries (e.g., Kirk, 2010), including Norway (e.g., Säfvenbom et al., 2014). Hence, boys may not welcome a change to the subject as much as girls might do. On the other hand, a change should be welcomed by both students, PE teachers, school leaders and policy makers, as girls are shown to have a lower motivation for PE, and their performance in PE (measured by their final grade in compulsory school) is lower compared to that of boys. If girls perform less well, they might be inclined to take more advantage of the offered resources to reduce the observed and experienced gap. This assumption is supported by Chiang et al. (2018), who found female college students in Taiwan took more advantage of the FL approach compared to male students, who preferred a traditional approach when applying a FL framework in PE basketball. Further, if PE traditionally benefits boys, the expectancy for success would naturally be lower among girls compared to boys. This was demonstrated in studies by Zhu et al. (2012) and Gao (2009), who demonstrated that girls have a lover EB than boys in primary and middle school. Further, the present thesis reveals the same pattern to continue in lower and upper secondary school. The way FL was applied in the present thesis encouraged more cooperation and facilitated more interactions between both teacher and students, and among students. Havik and Westergård (2019) have suggested that emotional support from the teacher and perceived high-quality classroom interactions have a strong association with student engagement. A low engagement in PE among girls, alongside a low EB and experienced cost in PE, may be the reason why girls perform less than their male peers, as their final grade in compulsory school is lower than that of the boys. Hence, if PE changes to focus more on interactions and teacher support, as it does in a FL approach, girls would naturally benefit more from that change than boys. Considering these arguments, the reasons why a gender difference was detected using a questionnaire grounded in EVT but not in the questionnaire grounded in SDT needs attention. Assessing students needs support, satisfaction, motivation, positive and negative affect, task challenge, and concentration, Standage et al. (2005) presented results of invariance analysis, revealing that the model fit was largely invariant across gender. From this, one can make assumptions that measurement instruments based on SDT might not apply equally well among genders, although there is still not full agreement on this assumption, as some studies find, and others do not find, consistency of basic SDT constructs across gender in the exercise context (Guérin et al., 2012). On the other hand, inquiry based in EVT has also received critique on relying on quantitative measures (Lykkegaard & Ulriksen, 2016), including also this work, so it might be

appropriate to ask if this gender difference would have been found if a qualitative approach had been chosen in Papers I and II.

The EBs among both girls and boys are shown in the present thesis not to correlate negatively with age as the general motivation for PE does, and these findings are supported by Zhu et al. (2012) and Gao (2009). This can be a sign that how PE is conducted does not vary much from middle- to secondary school. Nevertheless, in Norwegian PE Moen et al. (2018) demonstrated a greater gap between genders in Year 10 than in Year 5 regarding how much the students reported liking PE, where only 4 out of 10 girls reported liking PE "very much", whereas 6 out of 10 boys reported the same by Year 10. In Year 5, 7 out of 10 girls and 8 out of ten boys reported liking PE "very much". This demonstrates that there might be some differences in how PE is conducted among the youngest and oldest students in elementary school, but it is likely that a change in how PE is conducted is needed in compulsory and upper secondary school as a whole. This passage in education is called the "Year 1 till 13 school career"[7] in the new Norwegian PE curriculum, where the idea is to see all these years in combination to enhance the quality of each student's learning outcome (NOU 2015:8, 2015). How PE is conducted should be recognisable and understandable for all students at all ages in school, and hence, how PE is conducted should appear coherent from Year 1 to Year 13.

A full stop in the decline in motivation for PE as the students move from primary to secondary- and upper secondary school might be a utopian idea, but there should definitely not be a gender difference where girls draw the shorter straw. As suggested by Hobson and Townsend (2010), qualitative interviews can be a good source for understanding 'why', and the observed rise in motivation was connected in Paper IV to the preparation part of the intervention. Being able to understand both how and why they did the activities, in addition to feeling prepared, seemed important, and resulted in a rise in motivation for participation in PE. As there are divergent results in the present thesis regarding how FL affects motivation for PE among girls and boys, it might be appropriate to call for more research on the matter.

The present thesis conclusively demonstrates that both boys and girls benefit from FL in PE, but the benefits might differ among genders. Girls find FL to redefine PE not as a boys'

[7] Year 1 is first year of primary school, the year the student fill 6 years of age. Year 13 is the last year of upper secondary school, normally the year the student fill 19 years of age.

subject as their expectancy-beliefs, attainment value, and perceived cost of attending are observed to change in a positive direction. Boys find FL helps them to contextualise the activities, resulting in stabilising their intrinsic motivation for PE.

Motivation through contextualisation

Paper II revealed that the girls experienced less cost of participating in PE when FL was applied, resulting in a change in the motivation to participate. Among boys there was no change in perceived cost. This change in motivation, as a result of less perceived cost, was explained by the girls as appreciation of having the activities put into context. The findings in Paper III revealed that the boys maintained their intrinsic motivation when play-like activities were applied through the FL intervention only if the activities were put in context. In general, a more enjoyable PE will lead to more engagement (Prochaska et al., 2003) and in turn affect motivation to participate, supporting that play-like activities did affect student motivation.

Further, Paper IV revealed that the students felt the importance of understanding why they did the activities; they needed a context. A similar finding comes from Bennie et al. (2016) among Australian PE teachers implementing different strategies to enhance student motivation, PA and learning. The teachers reported "the 'explaining relevance' strategy to be the most effective and acceptable strategy for increasing student enjoyment, motivation, PA, and learning during PE lessons" (p. 9) followed by the strategy of 'giving choice'.

The approach of *how* to contextualise the activities in PE deserves attention. For the student to understand the context they need to be informed of that context, and the implementation of a digital tool like online videos seemed to be a positive contribution to this matter. In the present intervention the preparation video on the topic 'endurance' consisted of the researcher explaining why endurance improves health, what happens in the body when endurance is gained and how to increase endurance. This contextualisation was supported and strengthened by the students' peers and by the teachers constructing a scaffold for each student´s learning. As peer students engaged in the activities, with the knowledge and understanding acquired in the preparation phase, they formed a scaffold for each other and learned from one another by engaging in discussions on the activities they undertook. This was supported by the teacher in a transformed role from instructor to mentor or guide. This contextualisation seemed to help

students to be assisted through the ZPD, described by Sun and Chen (2010) as "an individual's ZPD is satisfied through internalizing knowledge acquired through communicating with the others" (Sun & Chen, 2010, pp. 370-371). Nevertheless, how PE education is delivered where one wants to incorporate both cognitive and physical features in the learning process as a too vigorous context might shift student motivation away from cognitive learning toward physical participation (S. Chen et al., 2013).

To understand why girls and boys seem to differ in their needs of contextualisation when there is a change in the practical content, one must also take account of the constructivist view. The constructivist approach underpinning the intervention in the present thesis emphasises, with support from Kirk and Macdonald (1998), that learning is an active process in which the individual seeks out information in relation to the task at hand. It seems that girls welcomed the change more than boys; thus, the importance of seeking out information related to the activities in class seemed more important to the boys than for the girls when motivation was related to the activities per se. When the information concerned practical information like the type of activity and the intensity of the activity, Paper IV revealed that this type of contextualisation was important for both boys and girls. This might further be connected to the importance of contextualisation in reducing the girls' perceived cost of participating in PE, as they reported 'physical discomfort' before and after the intervention differently when compared to the control group.

In sum, it seems to be important for student motivation in PE to include both physical activity and cognitive learning to provide a context, and FL seems to facilitate and promote this.

Motivation through autonomy

The results from Paper III demonstrated that student intrinsic motivation was affected positively when compared to the control group. Intrinsic motivation contributes to what is called autonomous motivation (see Figure 1.3.). As students are informed on class content and are then able to contextualise the activities with cognitive knowledge, they seem to enhance their autonomy regarding their learning process. Paper IV also revealed that students appreciated FL as a mean of acquiring more control over their learning situations in PE as they could choose to engage in the preflection materials: the online videos assigned as

homework, and in this way control the pace of their learning process. Through this we can see that the videos function as part of the scaffold, what Yelland and Masters (2007) call technical scaffolding, supporting student learning in PE. As students become more self-driven and take more control of their learning, supported by a scaffold that consists of the teacher, peer students, and technology prompts, their autonomous motivation rises, and their learning outcome improves. This finding is supported by Ntoumanis and Standage (2009), who concluded that if the PE teacher provided a meaningful rationale, expressing the importance of partaking in that activity (e.g., health benefits), inherent interest in PE was supported. The assumption of the students included in the present project becoming more self-driven is further supported by Bing (2017), who found an obvious increase in students' self-study ability after applying FL in university PE, and by Ryan and Deci (2017), who linked a rise in autonomous motivation to a rise in engagement.

The teacher, working in the role of supporter and guide in the students' learning process, provides more possibilities for individualisation and tailor-made support. This assumption is further supported by Lekanger and Olsen (2019), who state that the use of digital technology in school makes it easier for the teacher to see each student's possibilities and needs, and support adapting the education to each individual. They further suggest that technology can be a positive enhancer for learning focus in class and a facilitator for each student's learning, and this is important when considering adapted education[8]. The conflict between autonomy development and the controlling nature of schooling serves as an example reminding us of the need to re-examine the way we conduct PE.

Although the intervention in the present thesis did not focus on giving students more choice, the nature of a FL learning environment produces more opportunities to give the students choices. Bennie et al. (2016) and Lonsdale et al. (2009) found that giving students opportunities to make choices in PE was a successful strategy to enhance student motivation, PA levels and student learning. In a FL context, the preparation material can contain an introduction to a variety of activities, or a set of videos, from which the students can select. In this way, students can choose to engage in different activities in class, and the teacher is not

[8] The principle of 'adapted education' is central to the Norwegian school. Section 1-3 of the Education Act states that the education must be adapted to the pupils' abilities and prerequisites. This is no individual right but must be done through variation and adaptation to the diversity of the student group within the community.

bound to instruct a whole class that subsequently often does the same activity. This, on the other hand, requires a change in how PE is conducted today, as the subject and its content is 'activity driven' (Dyson, 2014; Ennis, 2011), and not 'objective driven', with minimal room for individualisation. PE teachers must support students in deciding on their individual objectives, based in the curriculum aims, and realise that there might be a variety of ways to achieve these objectives. The results discussed in this section should give positive support to those wanting and working to make changes in our school system regarding motivation, as scholars like Collins and Halverson (2018) have stated that "the current school system does not help students develop intrinsic motivation to learn" (p. 131).

In sum, FL seems to enhance students' sense of autonomy in PE, resulting in a positive impact on their autonomous motivation for both preparing for and participating in PE.

Connecting motivation and learning through value

There is broad agreement that motivation is strongly connected to learning in schooling in general (Reeve, 2012; Reeve et al., 2004; Sun & Chen, 2010). Nevertheless, this connection is not found to apply that strongly in PE. A study by Shen et al. (2007) found no association between situational interest and skill and knowledge gains among middle school PE students. The results from a study of Haslem et al. (2016) reflected this by concluding that no relation was found between high school students HRFK and their self-determined motivation, PA behaviours, or perceived competence. Nevertheless, the present thesis found student motivation, in the form of expectancy-beliefs and values to be positively impacted by FL. Savolainen (2018) made the assumption that even a highly valued goal may not generate much behaviour if the expectancy of successfully reaching the goal is very small. This further suggests that students will be motivated to engage in a behaviour if they value the outcome and expect that their effort to achieve the outcome has a reasonable chance of success. As students seem to both value PE more and expect more success in PE when FL is implemented, we can look for a connection between motivation and learning in PE.

Value is demonstrated to predict fitness knowledge. S. Chen et al. (2013) found students' attainment value for PE predicted their fitness knowledge learning. This connection between motivation and (cognitive) learning was positive when the levels of PA were moderate and

constant. These findings support the assumptions made in the present thesis, suggesting that both motivation and learning is enhanced by FL in PE, but the specific connection between HRFK and value was not tested. One can only observe that both HRFK and AV were positively affected by FL, and that is an important finding as it is vital to find ways of conducting PE so that physical activities, physical and motoric learning, and cognitive learning can be promoted among all students, regardless of abilities and gender.

Stating PE as a subject of (deep) learning

Students' cognitive knowledge learning in PE was demonstrated to benefit from applying a learning framework like FL. Offering students the opportunity to see online videos, which included quizzes, was demonstrated to be a beneficial use of a digital tool to enhance this learning.

Cognitive knowledge learning

The present thesis measured HRFK among students, and both boys and girls enhanced their HRFK when compared to a control group. As the same test was done both before and after the intervention period, the control group also scored better the second time, but the intervention group had a significantly better development. As the online videos included the researcher explaining HRFK topics (connected to the upcoming PE-class), it would be natural to assume this was the main source of this difference between the intervention and control group. The videos functioned as stimuli for preflection, and the students achieved a higher learning outcome as a function of preparing prior to class. This is supported by Jones and Bjelland (2004), when they stated that preflection "adds an important component to developing core competencies and has the potential to further aid students in being able to reflect using higher order thinking responses and to generate knowledge" (p. 963-964). Through a constructivist lens this preflection is important, as learning is an active process in which the individual seeks out information in relation to the task at hand (Kirk & Macdonald, 1998). In concert with constructivist perspectives, the situated perspectives consider it very important for researchers and teachers to understand how students learn in school settings by understanding how

students' pre-existing knowledge facilitates and impedes learning (Rovegno, 2006), and the present thesis assumes that FL does facilitate and promote learning in PE.

The traditional way of conducting PE in Norway does not include much focus on learning (Arnesen et al., 2013; Leirhaug & Annerstedt, 2016; Moen et al., 2018; Prøitz & Borgen, 2010), while the general emphasis in schooling is learning. PE is a competence subject just like other school subjects, containing competence aims stated by the Ministry of Education[9]. It must be mentioned that the present thesis only focuses on cognitive knowledge learning when the term learning is used. There is, of course, more learning than cognitive knowledge learning going on in PE, such as the learning of bodily, motoric and social skills.

We must move beyond what, e.g., Larsson and Redelius (2008) call 'sweaty, smiley, and good kids' as the main objective of PE and start both talking about PE, conducting PE and assessing student achievement in PE, with the mantra of PE being a subject of learning. There are several discourses within PE, such as the dominating idealistic sport discourse, health discourse, motor learning discourse, and less on focused learning discourse (Hunter, 2004; Larsson & Redelius, 2008). It might be time for us to change to focus more on the learning discourse. The language of knowledge and learning does not make sense to PE teachers (Larsson & Karlefors, 2015), resulting in many PE teachers not talking to students about learning and knowledge in PE (Larsson & Nyberg, 2017). A change from the teacher showing proper technique, supposed to be conducted by all students, to a more exploratory approach to acquiring movement skills over time based on teachers reflecting on norms and values connected to different movement cultures is needed (Larsson, 2016). This is a shift away from a 'multi-activity-model', described by Kirk (2010) as a traditional, 'one-size-fits-all' technique based model, to a more thematic oriented curriculum model advocated by Penney and Chandler (2000) as being better at fostering more student-centred teaching and the facilitation of creative roles and approaches to learning. The curriculum model is research-based, designed to clearly focus on the class content and cover several curriculum aims, and is thematic oriented, stretching over a longer time-span and encouraging a meaningful and holistic approach to PE (Lund & Tannehill, 2014). Considering the upcoming new national

[9] https://www.udir.no/in-english/

curriculum in Norwegian PE, this approach to teaching PE is welcome. Involving the students in forming the class content, based on their experiences, is important for them to start seeing PE as something meaningful (Walseth, Engebretsen, & Elvebakk, 2018). If students are given more control of their learning, something that runs counter to the traditional learning exercised by schools, we can foster a generation of people who seek out learning. Fortunately, learning technologies can facilitate a change in both the process of teaching, learning and assessing to a more student-centred and student-controlled learning environment, fostering autonomous motivated students (Collins & Halverson, 2018). It is a paradox that the highly autonomous aim of PE, upholding a lifelong active and healthy lifestyle, is reflected in so little autonomous focus in school PE, where teachers function as instructors and the students as conductors. In other words, if we want the students to act autonomously, we need to prepare them for a physically active and healthy lifestyle in school by focusing on the students, focusing on their learning and in a framework that enhances their autonomous and cooperative skills.

The FL framework, as adapted in the present intervention, seems to advocate more learning, as the individuals' learning is supported by peers and the teacher in a scaffolding fashion, also named cooperative learning or guided learning (Gillies & Boyle, 2005). The students seem to be assisted through the zone of proximal development (ZPD) as they are learning from student peers and a supportive teacher who has skills and knowledge beyond those of the learners. Further, the social interaction strengthens the learning in what Vygotsky (1978) referred to as cooperative or collaborative dialogue. As students prepare before class, this dialogue is not only made possible, but also functions as a motivational factor as students find it satisfying to demonstrate their knowledge.

There has to an alignment between the national curriculum aims, the class content and how students are evaluated (Aasland, 2019; Barker et al., 2018; Larsson & Nyberg, 2017; Penney, 2013). Through the use of video as a pre-class learning resource, the PE teacher can contribute to student learning in PE by informing specifically and thoroughly on what students are supposed to learn, as pointed out as being very important by Redelius et al. (2015). This form of pre-class content can also contribute to the teacher using problem-solving and guiding teacher strategies, as these approaches are pointed out by Larsson (2016) to promote student learning in PE. Kurban (2018) argues that students are looking for

authentic learning experiences in their education that are useful for their life, requiring the FL approach in PE not only to include a flip of the instruction, but also a transformation of class content and assessment to align with the students' 'real life'. This change also includes a change in the teacher-student relationship, as illustrated in the 'design-oriented didactical triangle' (see Figure 1.1.) suggested by Selander (2017), where the teacher and the student are no longer placed in a typically hierarchical way. Nevertheless, this somehow changed role of the teacher does not imply that the teacher is a less important part of students' learning. On the contrary, the teacher is rather more important as he or she now can guide and support the student exactly where and when guidance and support is needed (Selander, 2017). Both students and teachers know that when digital tools are involved, the roles are likely to turn around, as the students often find them more competent than their teachers. An acknowledgement of this is important to further promote student competence as a resource in school, and this do not necessary imply less quality in the education system. The teachers must understand how students learn in school settings, which is upheld by Rovegno and Dolly (2006) as critically important in a situated perspective in concert with constructivist perspectives. As student leisure time has been digitalised, teachers must get insight into their 'real world' and apply this knowledge in practice in school. If the teacher, along with the student, as illustrated in Figure 1.1., gets this insight, explores, and learns *with* the students, this can lead to the development of what Rovegno (2006) calls "robust, meaningful knowledge useful in multiple contexts" (p. 271). Robust, meaningful knowledge useful in multiple contexts is named in the current political educational debate in Norway as 'deep learning'.

Deep learning

Can FL support students´ deep learning in PE? First, if there is uncertainty in what students are supposed to learn in PE, both among students and PE-teachers (e.g., Arnesen et al., 2013), how can researchers, teachers or students recognise deep learning? From this assumption, the parenthesis in the title arose. There is just not enough knowledge around deep learning in PE, and not enough solid empirical evidence in the present thesis to give more than some assumptions on the matter. There have been attempts to map out what can represent deep learning in PE, but Borgen and Hjardemaal (2017) first of all emphasise the lack of

knowledge regarding PE and transfer/deep learning, and that future inquiry should include a phenomenological first-person view of the learner. Nevertheless, deep learning or transfer is suggested by Borgen and Hjardemaal (2017) to be operationalised and recognised as metacognition among students, stating that

> "the learner is considered an important and active part in his or her own learning. He or she is capable of setting realistic goals, and to examine thoughts, emotions and behaviour in such a manner that there is a reasonable probability of success" (p. 9).

This view of transfer is rooted in the work of Pellegrino and Hilton (2012) and Frey et al. (2016), who suggest that transfer is a possible result of deep learning. If a student learns something 'deep enough' this competence can be used to learn in other contexts or situations. Hence, transfer is happening. Birch et al. (2019) also support this view when suggesting that deep learning in PE can be recognised by students using competence from one situation to achieve new competence in another setting: for example, a student's skill in passing a basketball can help the student learn skills in passing a handball, or knowledge about training can transform into action from this student, resulting in better health. This view might be argued to be rooted in a 'cognitive' understanding of the concept presented in government documents (e.g., NOU 2015:8, 2015) that now impact the educational debate in Norway with the upcoming revision of the national curriculum in all school subjects. This critique is supported by Dahl and Østern (2019), who present deep learning as a creating process, where body, relations, creative, affective and cognitive processes *together* give depth to the learning as no part is unaffected by all the others.

As there are few or no empirically-rooted suggestions of what deep learning could look like in PE, we must turn to the theoretical assumptions of deep learning presented in Chapter 2 and look how this aligns with the results presented in the present thesis. Paper III demonstrated that applying FL in PE gave a higher learning outcome regarding HRFK. The questions used in the HRFK test were mostly of a kind recognised as surface learning, but also questions about how, e.g., the training of endurance is connected to one's own health were included. In light of the view of deep learning presented by Dahl and Østern (2019) and Tochon (2010), this could be recognised as deep learning, as the achievement demonstrated by the students on the HRFK test were a combination of cognitive processes and participation in a relevant physical activity where the knowledge was somewhat ´experienced´. This can be associated

with what Tochon (2010) describes as “meanings are embodied in action” (p. 6). Nevertheless, we must also the remember the statement of Frey et al. (2016) that deep learning is dependent on surface learning. From the results from Paper IV, the qualitative study looking into the learners’ perceptions as suggested by Borgen and Hjardemaal (2017), we can draw several parallels to the presented theoretical assumptions. When a FL framework was applied, the students experienced learning more and deeper. They developed an understanding of how training affected health, and they experienced taking a more active part in their learning process as the online videos gave them a possibility to study and learn at their own pace and when they chose to do so. Through the students statements we found an experienced greater control of their own learning process, and this is by Kavanagh et al. (2017) the basis for constructivist learning, which from the beginning was the intention of the intervention. This promotion of self-paced learning resulted in higher motivation for preparing for, and engaging in, PE. As motivation is by Pellegrino and Hilton (2012) and Tochon (2010) stated to ground or mediate deep learning, further support for stating that FL supports deep learning in PE is found.

Ennis (2015) suggested applying innovative approaches to PE in integrating PA with conceptual understanding, as the FL framework in the present thesis does, and stated that such “knowledge-based, academic approaches to PE permit students to gain deep understandings that can be applied outside of PE across a range of physical activities in many different venues” (p. 123). Comparing the findings in the present thesis with the statement by Ennis, a suggestion of deep learning being facilitated by FL is appropriate. Paper IV also reached the conclusion that the students valued PE more as a subject, and as a subject of learning, when undergoing the FL intervention. This was also supported by the findings in Paper I, where the female students’ attainment value was significantly increased. How students value PE is regarded by Fu (1999) as important as this moderates the students’ selection of learning strategies (surface or deep). Hence, FL seems to enhance the students’ concept of the value of PE, and this might further promote deep learning in PE.

Following the thoughts on deep learning of Pellegrino and Hilton (2012), Dahl and Østern (2019) and Tochon (2010), and what is presented as ‘the design-oriented didactical triangle’ (see Figure 1.1.), we can reflect on the following two thoughts on deep learning in PE. The first thought is directly connected to the present work, while the second one is more of a free

flowing thought going further, a pragmatic inclusion intended to contribute to the field of PE, as the new term 'deep learning' might be difficult to interpret into the daily work of the PE teacher.

(1) As one of the main objects of PE is to prepare the grounds for a lifelong healthy lifestyle, there is a broad consensus on the importance of motivation, and especially intrinsic motivation, to achieve that. Pellegrino and Hilton (2012) recognise motivation to support deep learning, and Tochon (2010) further distinguishes deep learning, which is built on the intrinsic motivation of the learner, from surface learning, which is based on extrinsic motivation. We can assume from this that engagement in the task ahead, as a product of autonomous motivation, in a learning environment where peer students and the teacher form a scaffold, would then be a promoter of deep learning. Hence, could participation in the learning activities when highly intrinsically motivated be a sign of deep learning taking place? If so, FL is demonstrated in the present thesis to promote deep learning, as the students maintained their intrinsic motivation during the intervention period. When we know that the general motivation for PE sinks during middle and secondary school, this finding is quite remarkable when taking the short intervention period into account.

(2) Further, let us consider one curriculum aim from the national curriculum in secondary PE regarding outdoor life and 'the law of common access'[10]. The aim is to "practise various forms of outdoor life in different natural environments and explain access rights in Norway" (Norwegian Directorate for Education and Training, 2015). Students can learn the basics of the law of common access, through an online video, or even repeat this information on their smartphone during the later learning process. The practical activity would include experiencing what this law allows, e.g., camping, harvesting wild berries, etc. With these activities, conducted in a cooperative learning fashion with peer students and with the teacher constructing the scaffold of each student´s learning process, the students will be more likely able to apply this knowledge to other contexts. Students will acquire surface knowledge on the law text, which Frey et al. (2016) define as "acquisition and consolidation of initial knowledge base" (p. 570). The law allows for camping in one spot for a maximum of two days to, among other things, prevent damage to vegetation. As students take down their tents,

[10] https://en.wikipedia.org/wiki/Freedom_to_roam#Norway

they will through bodily experience, affect and sensation, observe the actual damage a tent inflicts on vegetation. Experiencing this in a well-connected group gives power to the learning process, as stated by Gillies and Boyle (2005), and this connection of the cognitive, bodily, relational, and affective gives depth to the learning according to Dahl and Østern (2019) and Tochon (2010). If these experiences in school result in extended participation and the conduct of 'outdoor life', students will also over time experience the effect this law, through activity, can have on their own mental and physical health, and even how this activity can be a means of including people and affecting social structures. This learning phase is what Frey et al. (2016) call 'transfer' when students start "making associations across knowledge bases and application to novel situations" (p. 570), and Tochon (2010) describes this phase of deep learning as meanings that are embodied in action.

In sum, FL seems to promote learning on various levels in PE, from surface to deep.

Chapter 5: Concluding remarks

The present thesis demonstrates that the learning framework flipped learning (FL) merges the use of digital technology and physical activity (PA) in a manner whereby both promote improved learning outcomes in terms of health related fitness knowledge (HRFK) and motivation for participation in learning processes in PE. It is also argued that FL advocates deep learning in PE, at least from the perspective of how deep learning is understood as a concept in the present thesis.

Both motivation and cognitive knowledge learning outcomes were improved over the short time span of three weeks, leading to the assumption that both a change in motivation and cognitive knowledge learning are parallel processes, not necessarily dependent on each other. This is somewhat contrary to the findings of Sun and Chen (2010), who stated that learner motivation is considered an important premise for learning achievement. The rapid change in motivation also supports the assumption taken in the present thesis about motivation being more a state than a trait, as stated by Reeve (2016).

The present thesis has demonstrated that by implementing digital technology effectively, in the form of a learning framework named FL, student learning and motivation in PE are both enhanced. As Isidori et al. (2018) have concluded:

> "flipping PE in contemporary school not only provides opportunities to innovate the discipline contributing to its development as a democratic knowledge within the curriculum…. The flipped classroom is a new and flexible way to learning and develops critical thinking in contemporary education taking advantage of the educational model offered by systemic pedagogy" (p. 279).

The implementation of FL in the present thesis was done with a social constructivist conviction that positive social interaction can facilitate students' knowledge construction. As the results showed, this seemed to be an appropriate assumption , and is further supported by Sun and Chen (2010), who state that "social and cultural factors can promote the internalization of both cognition and motivation and individuals themselves are the centre of these processes" (p. 380). They further suggest that "a curriculum that incorporates both social constructivist learning theory and SDT will be able to navigate students through the

controlled learning environment of schooling toward optimal motivation for learning achievement" (p. 380).

Applying a FL learning framework in a thematic curriculum model would be a successful way of facilitating more student (deep) learning in the three core elements described in the new national PE curriculum passed by the Ministry of Education and Research (2018) as: 'movement and physical learning', 'participation and cooperation in movement activities', and 'outdoor activities and movement in nature'. To achieve this, schools needs to relinquish some control over the learning processes, stretching their traditional practices to embrace the capacity of new digital technology.

Educational research is important for three reasons: "Research adds to our knowledge", "research improves practice" and "research informs policy debates" (Creswell, 2014, pp. 18-20). The present thesis has contributed to both adding to our knowledge and outlining improved practice, but the future will show whether policy debates will be coloured by the findings. If PE is to progress in the future, we must work together to end the unfortunately still valid statement of Telama (2002): "The gap between what we say we want to do and what we are doing in practice has been and still is the main problem in physical education" (p. ix).

Limitations and calls for further research

In the method section there is a thorough description of all aspects of how the research was conducted in an attempt to create sufficient transparency for the reader to assess the conclusions and quality of the work done in the present thesis. There is still one matter that needed elaboration, and this is the methodological question of whether the control group functioned as a control as they received the same practical classes, and the sole difference was that the intervention classes had access to the preparation videos. As mentioned in the theoretical section, a FL framework includes also the activities in school, not merely the preparation content. Did the intervention only measure the preparation aspect and not the learning framework FL per se, as the definition of FL includes a change in the in-class content as well? This is a legitimate question, but since FL in practical subjects like PE still does not have a framework, we must recognise that the traditional definition of FL might not apply to

practical subjects as well as it does for the more theoretical subjects. This is a consequence of FL having originated in theoretical subjects, and almost all the research has been conducted in those subjects. Thus, the limitation is in the nature of FL as we know this framework today.

This late argument also leads on to a call for further research, followed by other calls as a result of various aspects that arose in the discussion, as follows. (1) A call for researchers to develop a FL framework for practical subjects in school, like PE. This call is supported by Isidori et al. (2018), who state that "the very scarce research on the application of flipped learning to PE must be developed and boosted at the highest level" (p. 279). This call also includes looking into how FL impacts girls and boys. (2) A call for research on deep learning in PE, and this research should include an alternative view of learning and motivation, as discussed. This call is supported by the call from Borgen and Hjardemaal (2017), emphasising that future inquiry needs to take both the student and teacher perspective. (3) A call for research looking into how motivation and (deep) learning is connected in a PE setting, as earlier findings seem inconclusive. This call is supported by Haslem et al. (2016), and further by S. Chen et al. (2013) in stating that "there is a need to pursue both physical and cognitive learning achievements in a regular PE lesson or unit, it is important to seek a common ground where students can attain and enjoy success in both" (p. 268). Further, this call includes a suggestion to take different approaches to motivation, including the importance of value and autonomous motivation, as proposed by Shen et al. (2007).

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Paper I

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Journal for Research in Arts and Sports Education **Peer-reviewed article**

Can flipped learning enhance adolescents' motivation in physical education? An intervention study

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Abstract
Objective: To be engaged and successful in learning in physical education (PE), students needs to be motivated. The purpose of this study was to examine the impact of flipped learning (FL) on adolescents' motivation to participate in PE.
Methods: Students in Grades 8–11 (N = 338, 45.3% girls) were recruited from 6 secondary and upper-secondary schools from three different counties in Norway in the spring semester of 2016. Following a quasi-experimental design with a control group, data were gathered using an expectancy–value questionnaire (EVQ).
Results: Mean results revealed that FL has a significant impact on adolescents' expectancy beliefs and attainment values regarding participation in PE. All significant changes in the intervention group could be explained by gender.
Conclusion: In an expectancy-value perspective, FL positively influences the motivation of adolescents, especially that of girls, to participate in PE. Therefore, FL can be used to enhance adolescents' motivation to participate in PE.

Keywords: *Expectancy beliefs; subjective task values; expectancy–value questionnaire; flipped classrooms; blended learning; physical education (PE)*

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Introduction

As part of a research project on how flipped learning (FL) affects adolescents' motivation to participate in physical education (PE) and their learning outcomes in PE, this article describes how FL affects motivation from an expectancy–value perspective. The study reported here took a student's perspective in analysing self-reported motivation to engage in PE. In what follows, after this introduction's discussion of

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key concepts, the article describes the study's methods, presents the results of the research, discusses the implications of the results and closes with a conclusion and outline of recommendations for further research.

Worldwide, children tend to engage in sedentary lifestyles and thus insufficient levels of physical activity (World Health Organization [WHO], 2010, 2016). PE plays an important role in the constellation of factors that affect levels of physical activity among children (Cheval, Courvoisier & Chanal, 2016; Cooper et al., 2016; Fröberg, Raustorp, Pagels, Larsson, & Boldemann, 2017). Although motivation is strongly linked to learning in school (Hattie, 2009), students' motivation to participate actively in PE is low and declines as students age (Gao, Lee & Harrison, 2008; Säfvenbom, Haugen & Bulie, 2014), especially among girls (Säfvenbom et al., 2014; Thomas, Lee & Thomas, 2008). For the first time, in 2012 the Norwegian national curriculum for PE recognised the concept of motivation by stating that, as a school subject, PE should "… help pupils acquire knowledge about exercise and training, lifestyle and health, and motivate them to have an active life and continue physical training into adulthood." (Norwegian Directorate for Education and Training, 2015, p. 2). Such recognition calls for added focus on motivation to participate in PE among children and adolescents and how teachers can support and improve their motivation.

The WHO (2016) promotes the exploration of innovative approaches to promote physical activity among adolescents in their member states. In general, society benefits from PE given its contributions to encouraging students to actively participate in PE and engage in active, healthy lifestyles throughout their lives. However, to realise that potential, PE as a subject needs to develop content that is more relevant to its aims (Arnesen, Nilsen & Leirhaug, 2013; Moen, Westlie, Brattli, Bjørke & Vaktskjold, 2015). For instance, the content of PE should encompass a variety of activities and skills (Rikard & Banville, 2006), convey knowledge about physical activity, mobility and movement, and promote teamwork and competitive aspects of sport so that all children and adolescents can enjoy physical activity and gain from its health-related benefits, regardless of their preferences or previous experience (WHO, 2016). However, the subject and its curriculum continue to endorse 'sportified' PE (Vlieghe, 2013) that seems to privilege boys (Engelsrud, 2015; Flintoff & Scraton, 2006; Klomsten, 2013; Klomsten, Marsh & Skaalvik, 2005; Valley & Graber, 2014) and adolescents who participate in competitive sports outside school (Säfvenbom et al., 2014). Since motivation has declined as the use of traditional teaching methods persists, exploring other methods of teaching to expand the PE teacher's toolbox is both timely and necessary.

Flipped learning

FL is a pedagogical approach in which direct instruction gradually shifts from a group learning space to an individual learning space, which then becomes a dynamic, interactive learning environment in which educators guide students as they apply concepts and engage creatively in the subject matter (Flipped Learning Network [FLN], 2014a).

Using FL can help teachers approach their subjects from more holistic perspectives (Segolsson & Bäcklund, 2016). Moreover, as observed across a range of subjects and student age groups, learning outcomes and levels of satisfaction have improved among students whose teachers have used FL (FLN, 2014b; Zainuddin & Halili, 2016). In elementary schools, FL can cultivate better problem-solving skills among students (Segolsson & Bäcklund, 2016) and enhance students' self-efficacy and learning strategies (Lai & Hwang, 2016). At the university level, when classes meet students' preferences for pre-class preparation via video instead of text-based modes (Long, Logan & Waugh, 2016), their engagement in coursework has improved (Lumpkin & Achen, 2015; Thompson & Ayers, 2015). FL can also benefit students with low performance as well as girls and women (Gross, Pietri, Anderson, Moyano-Camihort & Graham, 2015). However, given the overly broad variety of interventions and research designs in FL, the effects (Bishop & Verleger, 2013) and effectiveness (Abeysekera & Dawson, 2015) of specific methods require additional investigation.

Flipped learning in physical education

In PE, FL could involve, for example, students' preparing for class at home by watching a video about the next class topic—for instance, strength training. In FL, the video would consist of the teacher's explanation and demonstration of strength training, as well as an explanation of physiological changes that occur when you become stronger and how the changes affect personal health. Thereafter, the video would likely shift to explaining the content and activities of the next class and pose questions about the content of the video. At the beginning of class, students would therefore already know what they have to do for that class and even commence activities without needing their teacher's instructions. During the lesson, students could talk about strength training in light of content presented in the video both among themselves and with the teacher. The class would likely conclude with students' presenting explanation of the key topics related to strength training.

Killian, Trendowski, and Woods (2016) have reported that flipping content in university PE classes affords positive outcomes because it expands time spent on practical activities and extends feedback from instructors. In secondary-school PE classes, FL can benefit individualisation when applied to teach learning skills during orientation activities (García, Castro & Morales, 2015). In other research, despite PE teachers' use of an FL model to introduce students to the rules of unfamiliar games (Bergmann & Sams, 2014), evidence of the model's impact remains unclear, as does its effects. Nevertheless, in general, researchers have called for more innovative teaching methods in PE (Zhang, 2016), and FL continues to rank among the possible responses (Zainuddin & Halili, 2016; Østerlie, 2016).

Several pedagogical modes that focus on student-centred activities have gradually replaced the traditional so-called 'demonstrate–explain–practice' method in PE. Those modes (e.g. sport education, teaching games for understanding, cooperative

learning) all promote interaction and reflection among students during practical PE activities, and studies have investigated those behaviours among teachers and students in PE classes as they work together (e.g. Darnis & Lafont, 2015). Although such research has demonstrated positive results in terms of learning outcomes and student–teacher social relationships, additional investigations remain necessary (Barker, Wallhead & Quennerstedt, 2016).

FL ranks high among teaching modes that promote interaction and more on-topic conversations among students because they arrive better prepared for class with an increased level of knowledge and understanding about the lesson's topic and activities. FL also facilitates student-centred activities (Heinerichs, Pazzaglia & Gilboy, 2016) because students' preparation before class reduces the time spent on explanation and instruction in the classroom.

Expectancy–value theory

In educational research, expectancy beliefs (EBs) and subjective task values (STVs) are considered to be important predictors of students' academic performance and behaviour (Eccles, 1983; Eccles & Wigfield, 1995). From the other direction, students' achievement and performance are directly influenced by their EBs and STVs (Eccles, 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). EBs are conceived as broad beliefs about personal competence in a given domain (Zhu, Sun, Chen & Ennis, 2012), among which *expectancy of success* refers to beliefs about how well the person will perform on a given task. Expectancy of success functions as an independent motivational factor independent of the motivational factor of STVs, as Eccles & Wigfield (1995) have indicated. According to Eccles (1983), there are four task values attached to a certain domain: attainment value (AV), intrinsic and interest value (IV), utility value (UV) and cost. AV is a person's perceived importance of doing well on a task; IV is the level of enjoyment that a person perceives doing a task will offer; and UV is how the perceived usefulness in doing a task relates to current and future personal goals (Eccles & Wigfield, 2002). Arguably, EBs and STVs bear a more direct impact on learning behaviour and achievement than other motivation constructs, including self-efficacy and achievement goal orientation (A. Chen, Martin, Ennis & Sun, 2008).

Expectancy–value theory and physical education

Expectancy–value theory is an important theoretical lens with which to examine and understand student learning and motivation in PE (Gao, 2009; Zhu et al., 2012). Motivation is associated with students' intentions to perform, engage in and participate in PE (Xiang, McBride, & Bruene, 2004, 2006), but not necessarily with learning achievement (Zhu & Chen, 2010). Regarding gender-based differences in EBs and STVs in PE, boys tend to have higher EBs than girls, although the same

differences do not characterise their STVs (Gao, 2009; Xiang, McBride & Bruene, 2004; Xiang et al., 2006; Xiang, McBride, Guan & Solmon, 2003).

Research has shown that students' general expectancy–value motivation declines with age throughout their elementary, middle and secondary school career in academic subjects, especially PE, for both boys and girls (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Jacobs, Lanza, Osgood, Eccles & Wigfield, 2002; Xiang et al., 2006; Xiang, McBride & Guan, 2004). Although age has recently been observed to explain STVs, it has not been shown to affect EBs. Moreover, in primary and middle school, although STVs decline, EBs do not (Zhu & Chen, 2010; Zhu et al., 2012).

Identifying adolescents' motivational dynamics in relation to their participation in PE might be a vital resource for facilitating PE learning and preventing further declines in students' motivation. In response, the goal of the study reported here was to determine whether using FL as a teaching method affects student motivation to participate in PE based on their EBs and STVs for the subject. To that end, two research questions emerged:

> Q1: Can flipped learning enhance adolescents' expectancy beliefs in physical education?
>
> Q2: Can flipped learning enhance adolescents' subjective task values in physical education?

Methods

Participants

Students (N = 338, 92.9% of 364 invited) from six different secondary and upper-secondary schools were recruited to participate in present study. Twenty random schools belonging to three different regions in Norway were requested to participate by an e-mail to their respective managers resulting in participation of five schools. One school was included by their own request. The six schools that participated represented both rural and central communities with a normal distribution of immigrants and social status.

Demographic variables

Self-reported information on sex, date of birth and name was obtained from the expectancy-value questionnaire (EVQ) to characterise the sample. Girls (n = 153) had a mean age of 15.26 years (SD = 1.3), whereas boys (n = 185) had a mean age of 15.01 years (SD = 1.12). Participants were from four different levels in the Norwegian school system: the three grades of secondary school and the initial grade in upper-secondary school—that is, Grade 8 (n = 114), Grade 9 (n = 101), Grade 10 (n = 38) and VG1 (n = 85). The students' academic marks (girls: 4.45, boys: 4.48) during the same semester reflected the national average for Grade 10 (girls: 4.5, boys: 4.6), according to Statistics Norway (2016).

Research design

An intervention designed as a quasi-experimental randomised trial with a control group was conducted during a 3-week period during the 2016 spring semester. Since different classes were used in the intervention and compared with control groups, the experiment posed the possibility of selection bias, but also afforded the advantage of comparing naturally occurring events (Hartas, 2010).

Three learning resources dealing with endurance, strength and coordination were used, each of which consisted of a video assigned to students to watch as homework before class, an in-class lesson plan that the PE teacher followed and a teacher's guide. To maximise equivalence among the classes all teachers were instructed by the researcher, by telephone, regarding how to conduct the different activities.

The videos lasted approximately 12 minutes each, which was well within the suggested length for FL videos (Long et al., 2016), and were published on a digital learning platform. Each video gave a thorough, but easily understandable introduction to the content of the in-class topic. For example, when strength was the weekly topic, the video explained strength in an age-appropriate way by discussing why strength benefits personal health, what happens in the body when strength is gained and how to train for strength. Each video ended with a summary of the content of the next class. Short quizzes embedded in the videos were used to enhance students' motivation to continue watching and to deepen their understanding, as suggested by Long et al. (2016) and Frydenberg (2012). The research group and the teachers could view statistics on the platform to monitor which students have watched which videos and their answers on the corresponding quizzes.

Since no framework for FL environments has been established to date (Bishop & Verleger, 2013), the design of the study's FL environment followed the recommendations of Kim, Kim, Khera, and Getman (2014), who defined nine principles for flipped classrooms and the FLIPPED model (Y. Chen, Wang, Kinshuk & Chen, 2014). The content in practical lessons were game-based activities with few parallels to sport but instead a focus on enjoyment and cooperation during PE. Topics for discussions between students and between the teacher and students were encouraged and increasingly held as the teacher spent less time explaining and became freer to walk among the students. Learning goals in the practical class about endurance included being physically active to develop the body and improve health, talking about endurance training and talking about the connection between endurance and health. In the other two practical classes, the aims were similar but with a different topic and derived from the national curriculum in PE after Grade 10 (Norwegian Directorate for Education and Training, 2015).

Participating classes were randomly divided into two categories. The intervention group (n = 141) had access to the videos as homework before coming to class, and the control group (n = 197) was subjected to the same practical class as the

intervention group. To represent the conventional methods of conducting PE classes in Norway as realistically as possible, some of the control groups received a summary of the class topic and of what the videos watched in the intervention groups explained, delivered orally by the PE teacher at the beginning of each PE class and typically lasting about 5 minutes. Some control groups conducted the practical class without any oral explanation of the topic. Both the intervention and control groups performed the same practical activities in class. The control groups were educated during the intervention period according to the traditional way of conducting PE classes in Norway, which ensured that the sole difference was that the intervention group had access to the videos for preparation before class. The control group was not granted such access. As research has shown, although the link between the video content and content of in-class activities is essential to success in FL environments, it is often overlooked (Long et al., 2016). In response, the videos and lesson plan were produced by the researcher, not each individual teacher.

Before the intervention commenced (T1) and at its conclusion (T2), students' motivation for participating in PE was measured with an EVQ. The students' PE teachers administered and collected the self-report questionnaires as instructed by the researcher. The study was reported to the Norwegian Centre for Research Data (project no. 47604).

Variables and measures

Expectancy–value constructs: The EVQ consists of 11 items on four sub-scales. Five items measure EBs and six measure STVs on three sub-scales: AV, IV and UV (Zhu et al., 2012). Responses to all items are submitted on a 5-point Likert scale (1 = *not important*, 5 = *very important*). A sample item used to measure student AV is, 'How important do you think PE is for you?'

The EVQ measures students' EBs and STVs of the domain content and can be used to measure expectancy–value constructs in PE for both middle-school and elementary students (Zhu et al., 2012) with good construct validity and internal reliability (Zhu et al., 2012). It has also shown satisfactory validity and reliability in measuring EBs and STVs for PE among Norwegian adolescents (Østerlie, Løhre & Haugan, in press).

Data reduction

Responses to items on the EVQ were entered into the Statistical Package for the Social Sciences version 24 and reduced into EBs and STVs dimensions (i.e. AV, IV and UV). Analysis was performed both on the EVQ as a two-dimensional (i.e. EB and STV) and four-dimensional reduction (i.e. EB, AV, IV and UV), since the dimensionality of the EVQ has been shown to be unclear (Østerlie et al., in press).

Data analysis

Initially, the dataset was cleaned and screened for missing data, out-of-range values, outliers and sample distribution normality. A missing values analysis was performed on the dataset, and the result of Little's MCAR test was not significant when all items were tested together ($\chi^2(520) = 511.94, p = .161$). Since each item had between 7.4 and 14.5% of data missing, the missing values, as unneglectable values, could not be replaced at a limit of 2%. Since data were assumed to be missing completely at random by Little's test, analysis was continued. Gaps in the data perhaps stemmed from the fact that the T1 and T2 forms were completed at school on specific dates. Absence from school would have prompted a lack of response from some students at either T1 or T2. Formal normality tests showed values of skewness and kurtosis within the normal range for all constructs ($< |1.4|$), with a normal range of $< |2|$ (West, Finch & Curran, 1995). Accordingly, data were regarded fit for testing and comparing means. Any p value less than .05 was considered to be statistically significant.

A paired samples t test, with list-wise exclusion, was used to identify any significant change in mean score from T1 to T2 for both the intervention and control groups and between genders in the intervention group. A t test (i.e. analysis of variance) was used to identify any significant differences between the intervention and control groups at either T1 or at T2 for any dimension of the EVQ. Pearson's correlation coefficient was computed to assess the relationship between the EVQ and the age of students.

Results

Results from the EVQ

Table 1 presents descriptive statistics for each dimension of the EVQ.

The paired-sample t test demonstrated a significant increase from T1 to T2 for the EB construct ($p = .020$, 95% CI [0.20, 0.02]) and the AV construct ($p = .034$, 95% CI [0.26, 0.01]) in the intervention group. No significant changes emerged in the control group in any of the EVQ constructs.

Table 1. Descriptive statistics for each variable of the expectancy–value questionnaire (EVQ) with T1 values and, in parentheses, T2 values

EVQ dimensions	Intervention group (n = 141)		Control group (n = 197)	
	M	*SD*	*M*	*SD*
EB	4.01 (4.18)a	0.73 (0.58)	3.85 (3.88bb)	0.84 (0.87)
STV	3.84 (3.95)	0.80 (0.73)	3.59b (3.66bb)	0.90 (0.85)
AV	3.90 (4.07)a	0.89 (0.83)	3.59bb (3.72bb)	1.08 (1.02)
IV	3.90 (3.96)	0.92 (0.79)	3.64b (3.71b)	1.05 (0.90)
UV	3.76 (3.81)	0.91 (0.87)	3.47b (3.59b)	1.03 (0.96)

Note. T1 = measurement before intervention period; T2 = measurement after intervention period; EB = Expectancy belief; STV = subjective task value; AV = attainment value; IV = intrinsic value; UV = utility value
a = significant change from T1 to T2 ($p < .05$); b = significant difference between the intervention group and the control group ($p < .05$); bb = significant difference between the intervention group and the control group ($p < .01$).

Table 2. Descriptive statistics for each variable of the expectancy–value questionnaire (EVQ) in the intervention group by gender with T1 values and, in parentheses, T2 values

EVQ dimensions	Girls			Boys		
	n	*M*	*SD*	*n*	*M*	*SD*
EB	44	3.88 (4.03)a	0.73 (0.57)	66	4.15b (4.23b)	0.67 (0.56)
STV	42	3.82 (3.92)	0.87 (0.73)	65	3.89 (3.90)	0.77 (0.75)
AV	45	3.90 (4.11)a	0.95 (0.76)	68	3.90 (3.98)	0.86 (0.85)
IV	46	3.86 (3.96)	0.95 (0.81)	69	4.00 (3.98)	0.91 (0.80)
UV	43	3.77 (3.74)	1.00 (0.90)	67	3.86 (3.81)	0.84 (0.89)

Note. T1 = measurement before intervention period; T2 = measurement after intervention period; EB = expectancy belief; STV = subjective task value; AV = attainment value; IV = intrinsic value; UV = utility valuea = significant change from T1 to T2 ($p < .05$); b = significant difference between girls and boys ($p < .05$)

In the intervention group, gender-based differences were clear, as presented in Table 2.

The paired-sample *t* test revealed a significant increase from T1 to T2 for the EB construct ($p = .045$, 95% CI [0.30, 0.00]) and the AV construct ($p = .016$, 95% CI [0.37, 0.04]) among girls. No significant changes emerged among boys in any of the EVQ constructs. The boys had significantly higher scores on the EB construct, but not on the other constructs, at both T1 and T2.

Since several studies have found that EB and STV decline with age, that dynamic was also tested at T1 with the results of a Pearson's correlation coefficient test with two-tailed, pairwise exclusion, the results of which showed that age correlated with STVs ($n = 286$, $r = -.251$, $p < .001$), but not EBs ($n = 302$, $r = -.032$, $p = .584$).

Discussion

Flipped learning and students' expectancy beliefs about physical education

Results show that FL had a significant impact on students' EBs. In the intervention group, that change emerged among girls, but to only a weakly significant degree. Similar to previous research (e.g. Gao, 2009), initial EBs were on the same level and demonstrated the same variations in gender. Boys had significantly higher EBs than girls both at T1 and T2. Using the definition of *expectancies* as specific beliefs that individuals have regarding their success on tasks that they will perform sooner or later in the future (Eccles & Wigfield, 2002) in traditional PE settings, girls have shown lower final grades (Statistics Norway, 2016), less motivation and less satisfaction (Klomsten et al., 2005; Stormoen, Urke, Tjomsland, Wold & Diseth, 2016; Säfvenbom et al., 2014).

The intervention included three lessons on endurance, strength and coordination. Practical lessons involved activities with few elements from sports or competition. Gender-based differences often appear in conventionally gendered activities in which boys have been more likely to feel competent about and perform better on tasks such as football and basketball than girls have, whereas girls have tended to

feel more competent and perform better on tasks such as dance and gymnastics than boys have (Xiang et al., 2006). However, those trends alone cannot explain the difference detected in the study reported here, since both the intervention and control groups performed the same activities.

The chief difference and thus the chief contributor to the effect on EBs using FL seems to be the videos assigned as homework, which conveyed information about the activities in the upcoming class. In class, such content was briefly repeated by the teacher and discussed among students. The shift in amount of information prior to class, being somewhat different than that of their typical experiences, can explain why girls showed significantly increased EBs, but not the boys. The intervention period, having included only three lessons, could have prompted possible bias, which bears consideration during the interpretation of results. Would this shift among girls' expectancy beliefs stabilise, increase or decrease if FL were used over a longer period of time? At least one study has demonstrated the importance of information to students, who are more likely to engage in class when they understand and believe in the subject matter (Dyson, 2006).

PE is a subject in which a lack of competence is far more visible than in most other school subjects, since the primary tool in the learning process is the body. That circumstance might explain why girls have lower EBs, as the content in PE is culturally assumed to be somewhat more beneficial to boys than to girls (e.g. Engelsrud, 2015). Regarding mathematics education, Lai and Hwang (2016) found that FL enhanced elementary-school students' self-efficacy by promoting more self-regulated learning processes. That result implies that PE curriculum could also be more directed at boys than girls compared to mathematics, since those authors did not detect similar differences by gender. By extension, the finding could explain why girls benefitted more from FL in PE than boys did in the study reported here. When individuals are informed about how to perform a task, they tend to have more confidence that they can succeed in performing the task. Historically, girls have been seen as problematic in PE because they do not engage as much as boys do (Enright & O'Sullivan, 2010). Of course, researchers have increasingly challenged that discourse of blame, and the study reported here supports the idea that teachers need to reconsider PE content and its delivery more than simply demanding girls to change.

Age does not seem to explain students' EBs in PE. Empirical results show that EBs did not negatively correlate with age to a significant degree. That finding supports Zhu et al.'s (2012) and Gao's (2009) results among elementary- and middle-school students. Furthermore, the rather low *n* among students in Grade 10 could have prompted possible bias, which bears consideration during the interpretation of results.

Flipped learning and students' subjective task values of physical education

Interpreting results from the EVQ can follow one of two approaches — namely, imposing either a two- or four-dimensional construct — since its dimensionality is somewhat blurred (Xiang et al., 2003; Østerlie et al., in press).

When comparing the intervention group to the control group, significant differences regarding STVs as a dimension were not observed, which corroborates earlier findings among middle-school students (Gao, 2009; Xiang, McBride & Bruene, 2004; Xiang et al., 2006; Xiang et al., 2003). When considering the different dimensions involving STVs, a significant, albeit weak, difference regarding the students' attainment value for PE surfaced, but only among girls. Attainment value is a person's perceived importance of doing well on a task as it relates to how their self-conception and ideals inform their competence in the domain (Wigfield, 1994).

Considering the videos' content the importance of being familiar with the context of activities conducted, knowledge about the curriculum and activities, as well as recognised competence seems to be a motivator for participation. These findings align with earlier research that has stressed the importance of emphasising the value of PE by informing students about the benefits of each PE activity prior to its performance (Gao et al., 2008) can greatly motivate students to participate in PE, especially girls (Inchley, Kirby & Currie, 2011). Since those factors seem to positively affect gender variations in PE, FL is arguably an effective facilitator of that process. Previous research has unsurprisingly shown inconsistency in conclusions about gender-based differences regarding STVs (Gao et al., 2008). Gao (2009) has reported gender-based differences regarding interest, but not regarding usefulness and importance, whereas no gender-based differences regarding task values have been observed in other studies (e.g. Xiang et al., 2006). Such inconsistency underscores the need for more research on gender-based differences and student motivation in PE in elementary, middle and secondary schools.

Age seems to explain STVs in PE, which declined over the course of secondary school in the results. That finding corroborates the results of Wigfield et al. (1997), Zhu et al. (2012) and Zhu and Chen (2010), who detected the same trend among children in elementary and middle school. That decline also emerged in a 12-year longitudinal study (Jacobs et al., 2002). As expectancy–value theory describes (Wigfield & Eccles, 2000), it is exceptionally difficult for students to value the content of a subject without deeper learning. The more explicitly that the values of an assignment are explained, the more likely students will become engaged in the assignment and remain motivated to further their study of the content area (Paris, Lipson & Wixson, 1983; Wigfield, 2000). Accordingly, increased focus on in-depth learning in PE is a valuable approach and should include knowledge, physical literacy and social skills. FL is a tool that PE teachers can use to increase the depth of learning because it requires students to prepare before class by watching curriculum-related content, their knowledge of which is further constructed in class with other students and their teacher, which could contribute to curbing the decline in students' valuations of PE.

Strengths and limitations

The sample of 338 adolescents (response rate 93%) from six schools in three counties in Norway was a major strength of the study. The sample represented a diversity

of locations in both urban and rural areas, thereby reflecting the general adolescent population in Norway. Moreover, the students' semester marks corresponded with the national average grade for the actual semester, which indicated that the sample did not differ from the general Norwegian adolescent population in terms of academic performance. Plus, PE teachers administered data collection at the start of a PE lesson, which ensured participant anonymity and enough time for participants to complete the questionnaire. The procedure of using a familiar questionnaire administrator in familiar surroundings contributed to students' feeling comfortable in the assessment situation and, in turn, generated reliable data, which was another strength of the study.

Nevertheless, some limitations should be taken into consideration. Since the sample included adolescents 13–17 years old, its results cannot be generalised to younger children or older adolescents. The intervention period, which spanned only three sessions, and the low *n* among Grade 10 students and subgroups (Table 2) could have been other limitations. Lastly, the study did not present strong significance in much of the statistical results, and when interpreting interviews from such a small sample, generalisability must be considered as a limitation.

Conclusions

The study reported here has shown that flipped learning (FL) increases expectancy-beliefs and attainment values among students regarding physical education. FL can thus benefit adolescents' motivation to participate in PE. As discussed, FL seems to benefit girls more than boys in PE settings and can therefore be an important contributor for equalising gender-based differences in PE. The study has provided additionally, an observed decline in STVs, but not in EBs, among students from elementary to secondary school. In sum, FL is an appropriate pedagogical approach in PE for deeper learning and can contribute to halting the decline in children's valuation of PE.

Future research should further identify and examine FL practices and the impact that the method can have in PE, both in a broader context and longitudinally. Furthermore, research on both general motivation in PE and gender-based differences in that motivation is necessary. Since motivation is linked to learning and a strong predictor of behaviour, more research on how to preserve and enhance children's motivation to participate in PE is important.

Conflict of interest

I declare that I have had no conflicts of interest in conducting or publishing my research.

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Paper II

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Adolescents' perceived cost of attending physical education

A flipped learning intervention

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Abstract

Objective: The purpose of this study was to examine the effect of flipped learning (FL) on adolescents' motivation to participate in physical education (PE) lessons in secondary and upper secondary schools based on adolescents' perceived costs of attending PE.

Methods: The students (N=338; 45.3% girls) were recruited from six secondary and upper secondary schools from three different counties in Norway during the spring of 2016. The data were collected using open-ended questions.

Results: The data analysis revealed that FL positively affected the adolescents' motivation to participate in PE, as their perceived costs of attending PE significantly reduced, and their intention to participate in PE significantly increased. All the significant changes within the intervention group were explained by gender. The adolescents who reported perceived costs in attending PE were more likely to be unmotivated to attend PE. The perceived costs of attending PE increased with age, and the intention to participate in turn declined.

Conclusion: Depending on adolescents' perceived costs of attending PE, FL has a positive effect on their motivation to participate in PE, especially among girls. Thus, FL can be used to enhance adolescents' motivation to participate in PE in secondary and upper secondary schools.

Keywords: *Blended learning; flipped learning; flipped classroom; expectancy-value; motivation; motivational costs; Physical Education (PE)*

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Due to increasing evidence regarding the discrepancy between suggested and observed levels of physical activity among adolescents, it is important to conduct high-quality studies that provide solutions to this issue. Schools are essential in shaping children's lives, as they can reach almost all children. Thus, several programmes, including programmes that aim to promote more physical activity during school hours, have been implemented in Norwegian schools. Research has found that the implementations

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of these programmes are often unsuccessful due to a lack of competence among the implementers, that there are outcome differences between genders and ages, as girls are less active than boys, and activity levels decline with age (Gustavsen & Strømsvik, 2018). This research indicates that the solution to promoting more physical activity does not involve simply adding new elements to existing programmes (Wake, 2018); rather, programmes may need to be designed differently to promote a long-term, healthy and active lifestyle among children. A recent report demonstrates that physical education (PE) in Norwegian secondary schools is not beneficial for all students, as both the content and teaching methods lack variation (Moen, Westlie, Bjørke, & Brattli, 2018). This may mean that PE teachers must vary the content and methods and not just implement programmes in their quest to motivate students to participate in PE and physical activity.

This study was part of a larger research project, the goal of which was to investigate how the flipped learning (FL) teaching method affected adolescents' motivation to participate in and learn from PE. The purpose of this specific study was to examine how the costs perceived by adolescents in attending PE affected their motivation to participate. The expectancy-value theory (Eccles, 1983) served as the theoretical framework of the study, as this theory was considered an important theoretical lens through which to examine and understand students' motivation to participate in and learn from PE (Gao, 2009; Zhu, Sun, Chen, & Ennis, 2012).

Theoretical Framework

Flipped Learning

Flipped learning is a pedagogical approach in which direct instruction moves from the group to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment in which the educator guides students as they apply concepts and creatively engage with the subject matter (Flipped Learning Network [FLN], 2014). A review of the literature shows that FL can improve students' academic achievement, satisfaction, engagement, promote self-paced learning and increase interactions between students and teachers (Akçayır & Akçayır, 2018; L. L. Chen, 2016). The definition of FL is conceptualized from the method originating in theory-dominated subjects like mathematics and science, rather that more practical subjects than PE.

For the purpose of this study a flipped class in PE was planned and conducted as following: the students prepare for class at home by watching a video about the topic that will be covered during the next class. The topic is endurance training, and the video consists of the teacher explaining and demonstrating the subject. The teacher also explains what physiological changes occur when one´s endurance is increased and the effect this has on one's health. Finally, the teacher explains the content of the next class. After the video, the students are prompted to answer quiz questions. Thus, when the students come to class, they know what to do, and they can start activities without

the teacher having to explain in detail about the class content. During the lesson, the students discuss the content of the video among themselves and with the teacher. The teacher concludes the class by having the students explain the key topics of the lesson. In comparison, a traditional learning environment in PE is dominated by an instruction-conduction practice where the teacher demonstrates what students should do. Internationally, a "…teacher-centered teaching style continues to dominate the practice of PE teachers despite the emphasis on 'pupil-centered' approaches…"(Green, 2008, p. 221), and similar patterns are found in Norway (Moen et al., 2018). As no other study describes what an FL learning environment would look like in PE, this was the basis on which this study's intervention was conducted. This is further explained in the method section and possible biases are highlighted in the strengths and limitations section.

FL has a positive effect on adolescents' motivation to participate in PE, as the expectation for success and attainment value increases in FL contexts, especially among girls (Østerlie, 2018). Moreover, FL has been used in PE to help students learn the rules of new games (Bergmann & Sams, 2014). Several studies suggest that FL is beneficial in PE, as it allows for more time to be dedicated to practical activities and individual feedback than traditional learning (Killian, Trendowski, & Woods, 2016; Lina, 2017; Østerlie, 2016). In secondary schools, FL has a positive effect on individualization in PE when it is used to help students learn skills in orientation activities (García, Castro, & Morales, 2015). In universities, FL enriches the teaching resources of sports courses and enhances the students' interest in learning, which results in significant improvements in the their ability to engage in self-study of the PE curriculum (Bing, 2017).

The concept of FL in PE is to organize the learning to obtain more time for practical activity, and arrange for more learning, both physically and cognitively, by the students in their preparation prior to class. This preparation, preferably a video, needs to be specific to the upcoming class by including both practical information about the activities and theoretical knowledge underpinning the topic. One challenge in this method is ensuring that all students prepare at home, as there are reports that some students are not satisfied with the extra work-load which the method entails (Missildine, Fountain, Summers, & Gosselin, 2013). Nevertheless, the observed challenges are far less than the observed advantages (Akçayır & Akçayır, 2018).

Expectancy-value Theory

In educational research, expectancy beliefs and task values are considered important predictors of students' academic performance and behaviour choices (Eccles, 1983; Eccles & Wigfield, 1995). Moreover, students' achievement-related choices and performance in a domain are directly influenced by their expectancy beliefs and task values (Eccles, 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). Expectancy beliefs refer to one's broad beliefs about one's competence in a given domain (Zhu et al., 2012). The expectancy for success is defined as one's beliefs regarding how well one will perform a given task. This expectancy is independent of the motivational factor

known as subjective task-value (Eccles & Wigfield, 1995). Research has found that the expectancy for success is associated with students' performance, engagement and intention to participate in PE (Xiang, McBride, & Bruene, 2004; 2006) but not necessarily with learning achievement in it (Zhu & Chen, 2010). According to Eccles (1983), there are four task values attached to a certain domain: (a) attainment value, (b) intrinsic value, (c) utility value and (d) costs.

Researchers have theorized that costs, which refer to the negative aspects of engaging in a task, such as the fear of failure or lost opportunities due to choosing one task over another (Wigfield, 1994), negatively affect students' achievement behaviour (Eccles, 1983). This means that expectancy beliefs can motivate students to participate in PE, while costs can demotivate students. Several studies suggest that the way in which costs affect motivation should not be overlooked when examining students' expectancy-value beliefs in PE (Gao, 2009; Gao, Lee, & Harrison, 2008). However, the subject of costs has been largely absent in most studies of expectancy beliefs and task values. Although the topic of costs is often included in the theoretical articulation of many studies (e.g. Wigfield, 1994; Xiang, McBride, Guan, & Solmon, 2003), it is rarely measured in studies regarding PE (A. Chen, Martin, Ennis, & Sun, 2008).

In a study of PE in elementary schools, which included 298 third to fifth grade students in the U.S., 69% of the students reported that certain costs could affect their motivation to participate in PE. These costs were identified as originating from four sources: content (68%), peer behaviour (14%), physical discomfort (12%) and teacher behaviour (6%) (A. Chen et al., 2008). Similar results have been found among older students: 70.3% of 593 middle-school students who reported on the costs of attending PE identified curriculum content as the major source of cost (Zhu & Chen, 2013), in common with their younger peers. This construction of perceived costs is similar to that of a group of Chinese college students, who credited as much as 45% of perceived costs to the content of the PE curriculum (A. Chen & Liu, 2009). Nevertheless, all the aforementioned studies revealed that most students, ranging from 84%–100%, would choose to attend PE if given the choice, despite the costs they perceived in attending.

The lack of evidence regarding the role of costs in the motivation process may hinder our understanding of the full function of expectancy beliefs and perceived task values in PE. Gao (2009) supports this view and calls for further investigation due to inconclusive findings. Because of the limited amount of research conducted on the cost aspects of the expectancy-value motivation in PE, I turn to related research that examines the motivation to participate in PE and the levels of enjoyment of participating in it. The following section conceptualises these aspects.

Physical Education

Contrary to the intentions of the Norwegian PE curriculum, student motivation to participate in PE declines with age (Säfvenbom, Haugen, & Bulie, 2014); this reflects

the global trend (Gao et al., 2008). This decline is greater for adolescents than for young children (Fredricks & Eccles, 2002) and is greater among girls than boys (Säfvenbom et al., 2014; Thomas, Lee, & Thomas, 2008). This loss of motivation, especially among girls, is partly the result of a "sportified" PE curriculum (Ennis, 1999; Lundvall, 2016; Säfvenbom et al., 2014; Vlieghe, 2013). Nevertheless, studies show that PE is one of the best-liked subjects in compulsory school both in Norway (Moen et al., 2018) and internationally (Goodlad, 2004). Moreover, Moen et al. (2018) reported that in Norway boys tended to like PE more than girls did, as the number of students who reported liking PE "well" or "very well" was 92.3% for boys versus 84.8% for girls. This report also revealed that the number of students who liked PE "very well" declined significantly from fifth grade to tenth grade, with the rate of decline for girls being twice that of boys.

Lagestad (2017) shows that boys receive significantly better marks than girls overall in upper secondary-school PE and that more boys than girls receive the very top marks. These patterns appear in every type of class, independent of study programme and gender composition. This is echoed in the final marks of secondary students in 2017, as boys scored on average 4.7, and girls 4.5, which made PE the only subject in compulsory school in which boys performed better than girls (Statistics Norway, 2017). Compared with 2016, the difference increased from 0.1 to 0.2 between the two genders, so that the gender difference in PE only increased. Green (2008, p. 152) concludes that PE remains gendered in terms of organization, content and delivery, and that: "The tendency for PE to reinforce more than challenge hierarchical relations between the sexes remains."

Studies have shown a relative age effect in PE that is similar to that found in youth sports (Aune, Pedersen, Ingvaldsen, & Dalen, 2017), and moreover revealed that boys value sports more than PE and girls conversely value PE more than sports (Kjønniksen, Fjørtoft, & Wold, 2009). As motivation to participate in physical activity outside school is highly linked to motivation to participate in PE during school (Shen, 2014), especially among girls (Kjønniksen et al., 2009), it is important to maintain students' high motivation to participate in PE. Moen et al. (2018) found that the amount of involvement in sports by students, especially girls, outside school was strongly linked to how well they liked PE. Some studies argue that the PE curriculum is too narrow, as it does not include enhancing students' social and cognitive skills, nor does it ensure that students have a positive perception of their physical self-worth; rather, the PE curriculum only comprises sports-like activities and workouts aiming at target heartrates and burning calories (Dyson, 2014; Ennis, 2011). This trend is also echoed in Norway, where ball and fitness activities conducted in an instruction-conduction teaching manner predominate secondary-school PE (Moen et al., 2018).

Recent activist research shows that adolescents tend to experience less costs in attending PE when more information about class content is provided and when they are included in the process of creating the curriculum. Students who disliked PE

prior to the teaching period, especially girls, display the greatest improvement in terms of meaningfulness (Walseth, Engebretsen, & Elvebakk, 2018).

There is broad agreement in Norway and internationally, that PE favours boys and those who participate in sports outside of school (Andrews & Johansen, 2005; Dowling, 2016; Oliver & Kirk, 2015; Scraton, 2013; Säfvenbom et al., 2014). Thus, PE does not fully achieve its main aim, which is to motivate all children and adolescents to have a lifelong, healthy and physically active lifestyle (Kirk, 2010). New pedagogical approaches in PE should be adopted, as the subject remains dominated by a traditional instruction-conduction agenda and a limited range of activities.

Research Question

This study aims to determine whether the use of FL affects students' motivation to participate in PE based on the costs they perceive in attending PE lessons. From this, two research questions have emerged:

RQ1: Can flipped learning decrease the costs that students perceive of participating in PE?
RQ2: Can flipped learning positively affect students' intentions to participate in PE?

Methods

Research Design

The study was conducted over a period of three weeks during the spring of 2016. Three learning resources regarding endurance, strength and coordination were used. Each resource consisted of a video that was assigned for viewing as homework before class, one in-class lesson plan that the PE teacher followed, and a teacher's guide. The videos were about 12 minutes long, which was well within the suggested length for such videos (Long, Logan, & Waugh, 2016), and were published on a digital learning platform. Each video gave a thorough but easily understandable introduction to the in-class content topic. For example, when endurance was the weekly topic, the video explained endurance in an age-appropriate way by discussing why endurance improves health, what happens in the body when endurance is gained and how to increase endurance. At the end of the video, a summary of the upcoming class content was given. Short quizzes embedded in the videos were used to enhance the students' motivation to continue watching and to develop a deeper understanding of the content, as suggested by Long et al. (2016) and Frydenberg (2012).

The participating classes were randomly divided into two different categories. The intervention group (n = 141) had access to the videos as homework before coming to class. The control group (n = 197) conducted the same practical classes as the intervention group but were not granted access to the videos. To represent as closely as possible the conventional methods of conducting PE classes in Norway, some of the control groups received a short summary of what was explained in the videos that

the intervention group watched as homework. This summary was delivered orally by the PE teacher at the beginning of each PE class, and this presentation typically lasted about five minutes. Some of the control groups only went through the practical class and were given no oral explanation of the topic. Both the intervention and control groups underwent the same practical activities in class, and all the participating teachers managed both the classes that belonged to the intervention group and the control group. This ensured that the only difference between the two groups was that the intervention group was given access to the pre-class preparation videos. The connection between the video content and the content of the in-class activities is often overlooked, but it is essential to success in an FL environment (Long et al., 2016), so the videos and the lesson plan were produced by the researcher and not each individual teacher.

Before the intervention began (Time 1; T1) and when the intervention concluded (Time 2; T2), the students' perceptions of the costs of participating in PE were measured using four open-ended questions from the Expectancy-value Questionnaire (EVQ). To ensure the students' anonymity the teachers collected the questionnaires, including the self-reported information on gender, date of birth and name, and mailed these in closed envelopes to the researcher. Before analysing the data, student names were coded, and the names removed. The study was reported to the Norwegian Centre for Research Data (Project #47604).

Participants

Norwegian students (N = 338; 92.9% of the 364 invited) from six different secondary and upper secondary schools were included in this study. The selected schools represented both rural and urban communities with a normal distribution of immigration and social statuses. Self-reported information on gender, date of birth and name were obtained to characterize the sample. The girls (n = 153) had a mean age of 15.26 years (SD = 1.3), and the boys (n = 185) 15.01 years (SD = 1.12). The participants were from four different levels in the Norwegian school system, which were the three years in lower secondary school and the first year of upper secondary school: Year 8 (n = 14), Year 9 (n = 101), Year 10 (n = 38) and upper secondary level 1 (VG1) (n = 85). The students' average school marks in PE (girls: 4.45 and boys: 4.48) for the same semester also reflected the national average for Year 10 (girls: 4.5 and boys: 4.6) (Statistics Norway, 2016). The data were collected during the spring of 2016.

Variables and Measures

Cost constructs. Motivational cost has been under-researched, and there are no specific quantitative tools to measure it (Zhu & Chen, 2013). For this study, four open-ended questions were used, as was done in Chen and Liu (2009) and Zhu and Chen (2013), to measure the cost of attending PE. The four questions were

consolidated into the following two questions: "If there is anything that you do not like in PE, what would that be? Why?" (Question 1 [Q1]) and "If you had a choice, would you rather not come to PE? Why?" (Question 2 [Q2]). Q1 addressed what aspects of PE the students did not like and thus identified the costs of attending PE. Q2 revealed whether students experienced opportunity cost by attending PE because PE was a mandatory subject, and the students were asked a hypothetical question regarding if they would or would not attend PE if the subject was not mandatory. Two hundred and fifty-four (out of 338: 75.1%) students provided legible responses to Q1, and 291 (out of 338: 86.1%) provided legible responses to Q2. One hundred and eighty-two (out of 338: 53.8%) of the students provided legible responses to both open-ended questions at T1 and T2, so these responses were included in the repeated-measures analysis. The results of an ANOVA test and a Bonferroni post-hoc test showed no significant difference in expectancy beliefs (p>.167) nor task value (p>.358) between those who provided responses to the open-ended questions and those who did not. These two constructs were derived from the EVQ.

Data Collection

The PE teachers collected the self-reporting questionnaires in accordance with the instructions of the research leader.

Data Reduction

The open-ended questions regarding costs were reduced, based on a modified version of the categorization in Zhu and Chen (2013) and Chen and Liu (2009), to the following categories and sub-categories: Q1: *If there is anything that you do not like in PE, what would that be? Why?* (1) no cost, (2) perceived costs (curriculum content, instructional conditions/elements, lack of social support/competence, physical discomfort, teacher factor); Q2: *If you had a choice, would you rather not come to PE? Why?* (1) attend PE (attend PE with no reason, academic requirement, motivation, benefits of physical activity in PE), (2) not attend PE (not attend PE with no reason, enough physical activity, curriculum content difficult/boring/not useful, instructional conditions, academic conditions/opportunity cost) and (3) it depends/not sure. The assessment of the students' self-reported answers suggested that these categories covered all the answers, but the category of not attending PE because of "academic conditions" was added because several students responded with "I would focus on other subjects" and "My grade in PE lowered my overall average grade, so I would not choose it." The original category of "Do not like the teacher" was removed, as none of the students' responses fit that category. See Appendix A for a survey of the cost categories, sample student responses and codes.

Data Analysis

Students' responses to the open-ended questions were analysed using an open-coding approach to analysing a whole sentence or paragraph, which was especially useful

when the researcher already had several categories and wanted to code specifically in relation to those categories (Strauss & Corbin, 1998).

Analyses of the coded, open-ended questions were conducted with Friedman's test, as non-parametric distributions across the two test attempts were examined. A Pearson correlation coefficient was computed to assess the relationship between perceived costs and age, and a chi-square test was used to determine whether there was an association between Q1 and Q2. A significance level of 95% was used.

Results

Based on the data analyses, the results from T1 and T2 are presented for both the intervention group and the control group and between genders in the intervention group. Table 1 presents the results of Q1.

Table 1. Frequencies of the Cost Aspects of Attending PE at T1, with T2 in Parentheses. (Q1).

Cost aspect	Intervention group (n = 76)		Control group (n = 106)	
	Count	% within group	Count	% within group
No cost	28 (36)*	36.8 (47.4)	36 (42)	34.0 (39.6)
Perceived costs (total)	48 (40)*	63.2 (52.6)	70 (64)	66.0 (60.4)
Curriculum content	34 (33)	44.7 (43.4)	50 (48)	47.2 (45.3)
Instructional conditions	6 (5)	7.9 (6.6)	6 (6)	5.7 (5.7)
Lack of social support	1 (1)	1.3 (1.3)	2 (5)	1.9 (4.7)
Physical discomfort	6 (1)	7.9 (1.3)	9 (4)	8.5 (3.8)
Teacher factor	1 (0)	1.3 (0.0)	3 (1)	2.8 (0.9)

Note. T1 = measurement before intervention period; T2 = measurement after intervention period.

* = significant change from T1 to T2 ($p < .05$).

The Friedman's test indicated that the intervention group ($\chi^2(1) = 4.00$, $p = .046$) and the control group ($\chi^2(1) = 1.636$, $p = .201$) rated Q1 differently from T1 to T2. The gender differences within the intervention group are presented in Table 2.

Table 2. Frequencies of the Cost Aspects of PE in the Intervention Group by Gender at T1, with T2 in Parentheses. (Q1).

Cost aspect	girls (n = 35)		boys (n = 41)	
	Count	% within group	Count	% within group
No cost	9 (17)**	25.7 (48.6)	19 (19)	46.3 (46.3)
Perceived costs (total)	26 (18)**	74.6 (51.4)	22 (22)	53.7 (53.7)
Curriculum content	16 (14)	45.7 (40.0)	18 (19)	43.9 (46.3)
Instructional conditions	4 (3)	11.4 (8.6)	2 (2)	4.9 (4.9)

(*Continued*)

Tabell 2. (Continued)

Cost aspect	girls (n = 35)		boys (n = 41)	
	Count	% within group	Count	% within group
Lack of social support	1 (1)	2.9 (2.9)	0 (0)	0.0 (0.0)
Physical discomfort	4 (0)	11.4 (0.0)	2 (1)	4.9 (2.4)
Teacher factor	1 (0)	2.9 (0.0)	0 (0)	0.0 (0.0)

Note. T1 = measurement before intervention period; T2 = measurement after intervention period.
** = significant change from T1 to T2 (p < .01).

The Friedman's test indicated that within the intervention group, the girls ($\chi^2(1) = 8.00$, p = .005) and boys ($\chi^2(1)$ = .000, p = 1.000) rated Q1 differently from T1 to T2. Table 3 presents the results of Q2.

Table 3. Frequencies of the Choices of Attending PE at T1, with T2 in Parentheses (Q2).

Attend PE if not mandatory	Intervention group (n = 76)		Control group (n = 106)	
	Count	% within group	Count	% within group
Attend(total)	64 (69)*	84.2 (90.8)	77 (80)	72.6 (75.5)
Attend PE with no reason	5 (10)	6.6 (13.2)	8 (9)	7.5 (8.5)
Academic requirement	4 (3)	5.3 (3.9)	10 (7)	9.4 (6.6)
Motivation	27 (29)	35.5 (38.2)	31 (37)	29.2 (34.9)
Benefits of physical activity in PE	28 (27)	36.8 (35.5)	28 (27)	26.4 (25.5)
Not attend (total)	6 (4)*	7.9 (5.3)	25 (20)	23.6 (18.9)
Not attend PE with no reason	0 (0)	0.0 (0.0)	3 (5)	2.8 (4.7)
Have enough physical activity	2 (2)	2.6 (2.6)	6 (5)	5.7 (4.7)
Curriculum content	1 (1)	1.3 (1.3)	8 (3)	7.5 (2.8)
Instructional conditions	0 (0)	0.0 (0.0)	3 (3)	2.8 (2.8)
Academic conditions	3 (1)	3.9 (1.3)	5 (4)	4.7 (3.8)
Not sure / depends	6 (3)*	7.9 (3.9)	4 (6)	3.8 (5.7)

Note. T1 = measurement before intervention period; T2 = measurement after intervention period.
* = significant change from T1 to T2 (p < .05).

The Friedman's test indicated that the intervention group ($\chi^2(1)$ = 4.50, p = .034) and the control group ($\chi^2(1)$ = .077, p = .782) rated Q2 differently from T1 to T2. The gender differences within the intervention group are presented in Table 4.

The Friedman's test indicated that within the intervention group, the girls ($\chi^2(1) = 5.00$, p = .025) and boys ($\chi^2(1)$ = .333, p = .564) rated Q2 differently from T1 to T2.

Because several studies have found that motivation declines with age, age was also tested in terms of its relationship to the perceived costs of and intention to participate

Table 4. Frequencies of the Choices of Attending PE in the Intervention Group by Gender at T1, with T2 in Parentheses (Q2).

Attend PE if not mandatory	girls (n = 35)		boys (n = 41)	
	Count	% within group	Count	% within group
Attend (total)	26 (30)*	74.3 (85.7)	38 (39)	92.7 (95.1)
Attend PE with no reason	1 (3)	2.9 (13.2)	4 (7)	9.8 (17.1)
Academic requirement	1 (2)	2.9 (3.9)	3 (1)	7.3 (6.6)
Motivation	11 (12)	31.4 (38.2)	16 (17)	39.0 (34.9)
Benefits of physical activity in PE	13 (13)	37.1 (35.5)	15 (14)	36.6 (25.5)
Not attend (total)	3 (3)	8.6 (8.6)	3 (1)	7.3 (2.4)
Not attend PE with no reason	0 (0)	0.0 (0.0)	0 (0)	0.0 (0.0)
Have enough physical activity	1 (2)	2.9 (5.7)	1 (0)	2.4 (0.0)
Curriculum content	0 (0)	0.0 (0.0)	1 (1)	2.4 (2.4)
Instructional conditions	0 (0)	0.0 (0.0)	0 (0)	0.0 (0.0)
Academic conditions	2 (1)	5.7 (2.9)	1 (0)	2.4 (0.0)
Not sure / depends	6 (2)*	17.1 (5.7)	0 (1)	0.0 (2.4)

Note. T1 = measurement before intervention period; T2 = measurement after intervention period.
* = significant change from T1 to T2 ($p < .05$).

in PE (both at T1). The results of a Pearson correlation coefficient test (two-tailed, pairwise exclusion) showed that age correlated with perceived costs (Q1) (n = 252, r = .140, p = .026) and with the intention to participate in PE (Q2) (n = 287, r = .190, $p < .001$). Neither of the correlations were strong. When controlling for gender, the results of Q1 were as follows: girls (n = 122, r = .100, p = .274) and boys (n = 130, r = .164, p = .062). When controlling for gender, the results of Q2 were as follows: girls (n = 139, r = .218, p = .010) and boys (n = 148, r = .095, p = .249). These analyses included all students who answered Q1, Q2 or both, independent of belonging to the intervention group or the control group.

A chi-square test was used to demonstrate whether there was an association between cost aspects and subsequent hypothetical choices at T1. The result of the chi-square analysis revealed that the association between these two variables was statistically significant (n = 249, $\chi^2(2) = 16.13$, $p < .001$), which suggested that adolescents' cost aspects were associated with their hypothetical choices. A medium Cramer's V effect size of .255 was estimated (Cohen, 1988). The adolescents who reported no motivational cost were more likely to choose to attend PE than those who reported a motivational cost. When comparing genders, more than 20 % of the expected counts were less than five, and the test could not be used. These analyses included all students who answered Q1, Q2 or both, independent of belonging to the intervention group or the control group.

Discussion

The answers to Q1 revealed what aspects of PE the students did not like and thus the costs of attending PE. Table 3 shows that FL significantly reduces the perceived costs of attending PE. Table 4 shows that the difference between the intervention group and the control group is due to gender. Compared to the boys, the girls perceived significantly less costs in attending PE after three lessons in which FL was used as a method, whereas no differences were observed among the boys.

About 45% of all students reported that "curriculum content" was the perceived cost of attending PE. This percentage was similar among all the students and did not change significantly from T1 to T2. A comparable distribution of perceived costs of attending PE is also found in previous studies among Norwegian adolescents (Säfvenbom et al., 2014), students in U.S. elementary schools (A. Chen et al., 2008), students in U.S. middle schools (Zhu & Chen, 2013) and Chinese college students (A. Chen & Liu, 2009).

Q2 revealed whether the students experienced opportunity cost in attending PE, as PE was a mandatory subject. Table 5 shows that FL significantly increases the number of students who would attend PE if given the choice. Table 6 shows that this difference is due to girls and their shift from "not sure/it depends" to "attend PE." There is a minor, positive change among boys as well, but this change is not significant.

So, why do girls perceive significantly less costs in attending PE when the class content is delivered as FL compared to boys, and why do boys not report the same change? "Physical discomfort" was one category that was reported less at T2 than T1, both for the intervention group and the control group. This shows that the practical lessons in this project were somewhat different from their normal class content. Among boys in the intervention group, responses to the category "physical discomfort" went from two counts to one count, but among girls in the intervention group, this went from four counts to zero counts. One possible answer to why the perceived costs of attending PE are less when the class content is delivered as FL may be that students tend to be more motivated when they understand why the learning activities are conducted and when they understand the context, as shown by Ryan and Deci (2000) and Skaalvik and Skaalvik (2015). The control group performed the exact same activities but did not demonstrate a significant change in counts. This view is also supported by Moen et al. (2018), who found that a representative selection of Norwegian primary school students wanted the PE teachers to ask more questions, the PE classes to have more opportunity for discussion and the curriculum content to focus on knowledge development.

Considering that curriculum content produces the most negative feelings towards PE, FL can provide meaning to the activities to enhance their relevance and to increase students', especially girls', motivation to engage with the content. Responses to Q1 in the category of "physical discomfort" included "we have to be outside when it is cold," "I don't like running because I have trouble with my legs" and "I don't like that it hurts when we do exercises, but if we do then it will get better." These

responses indicated dissatisfaction with the activities in terms of the weather, the type of activity and where the activity was conducted. Hence, the perceived costs mainly stemmed from the class content. It seems that variation and more information and knowledge about the practical activities can lower the perceived sensation of physical discomfort and thus reduce the costs of attending PE. Out of these factors, FL can contribute with information and knowledge, while the PE teachers must take responsibility for providing variation. But if teachers start exploring new teaching methods, this alone will create more reflection on and consciousness of the curriculum and class content. Several researchers suggest a more holistic approach to teaching in PE (Dyson, 2014; Ennis, 2011), and teachers who use a wide range of learning methods tend to motivate students to participate in PE more than teachers who use limited learning methods (Dyson, 2014; Moen & Green, 2012).

This study supports earlier studies in which PE was found to present challenges in terms of class content and teaching methods (e.g. Moen et al., 2018) but not that the class content was more beneficial for boys than for girls (e.g. Engelsrud, 2015), as both boys and girls had the same distribution regarding the perceived costs of attending PE lessons. Nevertheless, PE teachers must reflect more upon the content applied to practical classes, as the perceived cost of attending PE is mostly the result of the content and is not due to other factors, such as peers and teacher-student relationships. As suggested by Moen et al. (2018), it seems that PE has not become less "sportified" than it was before.

PE teachers must be aware of the gender differences in PE considering that girls receive lower marks in PE than boys (Statistics Norway, 2017) and have a less positive attitude towards PE than boys (Säfvenbom et al., 2014). There is clear evidence that FL, if conducted in a similar way to that done in this study, can have a significant, positive impact on adolescents', especially girls', perceived costs of attending PE. The responses to the open-ended questions and the results presented in Tables 3 and 4 must be juxtaposed with earlier findings demonstrating that FL significantly affects girls' expectancy beliefs and attainment value in PE (Østerlie, 2018). As the value of attending PE increases and expectancy beliefs increase, less costs are perceived. This assumption is also observed in academic settings, such as reading. The more explicitly the values of an assignment are explained, the more likely students will become engaged in the assignment and remain motivated to continue studying in the content area (Paris, Lipson, & Wixson, 1983; Wigfield, 2000). These findings provide empirical evidence for the demonstrated theoretical coherence of adolescents' motivation to participate in PE according to expectancy-value motivation, which suggests that expectancy beliefs and subjective task values work in the opposite direction of perceived costs when motivation is changing (Eccles & Wigfield, 2002).

This study found that the majority of adolescents would attend PE if given the choice, despite their perceived costs of attending. About 65% of adolescents reported perceived costs in attending, but only about 21% indicated that they would not attend PE if given the choice. Chen et al. (2009; 2008) found the same among college

PE students and PE students in elementary school, suggesting that the strong, positive values of physical activity override the effect of cost. Thirty-five percent of adolescents reported no negative perceptions of PE, suggesting that it is one of the most-liked subjects in school, as this percentage was even higher than that found in other studies (Zhu & Chen, 2013).

This study shows that adolescents who report perceptions of cost in attending PE are more likely to not want to attend PE lessons. The same association is observed among younger students (Zhu & Chen, 2013), but not among college students (A. Chen & Liu, 2009). Several researchers have shown that both internationally (e.g. Gao et al., 2008) and in Norway (Moen et al., 2018), the motivation to participate in PE declines with age. This study confirms this by demonstrating how the perceived costs of attending PE increase with age and the intention to participate in PE declines with age. Both girls and boys report an increase in perceived costs as they get older, but these costs have a different effect on girls than on boys regarding the hypothetical choice of participating in PE. It would be important to investigate these gender differences further. Nevertheless, age predicts a motivational decline among young people, and this study shows that FL can be an important contributor to decelerate motivational loss, especially among girls.

Strengths and Limitations

The sample used in this study represents a diversity of locations in urban and rural areas and thus reflects the general adolescent population in Norway. Moreover, the students' semester marks in PE corresponded with the national average grade for the actual semester, which indicated that the present sample did not differ from the general population of Norwegian adolescents. The PE teachers administered the data collection at the beginning of a PE lesson, thus ensuring anonymity and ensuring that students had enough time to complete the questionnaire. This procedure of using a well-known teacher in familiar surroundings contributed to the students feeling comfortable in the assessment situation, which helped to generate reliable data.

Despite its strengths, the study has some limitations. First, the study included adolescents who were 13–17 years old. Thus, the present results cannot be generalized to younger children nor to older adolescents. Second, the intervention period only included three sessions. Third, as there is no framework on how FL should be conducted in PE, these results must be interpreted considering the research design. Hence, the generalisability of the results of the study are limited if later FL designs in PE differ from the design in this study.

Conclusions

This study shows that FL lowers adolescents' perceived costs of attending PE. Thus, FL positively affects adolescents' motivation to participate in PE. As discussed, FL seems to benefit girls more than boys in a PE setting, and hence can reduce the

gender differences found in PE. This study shows that adolescents who report perceived costs of attending PE are more likely to not want to attend the subject and further that the perceived costs of attending PE increase with age and the intention to participate in PE declines with age.

The present study provides further evidence that class content remains a challenge in PE, as the adolescents reported curriculum content as the biggest contributor to their perceived costs of attending PE. Nevertheless, most of the students indicated that they would attend PE if the subject were optional, despite the costs they perceived in attending. Overall, the results suggest that teachers must design curriculum content that not only physically engages the students but also demands higher-order cognitive processes to maintain adolescents' motivation to attend PE. To achieve this end, FL can be used.

Future research should identify and examine best FL practices in PE, including a framework for FL use, and determine how FL and gender differences affect the motivation and intention to participate in PE among both younger children and older adolescents.

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Author biography

Ove Østerlie is an educator and researcher in physical education. Main research areas are didactics and teaching methods in physical education with speciality in flipped learning and physical education as an inclusion arena.

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Paper III

Østerlie, O., & Mehus, I. (n.d.). The impact of flipped learning on cognitive knowledge learning and intrinsic motivation in Norwegian secondary physical education. (Submitted)

The impact of flipped learning on cognitive knowledge learning and intrinsic motivation in Norwegian secondary physical education

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Abstract

The purpose of the present study was to examine if and how the introduction of a flipped learning (FL) framework in Norwegian lower- and upper secondary school PE could affect student situational motivation and health related fitness knowledge (HRFK). The results showed a negative motivational change for male students unless the activity changes were placed within an explanatory rationale through FL, and the application of FL caused more cognitive knowledge learning, resulting in higher levels of HRFK. The current research provided valuable insights into Norwegian students' motivation for PE and that cognitive knowledge learning can be affected when integrating the use of ICT in PE.

Introduction

In the Norwegian curriculum of physical education (PE), an important goal is to provide students with the necessary knowledge and motivation to ensure that participation in PE should translate into a life-long participation in physical activity (PA) (Norwegian Directorate for Education and Training, 2015). Motivation for participation in PE is considered important as motivation has, theoretically and empirically, been linked to several positive outcomes, such as intentions to be physically active outside of class (Cox, Smith, & Williams, 2008; Ntoumanis, 2001; Owen, Smith, Lubans, Ng, & Lonsdale, 2014; Standage, Duda, & Ntoumanis, 2003). Such research lends support to the trans-contextual model suggested by Hagger, Chatzisarantis, Barkoukis, Wang, and Baranowski (2005), in which an autonomy supportive teacher style creates autonomous motivation and leisure time PA among students, suggesting that PE may play a role in shaping young people´s beliefs and behaviour concerning PA outside school hours. Physical activity promotes physical and mental health, and is an important and well documented way of preventing and treating over 30 different diagnoses and conditions (The Norwegian Directorate of Health, 2014). Thus, participation in PE is often connected to worries concerning the physical activity level of the population. For instance, only 34% of European adolescents aged 13-15 years are active enough to meet the current guidelines of 60 minutes of moderate physical activity per day (World Health Organization [WHO], 2016), and in the USA only 27.1% meet these recommendations (Centers for Disease Control and Prevention [CDC], 2014). Norwegian 15 year olds appear to reach a higher level of physical activity level, with 40 % of girls and 51 % of boys reaching the recommended level, but the time that 15 year olds spend sitting still (sedentary time) has risen to about nine hours of their time awake (Norwegian Institute of Public Health, 2019).

However, research also show that students experience barriers to participating in PE, such as peer pressure and boys´ dominance, and have negative feelings towards participation (Allender, Cowburn, & Foster, 2006; Cardinal, Yan, & Cardinal, 2013). Internationally, and including Norway, PE is stated to be too dominated by sports-like activities (Dyson, 2014; Ennis, 2011; Moen, Westlie, Bjørke, & Brattli, 2018), and that boys and students who conduct sport outside schools benefit most from the subject (Andrews & Johansen, 2005; Dowling, 2016; Ennis, 1999; Lundvall, 2016; Oliver & Kirk, 2015; Scraton, 2013; Säfvenbom, Haugen, & Bulie, 2014; Vlieghe, 2013). Such issues might explain why PE does not seem to complete the given aim of inspiring all children to be active and to promote a life-long healthy lifestyle,

either in Norway (Moen et al., 2018; Säfvenbom et al., 2014) or internationally (Green, 2008; Palakshappa, Virudachalam, Oreskovic, & Goodman, 2015).

It is also important to acknowledge that there is uncertainty about the subject's educational purpose. Both teachers and pupils have difficulties in articulating what the pupils are supposed to learn in PE, and teachers maintain that the main purpose of PE is to 'have fun' (Larsson & Redelius, 2008), or keep the students 'happy, busy and good' (Henninger & Coleman, 2008; Placek, 1983; Ward & Griggs, 2018), and continue practicing a traditional teacher-centred teaching style (Green, 2008). Learning in PE is a complex matter, and, according to Rink (2003), PE stands out as a school subject, including learning in the three domains of psychomotor-, affective-, and cognitive learning. Even though cognitive knowledge learning is important in the curriculum of PE, it has rarely been included as an outcome measure in research (Haichun Sun, 2016; H. Sun, Li, & Shen, 2017). Furthermore, studies indicate that the gymnastics hall is not a suitable space for lecturing, as the vigorous context shifts the students` motivation away from cognitive learning, toward physical participation (S. Chen, Chen, Sun, & Zhu, 2013). Nevertheless, Zhu, Haegele, and Sun (2019) found that middle school students' health-related fitness knowledge (HRFK) was low, but growing linearly throughout middle school, with girls displaying a higher growth rate than boys, when implementing a curriculum tailored to enhance HRFK. A. Chen and Ennis (2009) presented results from an inquiry among elementary school students showing that PE levels do not decline when implementing cognitive learning processes in PE, and this gives support to the mantra of Silverman (2011) stating that the goal of teaching is learning, and learning in PE requires more than just activity. There seems to be a need for researchers to change focus from studying activities to studying learning outcomes (Larsson & Redelius, 2008), and to investigate how students can learn better in PE we need to understand what and how their motivation towards PE is affected.

Motivation

According to self-determination theory (SDT: Ryan & Deci, 2017), motivation is a multidimensional construct reflecting different degrees of self-determination. SDT distinguishes between different types of motivation based on the different reasons or goals that give rise to an action. A person's motivation is conceptualized by SDT researchers to vary on a continuum from intrinsic motivation to amotivation. Broadly speaking, the types of motivation that reflect behavioural engagement as a result of enjoyment/task interest (intrinsic

motivation - IM), or integration of a behaviour into one's core self and value system (integrated regulation), or due to the perceived personal utility and benefits of the behaviour (identified regulation - IR), have been combined to form *autonomous* motivation (Ryan & Deci, 2000). In disparity, motivations that reflect behavioural engagement stemming from internal pressures such as guilt or ego contingencies (introjected regulation), or external burdens such as rewards or castigations (external regulation - ER) are named *controlled* forms of motivation. Organismic Integration Theory (OIT: Deci & Ryan, 2002) posits a continuum of different types of motivation, ranging from amotivation (AM) to internal motivation. An important tenet of OIT is that behaviours can start as externally regulated, and then become more internally regulated over time as the behaviour is more and more integrated into the sense of self.

In a school context, it is desirable for all students to achieve a high level of engagement in learning activities that can result in a high learning outcome. Ryan and Deci (2017) argue that self-determined motivation is high-quality motivation and results in the desirable outcome of engagement. Autonomous motivation is considered an important basis for learning, and students who are autonomously motivated tend to learn better, especially in terms of conceptual understanding (Niemiec & Ryan, 2009).

Motivation in PE

In PE, *autonomous* motivation would be that students identify with the value of the activity and integrate it into their sense of self, and *controlled* motivation would be to participate in the activity due to some external reward or punishment (e.g. grades) or internal reward or punishment (e.g. pride or shame). In a recent review of 74 studies applying SDT in PE settings by Van den Berghe, Vansteenkiste, Cardon, Kirk, and Haerens (2014) support was found for the motivational sequence suggested by SDT, in which student motivation impacts the outcomes in PE and leisure time PA. Such findings are also supported within the Norwegian context, where self-determination in PE has been shown to positively affect adolescents´ intentions to be physically active after graduation from high-school (Erdvik, Øverby, & Haugen, 2014). There is a clear observation of a decline in motivation to participate in PE with age (Mowling, Brock, Eiler, Rudisill, & Dance, 2004; Säfvenbom et al., 2014; Xiang, McBride, & Guan, 2004), especially among girls (Moen et al., 2018; Thomas, Lee, & Thomas, 2008). This decline in motivation must be halted, as learning in school is

strongly associated with, and predicted by, motivation (Skaalvik & Skaalvik, 2015). Nevertheless, previous studies have also shown mixed results related to the development of students´ motivation related to age. Some studies show a decline in students´ internal motivation across the school years, whereas external motivation stays relatively stable (Digelidis & Papaioannou, 1999; Ntoumanis, Barkoukis, & Thøgersen-Ntoumani, 2009). There are also examples of internal motivation decreasing and external motivation increasing (Ullrich-French & Cox, 2014). Others again show internal motivation to be stable, whereas external motivation increases (Yli-Piipari, John Wang, Jaakkola, & Liukkonen, 2012). Yli-Piipari et al. (2012) suggest that stable internal motivation over time might be explained by the highly autonomy supportive environment created by Finnish PE teachers. Labbrozzi, Robazza, Bertollo, Bucci, and Bortoli (2013) found a decline in IM and IR among girls when passing the age of puberty and that both the levels of IM and IR were highly correlated to the levels of physical activity.

In addition to long term development of motivational regulations, there is also the important issue of short-term fluctuations. Carpentier and Mageau (2016) found that the type of feedback used during a training session impacts motivational regulations, and the more autonomy supportive change-oriented feedback athletes received, the higher was the level of autonomous motivation reported following such training sessions. In training interventions, autonomous regulations appear to increase over time, with increases being present already between the baseline and four weeks (Duncan, Hall, Wilson, & Rodgers, 2012). It appears that changes in external motivation take a somewhat longer time, with the earliest changes detected six to eight weeks after the baseline (Wasserkampf & Kleinert, 2016).

Research concerning participation in PE and cognitive knowledge learning have shown some contradictory results. Haichun Sun and Chen (2010) found no relationship between intrinsic or extrinsic motivation and students´ knowledge learning. There was, however, a significant negative relationship between amotivation and cognitive knowledge gain. In another relevant study, Langdon, Webster, Hall, and Monsma (2014) found students´ autonomous motivation positively related to a volleyball cognitive knowledge test score. H. Sun et al. (2017) suggest that the contradictory results might be explained by the clarity of learning goals. When teaching a sport unit like volleyball, PE teachers might give more clear and specific learning goals. Digital technologies can be a facilitator for both enhanced motivation and learning in PE (Armour, Casey, & Goodyear, 2017). Rather than dispensing knowledge in PE, digital technology can facilitate the building up of knowledge among

students (Parker et al., 2017). As students welcome innovative curricula and approaches (Dyson, 2006), new frameworks for teaching and learning, including the use of digital technology, should be applied to PE. Flipped learning is one of these new learning frameworks.

Flipped learning

Flipped learning (FL) approaches facilitate a more and student-centred and learning-focused view, rethinking the traditional way of conceiving and teaching: "The flipped approach inverts the traditional classroom model by introducing course concepts before class, allowing educators to use class time to guide each student through active, practical, innovative applications of the course principles" (Academy of Active Learning Arts and Sciences [AALAS], 2018). FL describes an inversion of where learning activities take place (Wilson, 2013), promoting active learning strategies and student motivation (McLaughlin et al., 2014). According to (Yough, Merzdorf, Fedesco, & Cho, 2017), SDT provides an ideal frame for investigating the motivational implications of FL, where FL could very well function as part of autonomy supportive classrooms, promoting students´ internalization process and internal motivation. Autonomy supportive intervention programs (ASIPs) basically rely on noncontrolling language, providing explanatory rationales, and accepting and acknowledging negative affect (Reeve, 2009, 2011). When teachers become more autonomy supportive, students show gains in autonomous motivation, engagement, well-being, conceptual learning, and academic achievement (Cheon, Reeve, Lee, & Lee, 2018). This study does not include a fully developed ASIP, however FL includes the introduction of digital technologies in terms of video introductions made available before class which aim to provide an explanatory rationale for the PE-class.

The concept of FL in PE includes obtaining more time for practical activity, and arranging for more physical and cognitive learning by the students in preparing prior to class. This preparation is preferably a video specific to the upcoming class and includes both practical information about the activities and theoretical knowledge underpinning the class topic/aim (Østerlie & Kjelaas, 2019). Very little research has been undertaken into the FL approaches (Abeysekera & Dawson, 2015) included in PE (Sargent & Casey, 2019). Casey, Goodyear, and Armour (2017) argue that there is a lack of research on how digital technologies are used and how they affect motivation and learning in PE. However, there are

studies suggesting that FL has a positive impact on student motivation in PE, especially among girls (Østerlie, 2018a, 2018b), and that both cognitive learning and perceived value of the subject are positively affected when a FL framework is applied in PE (Østerlie & Kjelaas, 2019). In a Chinese study of teaching basketball in PE, Chiang, Yang, and Yin (2018) concluded that female students benefit more from flipped learning strategies compared to boys. The authors suggested that the observed gender differences might be explained by female students taking better advantage of the possibility to watch and repeat practice.

Further, in secondary school FL, approaches are used to promote individualization in learning orienteering skills (García, Lemus, & Morales, 2015) and to help learn rules in new games (Bergmann & Sams, 2014), with positive outcomes. Student learning in PE, in general terms, has in several studies been demonstrated to be positively affected as more time is allocated to practical activities when comparing FL classes to traditionally conducted ones (Isidori, Chiva-Bartoll, Fazio, & Sandor, 2018; Killian, Trendowski, & Woods, 2016; Lina, 2017; Sargent & Casey, 2019; Østerlie, 2016). In university PE, Hinojo-Lucena, Mingorance-Estrada, Trujillo-Torres, Aznar-Díaz, and Cáceres (2018) have demonstrated that a FL approach improves academic performance and positively affects motivation. While some negative aspects of FL are pointed out, like the extra work-load that some students perceive (Akçayır & Akçayır, 2018; Missildine, Fountain, Summers, & Gosselin, 2013), the reported challenges are far fewer than the reported advantages (Akçayır & Akçayır, 2018), and a recent review of FL in K-12 education concludes that FL promotes active learning, providing a neutral or positive impact on student achievement (Lo & Hew, 2017).

Considering the limitations of previous research and the presented rationale, the purpose of the present study was to examine if and how the introduction of a flipped learning framework in Norwegian lower- and upper secondary school PE could affect student situational motivation and health related fitness knowledge (HRFK).

Method

Participants

Norwegian students (N = 206, 56.6 % of 364 invited) from six different secondary and upper secondary schools were included in this research project over a period of three weeks, during spring 2016. Self-reported information on sex, date of birth and name were obtained from the

questionnaires to describe the sample. The girls (n = 97) had an average age of 15.34 years (SD = 1.35) and the boys (n = 109)15.02 years (SD = 1.18). The participants were from four different levels in the Norwegian school system: the three years of secondary school and the first year of upper secondary school; Year 8 (n = 71), Year 9 (n = 63), Year 10 (n = 7), VG1 (n = 65). The students' marks (girls: 4.49 and boys: 4.54) in the same semester also reflected the national average for 10th grade (girls: 4.5 and boys: 4.6) (Statistics Norway, 2016). The schools involved represented both rural and central communities, with a normal distribution of immigration and social statuses. The Norwegian Centre for Research Data (NSD)[1] gave their consent to conducting the present project (Project #47604), and the researchers followed the ethical guidelines and recommendations of The National Committee for Research Ethics in the Social Sciences and the Humanities [NESH] (2016), including obtaining written consent from all participants above the age of 15 years, and from the parents of those students below the age of 15 years.

The intervention

The intervention took place in the spring of 2016 and lasted over a period of three weeks. Three learning resources regarding endurance, strength and coordination were applied to the PE classes. Each resource consisted of a video that was assigned for viewing as homework before class, one in-class lesson plan the PE teachers performed, and a teacher's guide. The participants were divided into two groups: an intervention group (The flipped learning group, FL) and a control group (The non-flipped learning group, NFL). The FL group had access to the assigned homework before class, which comprised an online video. To best reflect traditional PE in Norway, some of the NFL classes were given an approximately five minute oral lesson on the class topic, a short summary of the video content, while some classes only carried out the activities. The videos were published online and lasted about 12 minutes, a timeframe within the suggested length for educational videos (Lagerstrom, Johanes, & Ponsukcharoen, 2015; Long, Logan, & Waugh, 2016). Each video gave an age-appropriate presentation of the upcoming PE class topic. For example, when endurance was the weekly topic, the video explained endurance by arguing why endurance improves health, what happens in the body when endurance is gained, and how to raise endurance. At the end of the video, a summary of the upcoming class content was given. As suggested by Geri, Winer, and

[1] https://nsd.no/nsd/english/

Zaks (2017), Long et al. (2016), and Frydenberg (2012), short quizzes embedded in the videos were used to enhance the students' motivation to continue watching and to develop a deeper understanding of the content. The PE lessons were strongly linked to the video content and consisted of play-based activities, focusing on one of the three topics in the intervention. As the content of PE traditionally has been focused on ball games and fitness training, something affirmed by Moen et al. (2018), the activities were based in a play-like manner to best fit all the participating students. Both the intervention and the control group performed the same activities. Further, the activities were grounded in a student-centred approach with an emphasis on cooperative learning, as this approach is shown to produce high levels of student engagement and empowerment so that students become central to the learning process, thus facilitating learning in all three of the psychomotor, cognitive and affective learning domains (Wallhead & Dyson, 2017). As parts of the instructions of the activities were given in the videos, the teacher could take a role as more of a guide and co-learner than the role of an instructor. All video- and class content were based on relevant aims in the Norwegian national curriculum for secondary school physical education (Norwegian Directorate for Education and Training, 2015).

Measures

Motivation. Students` self-determined motivation for participation in PE was measured using the Situational Motivational Scale (SIMS; Guay, Vallerand, & Blanchard, 2000) with the initial question: "Why do you participate in PE?". The SIMS is designed to measure intrinsic motivation (IM), identified regulation (IR), external regulation (ER), and amotivation (AM). There are two versions of the SIMS where these four constructs are built from 16 or 14 items. Two items from the 16-item version are omitted in the 14-item version, and the 14-item SIMS has been demonstrated to be a superior fit than the 16-item SIMS in producing scores with acceptable reliability and validity in the educational and PE contexts (Martín-Albo, Núñez, & Navarro, 2009; Standage, Treasure, Duda, & Prusak, 2003; Østerlie, Løhre, & Haugan, 2019), and have since been used in the PE context in several different countries (Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009; Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011). The Norwegian version has been previously used in various studies (Erdvik et al., 2014; Säfvenbom et al., 2014) and later demonstrated to be both a reliable and valid instrument for measuring

situational motivation in PE, echoing the original version also in the superiority of the 14-item version (Østerlie et al., 2019).

Health related fitness knowledge (HRFK) was in the present study assessed by a multiple-choice test of the three topics of endurance, strength and coordination. Sample questions included “Why do you gain strength when training strength?” and “What does endurance mean?” with one or more options indicating the right answer(s). The twenty questions emerged from two curriculum aims for the 10th grade : “practice and explain the basic principles of exercise and training” and “elaborate on the relationship between different physical activities, lifestyles and health” (Norwegian Directorate for Education and Training, 2015). As students from the initial grade in upper secondary school were also included in the study, the test was checked to align with the curriculum aims for PE in VG1 on the topic of exercise, training and health. A pilot examination of the fitness knowledge test was conducted, resulting in some small adjustments to ensure that the questions were understood and that the levels of difficulty were appropriate for the given ages.

Procedure

The students’ PE teachers handed out and collected the self-reporting questionnaires. This was done as instructed by the research leader at the start of the PE classes.

Data Reduction and Analysis

The responses to the items on the SIMS were entered in SPSS and reduced by the constructs IM, IR, EM, and AM. The HRFK tests were scored as suggested on multiple choice tests, where more than one answer may be correct (Lesage, Valcke, & Sabbe, 2013), and the three constructs endurance, strength and coordination were computed from the twenty questions. The three constructs combined would represent the students’ HRFK. Before conducting the statistical tests, the data were cleaned and screened for out-of-range values, outliers, and sample distribution normality (Tabachnick & Fidell, 2007). The formal normality tests showed values of skewness and kurtosis within normal range (< |.62|). Normal range is suggested to be < |2| (West, Finch, & Curran, 1995). Considering this, the data were regarded fit for conducting statistical tests for comparing means. The one-way repeated measures ANOVA test, with an alpha level of .05, was used to determine whether male and female

student motivation and knowledge had changed over time and to what extent the introduction of FL would impact student motivation and HRFK. The Pearson correlational coefficients were computed to discover possible correlations between any types of motivation and HRFK.

Results

Table 1 shows descriptive statistics of each variable of the SIMS by gender, type of group and time of measurement.

Table 1. Mean and (SD) for each variable of the situational motivational scale (SIMS) and health related knowledge (HRFK) in the intervention and control group by gender at T1 and T2.

	T1						T2					
	FL		NFL		TOTAL		FL		NFL		TOTAL	
	Girls n = 36	Boys n = 49	Girls n = 61	Boys n = 60	Girls n=97	Boys n=109	Girls n = 36	Boys n = 49	Girls n = 61	Boys n = 60	Girls N=97	Boys N=109
IM	5.07 (1.37)	5.25 (1.13)	4.62 (1.51)	5.44 (1.41)	4.79 (1.47)	5.35 (1.29)	5.26 (1.44)	5.32 (1.27)	4.62 (1.58)	4.78 (1.69)	4.86 (1.55)	5.02 (1.54)
IR	5.67 (1.13)	5.52 (1.03)	5.16 (1.35)	5.47 (1.48)	5.35 (1.29)	5.49 (1.29)	5.60 (1.30)	5.56 (1.13)	4.98 (1.32)	5.11 (1.27)	5.21 (1.34)	5.31 (1.23)
ER	5.53 (1.21)	4.81 (1.62)	5.19 (1.62)	4.37 (1.55)	5.31 (1.48)	4.57 (1.59)	5.32 (1.50)	4.90 (1.40)	5.11 (1.57)	4.53 (1.59)	5.19 (1.54)	4.69 (1.51)
AM	2.26 (1.12)	2.47 (1.06)	2.39 (1.17)	2.07 (1.22)	2.34 (1.14)	2.25 (1.17)	1.94 (1.02)	2.57 (1.19)	2.35 (1.13)	2.36 (1.25)	2.19 (1.10)	2.45 (1.22)
HRFK	53.17 (6.91)	51.67 (5.42)	54.25 (5.96)	52.67 (6.22)	53.85 (6.32)	52.22 (5.87)	55.67 (7.13)	56.35 (6.77)	55.52 (6.25)	54.90 (6.29)	55.58 (6.56)	55.55 (6.52)

Note: FL = flipped learning group/intervention group; NFL = non-flipped learning group/control group; IM = intrinsic motivation; IR = identified regulation; ER = external regulation; AM = amotivation; HRFK = health related fitness knowledge

A set of independent sample *t* - tests at T1 show that girls (M = 4.79, SD = 1.47) scored lower on IM compared to boys (M = 5.35, SD = 1.29) (t = -2.94, df = 204, p < .01). On ER it was the opposite, with girls (M = 5.31, SD = 1.48) scoring higher compared to boys (M = 4.57, SD = 1.59) (t = 3.48, df = 204, p < .01). There were no differences between the FL- and NFL group.

For IM there was no main effect from time: $F(1, 202) = 1.43$, $p > .05$. However, the interaction effects of time by instruction type and time by gender were statistically significant: $F(1, 202) = 7.60$, $p < .01$, partial $\eta 2 = .36$, $F(1, 202) = 5.56$, $p < .05$, partial $\eta 2 = .027$, respectively.

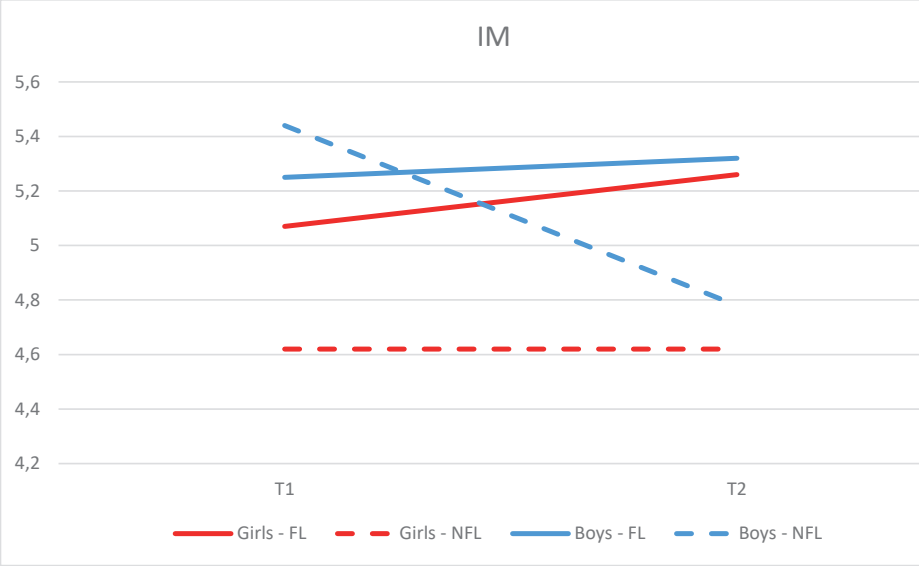

Figure 1. Intrinsic motivation (IM) for boys and girls in the FL- and NFL groups over measurement times.

Due to interaction effects, simple effects for gender and instruction type were calculated. There was an effect for boys: $F(1, 108) = 8.06$, $p < .01$, partial $\eta 2 = .069$. For girls this effect was not statistically significant: $F(1, 96) = .37$, $p > .05$, partial $\eta 2 = .004$. The simple effect for instruction group was significant for the NFL group: $F(1, 120) = 7.10$, $p < .01$, partial $\eta 2 = .056$, and not significant for the FL group: $F(1, 84) = 1.44$, $p > .05$, partial $\eta 2 = .017$.

There were no main- or interaction effects concerning IR or ER. There was, however, a time by gender interaction effect on AM: $F(1, 202) = 6.56$, $p < .05$, partial $\eta 2 = .031$. Calculating simple effects shows a significant effect for male students: $F(1, 108) = 4.12$, $p < .05$, partial $\eta 2 = .037$. The effect was not significant on female students: $F(1, 96) = 2.0$, $p > .05$, partial $\eta 2 = .020$.

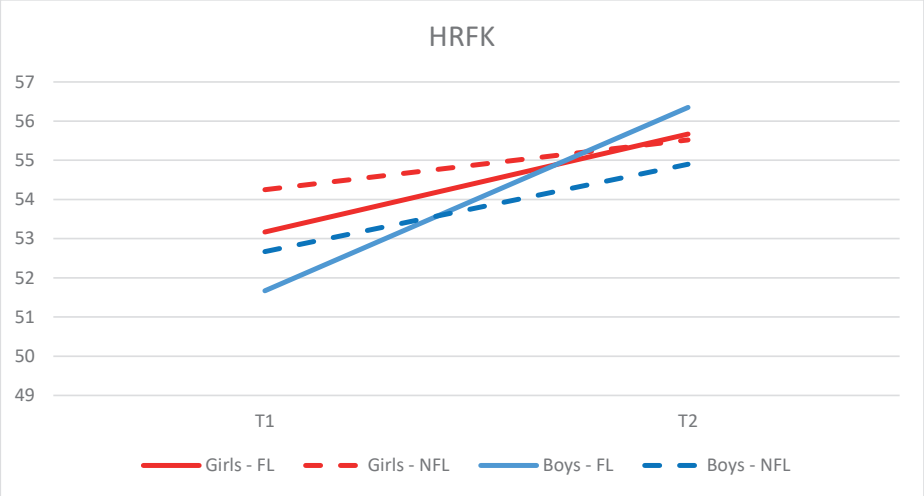

Figure 2. Health related fitness knowledge (HRFK) for boys and girls in the FL- and NFL group over measurement times.

There was a main effect of time on HRFK: $F(1, 202) = 55.48$, $p < .01$, partial $\eta 2 = .215$. There was also a significant interaction effect of instruction group and gender on HRFK: $F(1, 202) = 6.51$, $p < .05$, partial $\eta 2 = .031$ and $F(1,202) = 4.76$, $p < .05$, partial $\eta 2 = .023$, respectively.

Simple effects for gender show significant effect for both girls: $F(1, 96) = 12.51$, $p < .01$, partial $\eta 2 = .115$, and boys: $F(1, 108) = 42.42$, $p < .01$, partial $\eta 2 = .282$. Whereas simple effects for instruction group were significant for both the FL group: $F(1, 84) = 35.97$, $p < .01$, partial $\eta 2 = .30$, and the NFL group: $F(1, 120) = 18.22$, $p < .05$, partial $\eta 2 = .132$.

Discussion

When implementing changes from a traditional sport oriented PE towards a more varied and play-like PE, the main findings in this study show negative motivational changes for male students unless the activity changes are placed within an explanatory rationale through FL.

Motivation

Previous research involving SIMS in the Norwegian context has shown that boys score higher on IM compared to girls, and that girls score higher on ER compared to boys

(Säfvenbom et al., 2014). This was also the case in our sample at T1, showing a point of departure in which boys are more autonomously motivated, with girls displaying a higher level of controlled motivation towards participation in PE. Looking at previous studies, there is reason to expect decreasing levels of autonomous motivation during the school years for both girls and boys (Digelidis & Papaioannou, 1999; Ntoumanis et al., 2009). However, the results show an interaction effect between gender and time, with a decreasing level of IM for boys from T1 to T2, whereas girls´ IM appears to be stable. These results need to be interpreted together with the interaction effect between instruction group and time, with a decreasing level of IM for the NFL group from T1 to T2, whereas the FL group appears stable. Figure 1 illustrates both interaction effects and shows that the IM of boys in the NFL group decreases from T1 to T2. The slight increase in mean IM for boys and girls in the FL group is not significant and therefore appears stable, along with the IM of girls in the NFL group.

One important question is why boys in the NFL group experience a decrease in their IM. Part of the answer can be found in the activity change from traditional PE to a more play-like PE. The value system of traditional PE coincides with the value system of organized youth sport, emphasizing a discourse of competition, and resulting in a sport oriented PE (Säfvenbom et al., 2014). Studies in Norway and several other countries have shown that students who participate in organized sport outside school hours dominate and receive better grades in PE, particularly in the case of boys (Andrews & Johansen, 2005; Dowling, 2016; Ennis, 1999; Lundvall, 2016; Oliver & Kirk, 2015; Scraton, 2013; Säfvenbom et al., 2014; Vlieghe, 2013). The shift from a traditional, sport oriented PE could very well be expected to have more negative consequences for boys since they prefer and dominate traditional PE. Thus, the activity change could also explain the small (but significant) increase in AM for the boys.

This explanation is supported by the stable IM for girls in the NFL-group. Girls participate to a lesser extent in organized sport and therefore do not adapt equally well to traditional PE compared to boys (Säfvenbom et al., 2014), and the motivation for participation in PE is expected to drop, especially among girls (Moen et al., 2018; Thomas et al., 2008). We therefore argue that the activity change towards play-like activities in itself is more beneficial for girls´ IM.

We then turn our attention to the combination of activity change and FL-intervention. Since the IM of boys in the FL group is stable and the IM of boys in the NFL-group declines,

the FL intervention appears to decelerate the process of decreasing IM in boys when encountering activity changes. We interpret these results to show that providing context and meaning to activity changes in PE, in an autonomy supportive way, is of crucial importance. Chiang et al. (2018) found gender differences with FL to be more beneficial for female students, and suggest that female students take better advantage of the opportunity to watch and repeat video instructions. In contrast, the findings in the present study indicate relatively higher benefit from FL for boys. A plausible explanation for the contrasting findings is that the activity change from sport-like activities, in which boys are believed to be more dominant, increase the importance of providing context through FL. This is not to say that FL is not important for girls. However, the results show no differences between girls in the FL- and NFL-group, suggesting that in this particular study it might be difficult to separate the impact of activity change and FL on the IM of girls.

Health related fitness knowledge

In an effort to answer the call for more studies on learning outcomes (Larsson & Redelius, 2008), and more specifically cognitive knowledge learning (Haichun Sun, 2016; H. Sun et al., 2017), we included HRFK in the present study. The main effect of time on HRFK shows that students have a positive learning curve during the intervention period, independent of instruction group and gender. These results are in accordance with Zhu et al. (2019), who found that middle school students' HRFK was low, but grew linearly throughout middle school. In the same study, Zhu et al. (2019) found gender differences, with girls displaying a higher growth rate compared to boys, when implementing a curriculum tailored to enhance HRFK. Contradictory to these findings, the present study includes an interaction effect between time and gender, with accompanying stronger simple effects for boys (partial $\eta 2$ = .282) compared to girls (partial $\eta 2$= .115). Furthermore, these results need to be interpreted in light of the interaction effect between time and instruction group, where the FL group score higher on HRFK compared to the NFL group at T2. Clearly, the FL group learned more in terms of HRFK during the intervention period. We argue that introducing FL with emphasis on HRFK instead of the traditional PE curriculum could result in a more meaningful frame of knowledge and understanding in terms of why PE activities are beneficial. In this way, FL enhances cognitive learning by providing explanatory rationales and in functioning as an autonomy supportive classroom, promoting students´ internalization process (Yough et al., 2017) .

One interesting question following these findings is to what extent it is beneficial to move cognitive knowledge learning to outside of the gymnastics hall, supporting that the vigorous context of PE could shift the attention of students from cognitive learning towards physical participation (S. Chen et al., 2013). Inversing where learning activities take place and providing students with the opportunity to engage with learning material at a time and place that suits them are important aspects of FL and appear to translate into increased HRFK.

Another interesting question that arises is whether there is a connection between changes in motivation and changes in HRFK, for example whether students who become more highly IM also score higher on HRFK. We have run the appropriate correlational analysis and have found no significant correlations between any types of motivation and HRFK. This is in line with research from Sun and Chen (2010), who found no relationship between motivation and knowledge learning, and at odds with research that has found a relationship between cognitive knowledge and autonomous motivation (Langdon et al., 2014), and between HRFK and controlled motivation (Haslem, Wilkinson, Prusak, Christensen, & Pennington, 2016). Sun and Chen (2010), explain the lack of connection between motivation and knowledge learning in traditional PE in terms of it being centered on ´happy, busy, good´, which might be motivating, but not lead to learning achievement. The present study is not a traditional sport oriented PE program, but still we found no connection between motivation and HRFK, indicating that traditional PE in itself is an insufficient explanation. Clearly, the relationship between cognitive learning and motivation in PE is in need of more research.

However, the fact that students achieve a higher level of HRFK, without necessarily being highly motivated for learning, is obviously a good thing, since one important goal of the curriculum is to provide students with knowledge (Norwegian Directorate for Education and Training, 2015). HRFK covers the knowledge necessary to improve and maintain health enhancing levels of physical fitness and PA, and one could argue for the expectation of a positive relationship between HRFK and PA (Zhu et al., 2019). If this were the case, it would be beneficial to increase HRFK in order to achieve the goal of life-long participation in PA (Norwegian Directorate for Education and Training, 2015), and achieve some of the documented health benefits following PA (The Norwegian Directorate of Health, 2014). However, findings in previous studies are not in agreement about the relationship between HRFK and PA, with some finding a positive relationship (Thompson & Hannon, 2012), and others finding no significant relationship (Haslem et al., 2016). It therefore seems unclear

what the practical implications of increasing HRFK are (Demetriou, Sudeck, Thiel, & Hoener, 2015).

Strengths and limitations

The short intervention period and lack of follow up measures of motivation and HRFK is an obvious limitation in the present study. Even though previous training interventions have also found changes in autonomous motivation between baseline and four weeks (Duncan et al., 2012), it would have been very interesting to investigate the longevity of the FL intervention with a follow up at a later time (e.g. 1-2 months). Changes in boys´ AM was not expected since others claim that changes in external motivation take a somewhat longer time, with the earliest changes detected six to eight weeks after the baseline (Wasserkampf & Kleinert, 2016). Since the escalation in AM is exclusive to boys, we have argued that it is a result of the activity change from sport oriented PE to more play-like PE. Since the design of the present study lacks a control group embedded in traditional, sport oriented PE, we cannot claim to have isolated the possible impact of the activity change. We therefore suggest further research in this area.

Conclusions

As the motivation for participating in PE is demonstrated to decline as young adults go through secondary school, research must put shed on this issue, and possibly suggest proper measures to halt this decline. One such measure, central in the new PE-curriculum in Norway (Ministry of Education and Research, 2018), is implementing an activity change to establish a more play-like PE. The present study demonstrates that girls benefit from such an activity change, but that the IM of boys is susceptible to negative development when experiencing a more play-like PE. However, when a FL framework was applied, the fall in IM was significantly halted compared to the NFL group, emphasizing the importance of providing context and meaning to activity changes in PE, in an autonomy supportive way. Among both girls and boys, the application of a FL framework caused more cognitive knowledge learning, resulting in higher levels of HRFK compared to the NFL-group. The current research provided valuable insights into Norwegian students' motivation for PE and that cognitive knowledge learning can be affected when integrating the use of ICT in PE. The findings of

present study would be valuable for policymakers and stakeholders looking to promote the integration of ICT into PE as part of enhancing the outcomes of PE for all students. We recognize the limitations of the present study but also recognize that our findings might be relevant to other educational systems abroad. Readers of this paper should consider how the current findings could be relevant for their local context.

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Statement on author contributions

O. Ø. contributed to the design and implementation of the intervention, collection of the data and outlining of the methodological considerations. O. Ø. and I. M. contributed to the analysis of the results and the discussion, and to the writing of the manuscript.

Conflict of interest statement

The authors declare no conflicts of interest.

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Paper IV

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The Perception of Adolescents' Encounter With a Flipped Learning Intervention in Norwegian Physical Education

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Objective: The discrepancy between observed and suggested levels of physical activity among adolescents urges society to obtain more knowledge and insight into how physical education (PE) in school can be beneficial for all individuals. The purpose of the present study was to examine the perceptions of adolescents of a flipped learning (FL) framework, applied to enhance student motivation and learning in PE.

Methods: Ten students, from 13 to 17 years of age, were recruited from one secondary school and one upper secondary school from two different counties in Norway during the spring of 2016. The data were generated using semi-structured interviews, reduced, analyzed, and interpreted by constructivist grounded theory and stepwise-deductive induction traditions through constructivist and situated learning lenses.

Results: It was demonstrated that the video format is preferred as preparation material over text material, that instructions on class activities are preferably given in the preparation material and not in class, and that the students did not report any negative aspects of FL. The students showed a positive perception of preparing for PE classes if the preparation material is in the form of a video, and if it has a clear connection to the upcoming class content and outcome aim(s). FL has a positive effect on student understanding and learning in PE, and FL produces a positive change in how students value PE.

Conclusion: A clearly positive perception of FL in PE was demonstrated. FL seems to facilitate deep learning in PE, facilitated by motivation, knowledge, and the nature of the learning framework.

Keywords: physical education (PE), flipped learning (FL), flipped classroom, motivation, learning, digital technologies

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INTRODUCTION

Globally, there is a well-documented discrepancy between observed and suggested levels of physical activity among adolescents [World Health Organization (WHO), 2010, 2016] including in Norway (Norwegian Institute of Public Health, 2019). Worldwide, the proportion of 13–15 year-olds doing <60 min of physical activity of moderate to vigorous intensity per day is 80.3%, with girls being less active than boys (Hallal et al., 2012).

However, the proportion of Norwegian adolescents shows somewhat more positive numbers: girls are significantly less active that boys and sedate awake-time among 15-year-olds is high and increasing (Norwegian Institute of Public Health, 2019). As schools can reach virtually all children, they are vital in shaping children's lives. Hence, the school subject physical education (PE) is a vital arena for motivating young people in their early stages of life to create and uphold a healthy and active lifestyle. As the physical activity levels amongst late teens is the strongest predictor of adult physical activity levels (Anderssen and Andersen, 2004), it is vital to perform high-quality studies that might cast light on this issue.

The ubiquity of digital technology in our society can in many ways obstruct the aims of PE. Nevertheless, digital technology can give new perspectives and opportunities as new developments are constantly emerging. But this is followed by a demand for new critical reflection and research into its potential benefits for PE (Koekoek and van Hilvoorde, 2018). It is crucial for PE teachers to understand how to select from all the digital information and technologies without losing sight of the main pedagogical and educational goals. In other words, "physical educators, scholars and policy-makers increasingly face the challenge and need to create a digital pedagogy for physical education" (van Hilvoorde and Koekoek, 2018, p. 3). New pedagogical frameworks and methods merging the use of digital technology with students' learning processes are being implemented in schools to optimize learning, although education has been one of the last sectors to embrace this phenomenon (Armour et al., 2017). One of these new learning frameworks is flipped learning (FL).

Flipped Learning

A major part of the traditional model of classroom instruction includes the teacher as the central focus of a lesson and the primary disseminator of information. The Academy of Active Learning Arts and Sciences (AALAS) (2018) defined flipped learning as follows:

> "Flipped Learning is a framework that enables educators to reach every student. The flipped approach inverts the traditional classroom model by introducing course concepts before class, allowing educators to use class time to guide each student through active, practical, innovative applications of the course principles" [Academy of Active Learning Arts and Sciences (AALAS), 2018].

In rethinking the traditional way of conceiving and teaching, from both an epistemological and didactical point of view, the flipped approach shifts from mere teacher instruction to a learner-centered learning environment that can foster meaningful learning opportunities, where students and teachers together can explore topics in-depth. Educational technologies such as online videos are used to "deliver content" outside of the classroom. Recent literature reviews suggest that FL in general can improve students' academic success, satisfaction and engagement, promote self-paced learning, increase interactions between teachers and students (Chen, 2016; Akçayir and Akçayir, 2018; Cheng et al., 2018), and promote a more student-centered approach to education (Kim et al., 2014; Wang et al., 2019). FL is also considered applicable as a meta-strategy in education (Shin, 2018). In order to learn and develop new skills in school settings children must be motivated and engaged in activities (Reeve et al., 2004; Reeve, 2012), and both student motivation and student learning can benefit from the use of digital technology in an appropriate pedagogical manner (Casey et al., 2017; Gilje, 2017). As FL originates from, and is almost uniquely applied in theoretical subjects, the lack of a framework on how this pedagogical framework can appear in a practical subject like PE is missing. Hence, a thorough description of the intervention is included in the methods section, and possible biases are highlighted to strengthen the trustworthiness of the present study.

Flipped Learning in PE

Flipped learning in PE is a topic scarcely examined by scholars (Sargent and Casey, 2019). This reflects the general lack of research on how digital technologies are used and affect student motivation and learning in PE (Casey et al., 2017). Nevertheless, FL is suggested to have a positive influence on motivation to participate in PE among adolescents, as the attainment value and the expectation of success increase (Østerlie, 2018b), and the perceived costs of attending are reduced (Østerlie, 2018a), especially among girls. Furthermore, Hinojo-Lucena et al. (2018) suggest applying FL in university PE due to its positive influence on motivation and academic performance. Compared to a more traditional approach in PE, the flipped approach allows for more time to be dedicated to practical activities and individual feedback, resulting in improved student learning in PE (Killian et al., 2016; Østerlie, 2016; Lina, 2017; Isidori et al., 2018; Sargent and Casey, 2019). In universities, a significant improvement in the ability of students to engage in self-study of the PE curriculum is observed as FL enriches the teaching resources of sports courses and enhances the students' interest in learning (Bing, 2017). Moreover, in secondary school PE, FL has been applied to support students when learning the rules of new games (Bergmann and Sams, 2014), and García et al. (2015) demonstrated a positive effect on individualization when a flipped approach was used to guide students when improving orientation skills in PE. Reports of students not being satisfied with the extra work-load that FL might involve highlights one challenge for the FL approach; ensuring that all students prepare at home (Missildine et al., 2013; Akçayir and Akçayir, 2018). Nevertheless, the observed advantages outnumber the observed challenges (Akçayir and Akçayir, 2018).

Flipped learning interchanges the general organization of the lessons and may be used to rethink, from both an epistemological and didactical point of view, the traditional way of conceiving of and teaching PE as a subject in school. The idea of FL in PE is, among other things, that students prepare before class to obtain more time for practical activity, and promote more learning, both bodily and cognitively. The preparation content, preferably delivered as a video, must be tailored to the upcoming class content by including both theoretical knowledge underpinning the desired outcome of the activities, and practical information about the activities. Situated learning theories attempt to replace the image of the learner as an isolated individual to include an

emphasis on the social setting that constructs and constitutes the individual as a learner (Lave and Wenger, 1991). A major focus on learning and allocating more time to learning in a social setting makes FL a desirable learning framework seen through constructivist situated learning lenses.

In describing what knowledge, skills, attitudes, and values today's students will need to thrive and to shape their world, deep learning is a key concept [NOU 2014:7, 2014; NOU 2015:8, 2015; Meld. St. 28 (2015-2016), 2016; OECD, 2018]. As FL can facilitate students' higher-order thinking and skills, it can be used as a framework to advocate more reflection and deep learning (Bergmann and Sams, 2014; Lee and Lai, 2017; Wølner and Horgen, 2019). Parker et al. (2017) highlight three major constructivist tenets.

> "First, learning is an active process where students are viewed as agents in their knowledge construction and understanding comes through decision-making, critical thinking and problem solving.… Second, students construct knowledge in relation to their prior knowledge and experiences (Rovegno and Dolly, 2006).…Third, knowledge is a social product, and knowledge creation a shared experience" (p. 42).

The present study uses the definition of deep learning by Pellegrino and Hilton (2012), which states that deep learning is the process "through which an individual becomes capable of taking what was learned in one situation and applying it to new situations (i.e., transfer)" (p. 5). Frey et al. (2016) differentiate between the deep and transfer learning phases, where the deep learning phase is defined as "interaction with skills and concepts", with the driving question being "how do these facts and principles fit together?" recognized by the processes of "planning, organization, elaboration, and reflection". The transfer learning phase, on the other hand, is defined as "organizing, synthesizing and extending conceptual knowledge," with the driving question being "how and when do I use this for my own purposes?" recognized by processes of "making associations across knowledge bases and application to novel situations" (p. 570). Deep learning, which is conditional on surface knowledge (Frey et al., 2016), is, according to Wang et al. (2017), characterized by "a high level of engagement in learning, driven by intrinsic motivation and more importantly, supported by relevant learning approaches or strategies that allow learners to manage complexity and key challenges (most on cognitive aspects) to sustain engagement and achieve a high level of understanding and performance" (p. 162). Digital technology can be used appropriately to achieve just that.

How students employ learning strategies in PE, whether at a surface or deep level, hinges on the students' perceived value of the task to be learnt (Fu, 1999). Viewed thorough the lenses of Vygotsky (1978) and Wood et al. (1976), and their concepts of scaffolding and zone of proximal development (ZPD), schools form a controlled educational environment, and it is important to challenge, motivate and encourage successful deep learning from an early age, also in a subject like PE. To understand and learn, students need support from the teacher and their peers. Scaffolding is a concept, Wood et al. (1976) defined as a process "that enables a child or novice to solve a task or achieve a goal that would be beyond his unassisted efforts." (p. 90). As they note, scaffolding requires the adults "to control those elements of the task that are initially beyond the learner's capability, thus permitting him to concentrate upon and complete only those elements that are within his range of competence" (Wood et al., 1976, p. 90). Further, scholars argue that the future of PE also depends on whether and how teachers implement terms like self-paced learning, reflection, meta cognition, and deep learning in their practice (Ennis, 2015; Vinje, 2016). Teaching for transfer or teaching for deeper meaning hinge on enabling students to use knowledge in increasingly more complex ways, not only to remember and understand (Anderson and Krathwohl, 2001). The flipped learning framework seems to facilitate just that.

Physical Education in the Norwegian Context

The main aim of PE is to motivate all students to engage in a lifelong, physically active and healthy lifestyle (Kirk, 2010; Norwegian Directorate for Education and Training, 2015; Gerdin et al., 2019). A recent report reveals that PE in Norwegian schools lacks variation both in content and teaching methods, and that this has resulted in a subject that is not beneficial for all students (Moen et al., 2018). A decline with age in student motivation to participate in PE has been observed, contrary to the intentions of the Norwegian PE curriculum (Säfvenbom et al., 2014). Motivation to participate in PE declines already from an early age (Mowling et al., 2004; Xiang et al., 2004), and continues to decline throughout secondary school and upper secondary school (Säfvenbom et al., 2014), reflecting a global trend (Gao et al., 2008). This decline is greater in adolescents than in young children (Fredricks and Eccles, 2002), and is greater among girls than boys (Thomas et al., 2008; Säfvenbom et al., 2014). The loss of motivation in Norway especially among girls, is partly the result of a "sportified" PE favoring boys and pupils who engage in sports outside school (Andrews and Johansen, 2005; Säfvenbom et al., 2014; Dowling, 2016), echoing an international challenge (Ennis, 1999; Scraton, 2013; Vlieghe, 2013; Oliver and Kirk, 2015; Lundvall, 2016). In Norway, a "narrow" PE curriculum is observed regarding the subject content, where ball and fitness activities conducted in an instruction-conduction teaching manner seems to predominate (Moen et al., 2018). The same trend is also observed internationally, where researchers argue that the PE curriculum only comprises sports-like activities and fitness workouts and fails to include the enhancing of students' cognitive and social skills, with no focus on encouraging a positive perception of the students' physical self-worth (Ennis, 2011; Dyson, 2014).

Green (2008) concludes that PE, internationally, remains gendered in terms of organization, content and delivery, and that: "The tendency for PE to reinforce more than challenge hierarchical relations between the sexes remains." (p. 152). Some studies, although not specific to PE, demonstrate that the use of digital technology might reduce gender differences observed in school (NOU 2019:3, 2019). Despite the non-intended direction of PE, it is one of the most popular subjects in primary and

secondary school both in Norway (Moen et al., 2018) and internationally (Goodlad, 2004). Nevertheless, Moen et al. (2018) reported a great decline in motivation from fifth grade to tenth grade in Norwegian students, who self-reported liking PE "very much," and this decline was twice as great among girls than boys. Palakshappa et al. (2015) point to the fact that the manner in which PE classes are delivered may reduce the predicted positive connection between participation in PE and levels of physical activity in young adulthood. Recent research confirms a student view of PE as non-educational, being merely a "break" from other school subjects (Woods et al., 2012; Moen et al., 2018; Lyngstad et al., 2019).

As PE does not fully achieve its main intention, which is to motivate all students to engage in a lifelong, physically active and healthy lifestyle, change is needed. Digital technologies can be a facilitator for both enhanced motivation and learning in PE (Armour et al., 2017), although one should not assume that they are inherently positive or negative in a PE pedagogical context. The use of digital technology in PE provides opportunities and incentives to, in a constructivist view, build up rather than dispense knowledge (Parker et al., 2017). Innovative curricula and approaches in PE are in general welcomed by students (Dyson, 2006). Hence, new pedagogical approaches in PE should be adopted, as the subject remains dominated by a traditional teacher-centered teaching style (Green, 2008), despite emphasis being placed on pupil-centered approaches [Meld. St. 16 (2016-2017), 2017].

This study was part of a larger research project, the goal of which was to investigate how the learning framework of FL affected adolescents' motivation to participate in and learn from PE. To obtain insight into how FL affects student motivation and learning in PE, a quality research approach was chosen in the present study, as "listening to students can provide valuable perspectives and new insights into the complexities of teaching and learning that can then be applied to improving the quality of physical education" (Dyson, 2006, p. 343). Further, a synthesis by Karabulut-Ilgu et al. (2018) revealed that "there is a paucity of literature employing qualitative methodologies that would provide more in-depth understanding of learning in a flipped environment" (p. 407). The purpose of the present study was, by means of interviews, to examine the perceptions of adolescents' attendance in physical education when FL provided the learning framework.

METHODS

The present study is grounded in the qualitative research tradition to best understand the emic perspective of the participants' perception of being part of a flipped learning educational environment (Richardson and St. Pierre, 2005). Based on an epistemological world-view rooted in social constructivist theory, the generated data were sorted, reduced and analyzed by steps and consideration entrenched in constructivist grounded theory (see: Charmaz, 2014) and stepwise-deductive induction (SDI; Tjora, 2018). Grounded theory has from the classic statements of Glaser and Strauss (1967), and the further movement of the method by Strauss and Corbin (1990) and Corbin and Strauss (1990), been taken in various and divergent directions. Charmaz (2014) describes a development starting in the early 1990s, where scholars moved grounded theory away from the original positivistic version of Glaser's and Strauss and Corbin's theory in a constructivist turn, adapting the inductive, emergent, and open-ended approach, while not emphasizing the method as a method of verification. "The constructivist turn answers numerous criticisms raised about earlier versions of grounded theory. Constructivist grounded theory highlights the flexibility of the method and resists mechanical applications of it" (Charmaz, 2014, p. 13).

Social constructivist philosophies have been recognized as providing a potentially useful reconceptualization of existing approaches to teaching and learning in physical education (Dyson, 2006). Situated learning theory has been represented as one example of a social constructivist approach to learning (Kirk and Macdonald, 1998), and "situated learning provides an authentic framework in which to position the study of students' perspectives in physical education" (Dyson, 2006, p. 330). In the following is a presentation of the participants and the intervention they participated in, followed by how the data was generated, sorted and reduced, including some ethical considerations.

Participants

The participants comprised 10 adolescents from 13 to 17 years of age: seven girls and three boys. They were students from two schools, purposely chosen from the six schools that participated in the intervention, forming two groups of five participants. The whole class was asked to voluntarily participate in the interview by their own PE teacher. Among group A, only girls responded positively to participation. The teachers were instructed to choose from among those who gave their consent five students to represent major diversity based on gender, grades and involvement in PE. Group A consisted of five girls ranging from 16 to 17 years of age from an upper secondary school, level VG1[1]. Group B consisted of two girls and three boys ranging from 13 to 14 years of age from a secondary school, year 8. By selecting participants from both the youngest and oldest parts of the cohort, the diversity of perceptions could be generated following the principles of maximum variation among the participants (Creswell and Poth, 2018).

Intervention

The intervention was based on constructivist approaches, emphasizing that:

> "learning is an active process in which the individual seeks out information in relation to the task at hand and the environmental conditions prevailing at any given time, and tests out her or his own capabilities within the context formed by the task and the environment. Learning is situated in social

[1]VG1 is abbreviation for "Videregående 1," meaning the first year in upper secondary school.

> and cultural contexts and is influenced by these contexts" (Kirk and Macdonald, 1998, p. 376).

The intervention took place over a period of 3 weeks during the spring of 2016. Three learning resources with regard to endurance, strength and coordination were used. Each consisted of a video that was assigned for viewing as a homework task before class, an in-class lesson plan that the PE teacher followed, and a teacher's guide. The videos lasted about 12 min, which was well within the length suggested for such videos (Lagerstrom et al., 2015; Long et al., 2016), and were published on a digital learning platform which the students and teachers had access to. Each video gave a thorough but easy to understand introduction to the in-class topic. For example, when endurance was the weekly topic, the video explained endurance in away appropriate to the age-group by discussing why endurance improves health, what happens in the body when endurance is enhanced, and how to increase endurance. At the end of the video, a summary of the forthcoming class content was given. Short quizzes embedded in the videos were used to increase the students' motivation to continue watching and to develop a deeper understanding of the content, as suggested by Frydenberg (2012), Long et al. (2016), and Geri et al. (2017). The in-class lesson was strongly linked to the video content and consisted of play-based activities focusing on one of the three topics in the intervention. One possible bias was how to control for performance of the homework. The interviews revealed that some students watched the videos together, resulting in a situation where the statistics from the learning platform on logins and on-time could not be used. From a pragmatic viewpoint, not all students completing all of the homework is reality in school, and statistical analysis cannot alone give an absolute representation of reality (Olsen and Morgan, 2005).

Data Generation

The week after the intervention, the adolescents participated in a semi-structured interview with focus on motivation for, and learning in, physical education. An interview guide was used to ensure certain key topics were included in the conversations. Following the concept of sensitizing (Rennstam and Wästerfors, 2015, p. 34), the researcher was open to new topics in basing the interview more on discovering rather than merely asking questions (Charmaz, 2006). The mentioned key topics were motivation and learning in PE, as these were the two main focuses in the main study. The interviews were conducted by one of the researchers in the students' own school and lasted 23 and 16 min. The data were later transcribed to a written document and imported to NVivo 12 for further analysis.

Data Reduction

Grounded theory (GT) is a widely used framework in qualitative studies (Charmaz, 2014). This extended use has raised questions about inflation in references to GT and whether concepts are too broadly understood within this tradition (Tjora, 2018). Stepwise-deductive induction is argued by Tjora (2018) to provide a more linear process in respect to GT, with iterations generally limited to backward coupling between two adjacent stages in the model. In GT this iterative process is termed "theoretical sampling" (Charmaz, 2014, p. 192), shifting between data analysis and data collection, and this may be difficult to apply practically in the research process. Hence, this study relies on, and finds inspiration from, both GT and SDI in analyzing the generated data.

The initial coding stage in SDI differs from GT in that induction is more present (Tjora, 2018). What is named initial coding in GT, which is a sorting based coding, is in SDI actually two different stages: empirically close coding (EC coding) and coding (Tjora, 2018). An example from the present study is how the student response *"It's a bit more motivating to see a video than to sit and read ten pages of text without content"* was coded. The EC code generated was "more motivating to see video than to read text," while a more traditional sorting-initial-coding could be "motivation." As the analytic process started already during the interviews, the researcher was open to other topics occurring, and one specific topic did occur: the view and value of PE. This is named an "empirical-analytical reference point" (EAR-point) in SDI (Tjora, 2018, p. 35), or "memo" in grounded theory (Charmaz, 2014, p. 162). The response leading to this topic emerged from the conversation about the videos assigned for preparation for the practical classes: *"It's somehow like homework, so then it [PE] becomes more like a [school] subject."*

Initial EC-codes were counted as 113, then reduced to 10 focus codes and further to six empirical themes. This study uses the term *themes* and not categories, as we were looking to describe empirical themes rather than working toward an explicit development of *theoretical* categories (Charmaz, 2014, p. 199).

Trustworthiness

Reliability relates to the consistency and trustworthiness of research findings, often treated in relation to the issue of whether a finding is reproducible by other researchers and at other times. Tjora (2018) states that one of the most important requirements for all research, or the presentation of research, is linked to transparency. How the present study was carried out, what choices were made at what times, how the participants were recruited, what theories were applied, and how these contributed analytically, were just a few questions put forward in the present article to assure transparency. Tjora (2018) further states that "the purpose is that readers obtain such a good insight of the research that they can assess the quality of the research on their own" (p. 154). Transparency is linked to naturalistic generalization. The goal of naturalistic generalization is not for researchers to suggest conclusions, but by the ways the research is presented so the reader can assess how and in what ways the results may be applicable to their own situations (Stake and Trumbull, 1982). To further assure reliability in the present study, two researchers first produced a separate EC-coding followed by a comparison of EC-codes and the second step of focused coding before conceptualizing the empirical themes. Other types of generalization are also used in qualitative research in sport and exercise science to display quality, but Smith (2018) emphasizes that a lack of displayed generalization is not a sign of less quality. There is often a concern about leading questions regarding interview reliability. It might be that the interview subjects can change their answers during the interview

or give different answers to different interviewers. We rely on a view, and this view is an alternative to a view rooted in an empiricist and positivist conception of knowledge. Our view is based on Kvale and Brinkmann (2009) describing the interviewer as a traveler, "which follows from a postmodern perspective on knowledge construction; the interview is a conversation in which the knowledge is constructed in and through an interpersonal relationship, co-authored and co-produced by interviewer and interviewee" (p. 173). The key question is not if the interview questions are leading questions, but where the interview questions lead. They should preferably lead to new, dependable, and useful knowledge.

Validity refers in ordinary language to the reality, the accuracy, and the strength of a statement. In a methodological positivistic approach to social science, validity has been operationalized in the question "Are you measuring what you think you are measuring?" (Kerlinger, 1979, p. 138). However, "in a postmodern era, truth is constituted through a dialogue; valid knowledge claims emerge as conflicting interpretations and action possibilities are discussed and negotiated among the members of a community" (Kvale and Brinkmann, 2009, p. 247). The validity in the present study was constituted by craftsmanship, as communication and as pragmatic action, as suggested by Kvale and Brinkmann (2009). Through the transparency of the present research report, the quality of the researchers' craftsmanship can be assessed. A communicative validity was constituted through the two researchers' conflicting knowledge claims argued in a conversation. With an emphasis on instigating change, based on the researcher's observations and interpretations, the pragmatic validity and the trustworthiness of the present study were strengthened. The number of interviewees in the present study might be considered low, but through the coding constant comparison of incidents (indicators) in the data a "theoretical saturation" were achieved. "This constant comparing of incidents continues until the process yields the interchangeability of indicators, meaning that no new properties or dimensions emerging from continued coding and comparison" (Holton, 2007, p. 265).

In a school context, the researcher must also be aware of local culture and its role in constructing knowledge through studies like the present one. As the participants were from two different schools, the concept of "analytic bracketing" (Rennstam and Wästerfors, 2015, p. 53) was applied. Analytic bracketing is about accepting duality in social reality, and hence, trying to account for the influence local culture could have on the participants' responses by the researchers constantly shifting between analyzing what the participants are talking about and how they talk about it. As a final step to obtain satisfactory quality and trustworthiness in the present study, the researchers responded to the calls from Smith and McGannon (2018) to "subscribe to the notion of universal criteria and a criteriological approach as a way of ensuring rigor" (p. 118).

Ethical Considerations

Interview research is permeated with ethical issues, as the pursuit of interesting knowledge must be mediated by respect for the integrity of the interview subject:

> "The knowledge produced by such research depends on the social relationship of interviewer and interviewee, which rests on the interviewer's ability to create a stage where the subject is free and safe to talk of private events recorded for later public use" (Kvale and Brinkmann, 2009, p. 16).

The interviewer might find himself or herself offending the subject, transgressing a line that only friends or intimates can cross. The key lies in "calibrating social distance without making the subject feel like an insect under the microscope" (Sennett, 2004, p. 38). This project was reported to, and approved by, the Norwegian Centre for Research Data (NSD) (https://nsd.no/nsd/english/) Project #47604. Written informed consent was obtained from all participants above the age of 15 and from the parents of all participants below the age of 15, in accordance with the NSD guidelines and recommendations.

ANALYSIS

The initial coding and grouping of codes resulted in six empirical themes, of which three were further discussed. The three main themes emerging from the analyses were: "motivation for preparing for and attending PE," "understanding and learning in PE," and "the view of and value of PE." Three themes that emerged from the analysis were found interesting but not suitable for further discussion. These themes were: "the format of the videos," "FL and the consequences for the practical lessons," and "the disadvantages of FL." A description of these three last mentioned themes is followed by a deeper analysis of the three main themes.

The format of the videos matters. The students reported on interactive momentum being important for endurance. Hence, embedded quizzes make them watch more of the video or the whole video, as opposed to a video without such interactions. This is in line with the research mentioned in the method section, stating that quizzes embedded in the videos enhance the students' motivation to continue watching (Frydenberg, 2012; Long et al., 2016; Geri et al., 2017). The students also reported on the importance of video length. These reports fall into line with the findings of Lagerstrom et al. (2015) and Long et al. (2016), suggesting that video length limited to 20 min is appropriate, though length alone is not the sole factor in determining how students interact with online videos. The instructor in the video being visible and not just represented by voice seems to be an advantage according to the students, saying that it was easier to pay attention and that body language matters. A visible and enthusiastic instructor helps in terms of concentration and motivates the students to keep on watching (Stull et al., 2018).

FL and its consequences for practical lessons. As suggested by, e.g., Killian et al. (2016) and Sargent and Casey (2019), the students in the present study stated that more time could be dedicated to practical activity, as explanations of the activities were made in the videos. The students also mentioned that the gym is not a place where they want to sit still and listen to explanations, as one student stated: "I think it was best when we saw the videos, because if [the teacher] explained, it would not be

so informative and fun. You want to be in an activity when you're on the court [they had outdoor classes in this period], not sitting and listening, you know".

The disadvantages of FL seem to be absent in the students' statements in the present study. All the students seem to have only a positive perception of FL as a teaching framework, suggesting an extensive use both in PE and in other subjects. This finding contradicts the synthesized findings of, e.g., Akçayir and Akçayir (2018) in describing a student perspective of FL being a model requiring more work and time. However, the above-mentioned literature review, which included 71 research articles, was mainly sourced in higher education and non-PE courses.

Motivation for Preparing for and Attending PE

The students in the present study connect preparation for PE with improved outcome of the practical classes, and the feeling of being prepared has an impact on the motivation to attend. Preparation for PE is a scarcely examined topic in PE due to a tradition of PE being a non-homework subject (Hill, 2018). Our findings show that the students do not mind preparing for PE classes; in fact, they like it, for several reasons. This contradicts the findings of scholars like Kohn (2006), who suggest that homework does not promote higher-order cognitive skills, but rather leads to a loss of interest. The motivation for preparing is dependent on the form of material designated as homework. The students proposed a clear distinction between text material and video when it comes to motivation for preparing prior to class, where video was described as both "more motivating," "more interesting," and "more systematized," whereas text was described as "boring," "difficult to understand," and "easy to forget." Hence, the students displayed a positive perception of preparing for PE classes if the preparation material is in the form of a video and has a clear connection to the upcoming class content and outcome aim(s). The video interventions all had a short explanation of the upcoming class content, and this was mentioned as important by several students. It seems that this has contributed to the reported higher motivation for attending PE when a FL framework was applied. The present intervention and the FL model in general emphasize the important of homework being a preparation activity rather than a post-class activity. The focus on a understandable connection between the homework and the practical lesson might have contributed to the positive perception of the preparation, and this is supported by the recommendations of Hill (2018), who states that "if students are able to make the connection between homework and important learning objectives, they may be less likely to believe that the homework is just busy work" (p. 62).

As motivation for preparation in PE is increased, one can assume that this is also reflected in increased motivation to participate in PE. Even if this connection might not apply for all students, the responses included "I felt I got more motivated after seeing the videos, because then I knew what I was training and that it helped you," and "To me, it's about motivation. I like to know things; I like to know what I shall do." The importance of knowing something about the content in the upcoming class was emphasized by several students as making a significant contribution to motivation for participation. It seems that a better understanding and knowledge about a PE class topic (e.g., endurance training) acquired prior to the class contributes to increased motivation for participation. This falls in line with earlier findings of FL changing motivation for participating in PE in a positive direction based on higher expectancy beliefs in PE (Østerlie, 2018b), and lower perceived costs of attending PE (Østerlie, 2018a), although these changes were only observed among girls. With observations and statements from national and international scholars like Ennis (2011), Dyson (2014), and Moen et al. (2018), arguing that the PE agenda is too narrow, merely focusing on conducting activities, we can suggest that one reason for the decline of motivation for participating in PE is connected to the lack of knowledge and understanding of PE (cognitive) content.

Understanding and Learning in PE

The present intervention had a focus on cognitive knowledge in the preparation videos, closely connected to the practical activities conducted in class: how would the students react to this shift in focus, when for decades scholars have argued that PE is "sportified" (e.g. Säfvenbom et al., 2014) and when recent research confirms a student view of PE as non-educational, merely a "break" from other school subjects (e.g., Lyngstad et al., 2019). Surprisingly, all the interviewed students displayed a positive attitude toward being exposed to this shift in focus, including (cognitive) preparation before class in statements like:

> "The thinking process one has before a class allows one to spend more time, and one can go into what one wants, if something is unclear. And I believe it is not stupid to be able to think a little about one topic before coming to class,"

and "I felt it was interesting and I learned a lot from them [the videos]," which give an impression of a positive perception of FL in PE. The students seemed to prefer FL over a more traditional approach, characterized by a teacher-centered instruct-conduct approach, as they appreciated learning about a topic both in cognitive and physical ways. In general, the students reported a better learning outcome when compared to their "normal" classes in PE. Knowledge about a topic is perceived by the students to last longer when video preparation is applied, as students responded with: "when another person reads it or explains it for you, then it sticks better in your brain automatically. Especially when you see the face and movements, and so on, and examples, than just reading", and:

> "It is much easier to learn theory that way, to get a little bit all the time through what you are working on. Instead of, when you know you have a [knowledge] test, then you may not have read anything throughout the year, and then it will be a last-minute-effort and it [the knowledge] will be forgotten right after the test. So, it is very good to have some theory before every class, so you get it repeated all the time."

In analyzing the interviews, we saw a pattern of the students connecting prior knowledge to the content of the videos and the learning in the activities in class, with student statements such as:

> "Some of the video content was known, but parts were very clarifying and made it [the knowledge] more holistic. It's not just about training endurance to get in better shape. It was explained better. When you have a vague explanation followed by a deeper one, it sticks better."

Students in this study reported both enhanced understanding and learning in PE. Frey et al. (2016), p. 570 defined the deep learning phase as "Interaction with skills and concepts," with the driving question "How do these facts and principles fit together?" and the transfer learning phase being defined as "Organizing, synthesizing, and extending conceptual knowledge" with the driving question "How and when do I use this for my own purposes?" Students in the present study insinuated that by being exposed to FL, they acquired and constructed knowledge about how physical activity and training affected their health, and they included responses like: "after seeing the videos I knew more what I was training, and that it helped me," and:

> "I think it should be a subject where one should both learn and be in an activity. If you were to have PE without knowing what is being trained and knowing what is happening in your body, then you would not know what happens when you are over-trained and if you stopped exercising and such."

The analysis of the interviews in the present study suggests that FL can promote both deep learning and transfer learning in PE.

The View and Value of PE

The analysis revealed a clear pattern of changes in student perceptions of PE when FL was applied as the learning framework. The students said they started thinking of PE as a subject:

> "Because PE is a subject we only have one class a week, then it goes for a week and then something new without getting anything in between. Then it is in a way easier to look at physical education as a subject as well"

As PE in Norway is delivered once or twice a week, the students reported feeling more included and connected to the subject and the teaching when having to do homework between classes, and this made it easier to look upon PE as a school subject. This falls in line with the findings of FL affecting students' attainment value in PE, although this change was only observed among girls (Østerlie, 2018b). One can assume that the students' feeling of being more included in a learning process is a way of putting into words the perception of a more student-centered learning environment. Responses like "the PE classes made more sense because I understood more of what we were doing"; "maybe one takes it [PE] more seriously," and "normally, when we have PE, we just do things" underpins the view of PE being a mere "break" from other subjects in school emphasized by scholars like Lyngstad et al. (2019) and Woods et al. (2012), who describe a student-view of "traditional" PE found both in Norway and internationally. The students also stated that their normal classes, in what we can call traditionally conducted classes, seemed more "unstructured," "spontaneous," "non-connected," and that the norm was an instruct-conduct delivery of PE. Nevertheless, the students underlined the importance of PE being a mandatory subject.

DISCUSSION

The discussion of the findings was done through social constructivist and situated learning lenses in comparing with existing research presented in the theoretical framework. In general, the students had a positive perception of the learning framework FL. The present study further demonstrates that the video format is preferred as preparation material over text material, but video length, inclusion of interactive momentum in the video, and the instructor talking on the video and being visible are important. The students report that instructions about class activities are preferable when given in the preparation material and not in class and did not report any negative aspects of FL. The students presented a positive perception of preparing for PE classes if the preparation material is in the form of a video and has a clear connection to the upcoming class content and outcome aim(s). Furthermore, FL seems to have a positive effect on student understanding and learning in PE, and FL promotes a change in how the students value and look upon the subject.

General satisfaction with the FL model is reflected in international findings synthesized in larger reviews (Akçayir and Akçayir, 2018; Cheng et al., 2018). Decelerating the observed decline in student motivation in PE (Mowling et al., 2004; Xiang et al., 2004; Gao et al., 2008; Säfvenbom et al., 2014) is a global challenge that must be put forward as a matter of high importance, and the findings in the present study suggest that FL contributes in a positive direction in this matter, supported by the suggestion of Mowling et al. (2004), that designing lessons that students will find meaningful fosters higher intrinsic motivation among them. As students can prepare before class, their motivation to participate is increased and their learning outcome is better. During the preparation their knowledge helps learning, while information about the class content raises motivation for participation. Hence, both are important parts of the preparation video.

To understand and learn, students need support from the teacher and their peers. Central to the concept of scaffolding is the concept of aiding with tasks that students are unable to master for themselves. With this in mind, the way in which teachers pitch their expectations of students is a key issue. This paper argues that (cognitive) knowledge is important for students' learning and outcomes in PE. It is important for both motivational reasons and cognitive and physical learning. This is supported by scholars like Ennis (2015), who states that:

> "Knowledge, too, is at the heart of physical literacy and provides the foundation for knowing what to do and how and when to perform. In fact, physical literacy cannot occur without

> knowledge. Knowledge of facts, procedures, principles, and concepts and their cognitive and physical applications permit physically literate individuals to transfer knowledge to new contexts, solving previously unencountered problems in novel situations" (p. 90).

Further, this paper suggests that FL can function as a scaffold for deep learning in PE, supported by a view of FL as meta-strategy (Shin, 2018). However, deep learning does not just happen: "students first need time to become familiar with the factual or surface knowledge and principles of the discipline before they can consolidate and expand their knowledge" (Frey et al., 2016, p. 568). The connecting of cognitive knowledge and physical literacy through practical activity is fruitful in enhancing motivation, understanding and learning, and this is supported by the findings of Sargent and Casey (2019), who advocate the use of FL in PE, as more time can be devoted to more engaging, student-centered activities, more student learning and increased physical activity. Rooted in social constructivist theory, FL can promote learning in PE, as both teacher and peers support each individual learning process. As more time is allocated to more student-centered and learning-centered activities, the potential for more learning arises. With peer students being more prepared for class by having more knowledge both of the topic and the activities, the peers can be included in the scaffolding. Vygotsky (1978) stated that we cannot just look at what students can do on their own; we have to look also at what they are capable of doing in a social setting, defining the zone of proximal development (ZPD) as: "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers" (p. 86).

How students value and look upon PE is important. Fu (1999) concluded that "the selection of learning strategy (surface or deep) hinges on the students' perceived value of the task to be learnt and that teachers should structure activities which can foster value clarification processes among students" (p. 191). The findings in the present study indicate a positive direction regarding this matter. Students seem to value PE more with FL, and this promotes both motivation and learning. The feeling of being prepared for PE increases the motivation for participation as the attainment value changes in a positive direction, especially among girls (Østerlie, 2018b). Attainment value is a person's perceived importance of doing well in a task, and students will naturally feel more capable of doing well if they are better prepared. The change in focus of PE being a subject of learning, and a perceived better competence in PE affect the value allocated to the subject. Both Kim et al. (2014) and Wang et al. (2019) argue that FL environments are more student-centered than more traditional learning frameworks. A student-centered approach, among other factors, seems to impact on how students value PE and how they look upon it in terms of being a subject of learning, or in their words, a school subject. Kirk and Macdonald (1998) state: "our view is that constructivist influence, sometimes associated with student-centered learning, has the potential to contribute to new theoretical perspectives on learning in the physical domain that can regenerate school physical education" (p. 377). Following Kirk and other scholars like Locke (1992), we can observe that such regeneration is unfortunately still missing, but yet a matter of the utmost priority, as it has been for a (too) long period.

CONCLUSIONS

This paper investigated the perception of adolescents' encounter with a flipped learning intervention in Norwegian physical education. A clear positive perception was discovered. It was demonstrated that: (1) The video format is preferred as preparation material over text material, but the video length, inclusion of interactive momentum in the video, and the instructor talking on the video being visible are also important. (2) Instructions about the class activities are preferably given in the preparation material and not in class. (3) The students did not report any negative aspects of FL. (4) The students presented a positive perception of preparing for PE classes if the preparation material is in the form of a video and has a clear connection to the upcoming class content and outcome aim(s). (5) FL has a positive effect on student understanding and learning in PE. (6) FL promotes a positive change in how students value PE.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

This project was approved by the Norwegian Centre for Research Data (NSD) (https://nsd.no/nsd/english/, Project #47604). Written informed consent was obtained from all participants above the age of 15 and from the parents of all participants below the age of 15, in accordance with the NSD guidelines and recommendations.

AUTHOR CONTRIBUTIONS

OØ contributed to the design and implementation of the intervention, collection of the data, and outlining of the methodological considerations. OØ and IK contributed to the analysis of the results and the discussion, and to the writing of the manuscript.

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Paper V

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The Expectancy-Value Questionnaire in Physical Education: A Validation Study Among Norwegian Adolescents

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The Expectancy-Value Questionnaire in Physical Education: A Validation Study Among Norwegian Adolescents

Abstract

One of the main aims of the school subject physical education (PE) is to promote a lifelong healthy lifestyle. The expectancy-value theory represents an essential theoretical perspective to examine and understand adolescents' learning and motivation in PE. Based on this theory, the Expectancy-Value Questionnaire (EVQ) measures students' expectancy-related beliefs and perceived task values related to a subject like PE. The aim of the present study was to examine the dimensionality, reliability and construct validity of the Norwegian version of the EVQ among adolescents in PE. In total, 338 students from six schools completed the EVQ in their PE classes during the spring of 2016. Explorative and confirmatory factor analyses were conducted, suggesting the four-dimensional construct of the EVQ to be superior the two-factor-model. The EVQ measurement model of adolescents' expectancy-related believes and subjective task values in PE demonstrated satisfying reliability and construct validity.

Keywords: physical education, expectancy-belief, task value, EVQ, factor analysis, dimensionality, reliability, construct validity

Introduction

One of the main aims of the school subject physical education (PE) is to promote a lifelong healthy lifestyle. This object is more or less similar all over Europe (European Commission/EACEA/Eurydice, 2013). Leading organizations investigating in public health recognize that inactivity is increasing among children and that the young population needs to be more physical active (Centers for Disease Control and Prevention [CDC], 2014; World Health Organization [WHO], 2010) as health in later life is influenced by adapted lifestyle across the life-course (WHO, 2016). School and PE are significant contributors for adolescents to acquire knowledge about health and developing abilities to take care of one's health (Bailey et al., 2009; CDC, 2014; European Commission/EACEA/Eurydice, 2013). Motivation and achievement are inherently connected (Nicholls, 1979) and adolescents' motivation for active participation in learning activities is critical for the learning outcome. It is shown that adolescents' level of physical activity in leisure time is positively correlated with PE motivational levels (Cox, Smith, & Williams, 2008). Therefore, an understanding of student motivational dynamics might perform as a vital resource in facilitating learning in PE. Adolescents who believe in their own ability of mastering various PE tasks will, in general, expose positive expectations for attainment and consequently a higher motivation and success rate (Nicholls, Cheung, Lauer, & Patashnick, 1989). Accordingly, adolescents' expectations of success or failure will influence on their motivation and participating in the PE subject at school.

Correspondingly, the expectancy-value theory is considered to be an important theoretical lens to examine and understand adolescents' learning and motivation in PE (Zhu, Sun, Chen, & Ennis, 2012). Adolescents' motivation in PE is found to be associated with their performance, engagement and intentions to partake (Xiang, McBride, & Bruene, 2004, 2006), but not necessarily with learning achievement in PE (Zhu & Chen, 2010). Informing students about the usefulness of a PE activity and how it could help them to achieve their future goals, is shown to increase persistence and performance in PE (Simons, Dewitte, & Lens, 2003).

Expectancy-Value Theory

The motivation for success is a product of an individual's perceived probability of success and the incentive value of that success (Atkinson, 1957). Likewise, the

motivation to avoid failure can result from perceived probability of failure and the negative incentive value of failure. In educational research, where the expectancy-value theory is most widely applied and used, the theory is proposed, tested and found to be an important predictor of student academic and achievement performance, persistence and behavior choices (Eccles, 1983; Eccles & Wigfield, 2002). Important outcomes like engagement, continuing interest, and academic achievement are predicted by expectancies and values both theoretically (Eccles, 1983) and empirically (Nagengast et al., 2011; Trautwein et al., 2012). Relationships and the influence of significant others are important components in the expectancy-value theory (Wigfield & Tonks, 2002) . Expectancies and values are seen to be partly relationally determined (Martin & Dowson, 2009).

Expectancy-Related Beliefs (EB) represent an individual's specific belief regarding success in certain tasks, both in the short-term and long-term future (Eccles & Wigfield, 2002). It is shown that adolescents who believe in their ability to cope with schoolwork typically have positive expectations for success and, hence, high motivation and achievement (Nicholls et al., 1989). The expectancy-value theory is related to the theory of self-efficacy by Bandura (1977). However, while the self-efficacy theory ties one's beliefs about mastering to a specific task (Bong & Skaalvik, 2003) the expectancy-value theory includes beliefs about one's competence in a given domain, representing a broader area than a specific task (Gao, Lee, & Harrison, 2008; Wigfield, Tonks, & Klauda, 2009). This broader approach works well with the PE subject, acquiring a wide competence involving both students' theoretical knowledge, physical and social competence.

Subjective Task Values (STV) can be thought of as the motivation that allows an individual to respond to the question 'Do I want to do this activity and why?" (Wigfield & Cambria, 2010). These values are defined by Eccles and colleagues (1992) as task values with respect to the quality of the different tasks and how these qualities influence the individual's desire to do the task. The motivational and subjective aspects of these values are stressed; different individuals assign different values to the same activity (Wigfield et al., 2009). Expectancy-value theory breaks SVT into four subcategories: (1) Attainment Value (AV) (importance for identity or self by doing well on a given task), (2) Intrinsic Value (IV) (enjoyment or interest that results in deeper engagement and persistence), (3) Utility Value (UV) (usefulness or relevance for now and/or future) and (4) cost (loss of time, overly-high effort demands, loss of valued

alternatives, or negative psychological experiences, such as stress) (Eccles, 1983) . However, cost has until now not been a prioritized topic in empirical research (Wigfield et al., 2009), with some exceptions (Battle & Wigfield, 2003; A. Chen & Liu, 2009; A. Chen, Martin, Ennis, & Sun, 2008; Zhu & Chen, 2013).

The dimensionality of STV has been argued in different ways; it has both a broad and a more specific definition (Wigfield, 1994). Some literature refer to the STV as one dimension, both theoretically (Atkinson, 1957; Feather, 1982) and empirically (Xiang, McBride, & Guan, 2004; Xiang, McBride, Guan, & Solmon, 2003), while others claim STV to include several dimensions (S. Chen, Chen, Sun, & Zhu, 2013; Eccles & Wigfield, 1995; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Wigfield et al., 1997). The dimensionality seems unclear especially among students in early and middle elementary school (Wigfield & Eccles, 1992; Xiang et al., 2003).

Expectancy-related beliefs and subjective task values have demonstrated a positive correlation in physical education (Gao, 2009; Xiang et al., 2003) and researchers have suggested that they develop simultaneously (A. Chen et al., 2008). *Gender* seems to affect expectancy-related beliefs and task values differently. In general, boys tend to hold higher expectancy-related beliefs compared to girls whilst the studies report no gender differences in subjective task values (Gao, 2009; Xiang, McBride, & Bruene, 2004; Xiang et al., 2006; Xiang et al., 2003). *Age* also influence the general expectancy-value motivation, with a decline across age through elementary, middle- and secondary school both in academic subjects and in PE for boys and girls (Jacobs et al., 2002; Xiang et al., 2006; Xiang, McBride, & Guan, 2004). However, a recent study has shown differences with respect to beliefs and task values. As students move from primary school to middle school and further to high school they tend to devalue PE, but their expectancy-related believes do not vary across age (Zhu et al., 2012).

Performance in PE seems to correlate with expectancy-related beliefs (Xiang, McBride, & Guan, 2004), while persistence and effort are predicted by subjective task values (Xiang, McBride, & Bruene, 2004). Children tend to value what they are good at rather than something they do not expect to succeed in (Eccles & Wigfield, 1995). Students with high expectancy-related beliefs are more likely to demonstrate motivated learning behavior and better performance. However, the fact that the learning content mediates the motivation to learn must not be overlooked (A. Chen et al., 2008). Mainly, PE is a practical subject in which the desired competence represents a mixture of

practical and social skills, as well as theoretical knowledge. In Norway PE performance is assessed by means of a mark each semester. Previous research has demonstrated a positive correlation between PE competence, expectancy-related beliefs and subjective task values (A. Chen et al., 2008). Accordingly, we expected these variables to correlate positively.

In order to assess student motivation in PE a valid and reliable measurement model based on well-established theory is needed. The EVQ was developed by Eccles and Wigfield (1995) and further adapted to fit a PE setting by Xiang and colleges (2003). Zhu and colleges (Zhu & Chen, 2010; Zhu et al., 2012) made some further adjustments; this final version[1] is used in the present study. The EVQ is based on the Expectancy-Value theory (Eccles, 1983; Eccles & Wigfield, 1995), and reflects three out of the four dimensions mentioned above; (1) AV, (2) IV and (3) UV, along with the dimension EB. The EVQ measurement model comprises 11 items tapping into four dimensions. However, the dimensionality of the EVQ has shown to be unclear, studies have demonstrated both a two-factor-model (EB and STV) (e.g. Xiang, McBride, & Guan, 2004) and a four-factor model (EB, AV, IV, and UV) (e.g. Eccles & Wigfield, 1995). Still, most studies have published a four-factor-construct of the EVQ, in which subjective task values is represented by three separate constructs; AV, IV, and UV. The present study evaluates the measurement properties of the Norwegian version of the EVQ among adolescents in six Norwegian public schools.

Aims

The aim of the present study was to examine the psychometric properties of the Norwegian version of the EVQ among adolescents in secondary school. The research question was twofold: (1) How well does the two-factor model and the four-factor model of the EVQ fit to the observed data? (2) Does the EVQ questionnaire reveal good reliability and construct validity among Norwegian adolescents?

In accordance to the Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999; Goodwin & Leech, 2003) the

[1] From "Measurement invariance of expectancy-value questionnaire in physical education," by Xihe Zhu, Haichun Sun, Ang Chen and Catherine Ennis, 2012, Measurement in Physical Education and Exercise Science, 16, appendix A. Copyright [2012] by the authors. Reprinted and translated with permission by Xihe Zhu (personal communication, March 12, 2018).

research question addressed evidence related to the dimensionality, reliability and construct validity, all of which considered to be interrelated measurement properties.

Dimensionality examines the extent to which the internal components of a test match the defined constructs, and is concerned with the homogeneity of the items (Netemeyer, Bearden, & Sharma, 2003). Furthermore, a scale's internal structure is relevant to its reliability, reflecting internal consistency by revealing which items are consistent with which items.

Reliability may be viewed as an instrument's consistence and relative lack of error. One type of reliability is internal consistence representing the interrelatedness among items or sets of items in a scale. Cronbach's alpha (α) and composite reliability (ρ) are reliability coefficients assessing internal consistency (Netemeyer et al., 2003) used in this study.

Construct validity refers to how well a measure actually measures the construct it is intended to measure, and is based among others things on the construct's relationships to other variables (Netemeyer et al., 2003).

In order to assess discriminant validity, the associations between expectancy-related believes, subjective task values, performance in PE, gender and age were assessed. The following hypotheses were tested: EB and STV positively correlate with each other and with performance in PE (H_1). Boys have higher EB than girls (H_2), and STV decline with age (H_3)

Methods

Participants

In total, 364 students (Year 8, 9, 10 in lower secondary school and Year 1 in upper secondary school) from six schools in three different regions in Norway were invited to participate, 338 (92.9%) of whom participated in this study. Twenty schools belonging to the three actual regions were requested to participate by an email to their respective managers. The schools involved in the study represented both rural and central communities with a normal distribution of immigration and social statuses. Gender and age distribution in the present sample were 154 girls mean age 15.25 years (SD = 1.30),

and 185 boys mean age 15.01 years (SD = 1.12). The students' mark awarded for classwork the second semester of 2016 (girls: 4.45; boys: 4.48) reflected the national average for 10th grade (girls: 4.5; boys: 4.6) for the actual semester (Statistics Norway, 2016).

Measures

The adolescents' expectancy-related beliefs and subjective task values about PE were measured using a translated version of the EVQ (Zhu et al., 2012). This scale is measured by a five-point Likert scale including 11 items where item 1-5 measure expectancy-related beliefs and item 6-11 measure subjective task values. The subjective task values consists of three dimensions measuring the value of attending, intrinsic and utility value (Zhu et al., 2012) by two items each. A sample item is "How well do you think you are in PE?" where 5 indicated "*very well*" and 1 indicated "*very poorly*". In addition to the Likert scale the text "*very well*" and "*very poorly*" are printed to avoid confusion. The English version of EVQ has been reported with sufficient construct validity and internal reliability in elementary and middle school PE contexts (Xiang, McBride, & Bruene, 2004; Zhu & Chen, 2010; Zhu et al., 2012). Appendix A and Appendix B present the English (Zhu et al., 2012) and the Norwegian version of the EVQ, respectively.

Performance in PE was measured by the mark in PE for the semester during which the EVQ data were collected. Gender and date of birth was self-reported on the EVQ.

Translation of the EVQ from English to Norwegian

For use in this study the EVQ was translated from English to Norwegian using the cross-cultural adaption process (Gjersing, Caplehorn, & Clausen, 2010). Two professors in English, one native Norwegian and one English, in cooperation with the researcher (forming the "expert panel") made the translation. The process followed the suggested steps for cross-cultural adaption except one. The present study did not include a pretesting of the EVQ Norwegian version among adolescents. The expert panel discussed and evaluated the Norwegian version resulting in some vocabulary adjustments to fit a PE setting.

Data Collection

In order to assess a possible shift in the students' motivation for participation in PE after attended a 4-week intervention, data were collected at two points of time (T1 = baseline, T2 = after attending the 4-week PE course) during spring 2016. However, such changes in motivation were not focused in the present study assessing the psychometric properties of the EVQ Norwegian version. Still, including data from both T1 and T2 provided stronger evidence on the EVQ properties. The participating schools and PE teachers received detailed information from the researchers in accordance with a written instruction on how to conduct the data collection. The students filled in the EVQ anonymously in paper format at the start of a PE class. There was no time limit. All students had the opportunity to mark their answers without being observed and to ask questions if something was unclear. To minimize the adolescent's tendency to give socially desirable responses, they were asked to answer as truthfully as possible, along with an assurance that the teacher would not be able to read their responses and that their marks would not be affected by how they responded. A written consent in accordance with the procedure acknowledged by the Norwegian Center for Research Data (NSD, Project #47604) was given by their parents. The students normally needed approximately 10 minutes to complete the EVQ. The data collectors immediately put all EVQ's in a sealed package. This material was then sent to the researchers for data entry.

Statistical analysis

The data were analysed by descriptive statistics and explorative factor analysis (EFA) using IBM SPSS version 24, and CFA by means of Stata 14.1 (StataCorp, 2015). When evaluating a measurement scale, researchers face two important questions: (1) the underlying dimensionality of data, and (2) the adequacy of individual items. In these instances, EFA and CFA can provide complementary perspectives on data, giving different pieces of information (Hurley et al., 1997; Netemeyer et al., 2003). The implicit assumption underlying the use of EFA in the present study is the insecurity with respect to the dimensionality of the EVQ, which has not previously been tested in Norway among adolescents. Therefore, this study intended to gain insight into a potential factor structure of the EVQ, and provide a broad perspective on the observed data using EFA followed by the confirmation procedure by means of CFA.

Confirmatory factor analysis is a sub-model in SEM that deals specifically with measurement models (Brown, 2006), accounting for random measurement error. Thus, the psychometric properties of the scales used are more accurately derived. A high loading of an item indicates that there is much in common between the factor and the respective item (Sharma, 1996). Loadings below 0.32 are considered poor, ≥ 0.45 fair, ≥ 0.55 good, ≥ 0.63 very good, and above 0.71 excellent (Sharma, 1996).

A substantial body of research has indicated that Cronbach's alpha cannot be generally relied on as an estimator of reliability (Raykov, 2001). Thus, inter-item consistency was assessed by Cronbach's alpha (α) as well as the composite reliability (ρc) (Hair, Black, Babin, & Anderson, 2010) coefficients; and values (ρc) ≥ 0.7 are considered to be good (Bagozzi & Yi, 1988; Hair, Black, Babin, & Anderson, 2010; Mehmetoglu & Jakobsen, 2017). The present study assessed model fit adequacy by χ^2-statistics and various fit indices. In line with the "rules of thumb" given as conventional cut-off criteria (Mehmetoglu & Jakobsen, 2017) the following fit indices were used; the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMS) with values below 0.05 indicating good fit, whereas values smaller than 0.10 is interpreted as acceptable (Mehmetoglu & Jakobsen, 2017). Further, the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) with acceptable fit set at 0.90 (Mehmetoglu & Jakobsen, 2017) were used. The frequency distribution of the measurements was examined to assess deviation from normality; both skewness and kurtosis were significant, thus, the Robust Maximum Likelihood (RML) estimate procedure was applied. When analysing continuous but non-normal endogenous variables, the Satorra-Bentler corrected χ^2 should be reported (Kline, 2011; Satorra & Bentler, 1994).

Results

Descriptive Analysis

Table 1 presents the means (M), standard deviations (SD), Cronbach's α, and Pearson's correlation matrix for the EVQ scale estimated at both assessments (T1 and T2). Significant correlations in the predicted direction for EVQ towards performance, gender, and age were disclosed (Table 1).

Cronbach's alpha coefficients between .74 and .92 (Table 1) and composite reliability coefficients between .72 and 0.92 (Table 2) indicated good inter-item consistency.

Table 1. Expectancy-Value Questionnaire (EVQ). EVQ T1(T2) in relation to selected measures: Means (*M*), standard deviation (*SD*), Cronbach's alpha and correlation coefficients for EVQ and its dimensions.

	M	*SD*	*Cronbach's alpha*	*Correlation coefficients Pearson's r^2*				
EVQ				EB	STV	AV	IV	UV
Model-1 two-factor solution								
Expectation beliefs (EB)	19.54 (19.94)	4.06 (3.98)	.92 (.92)	-				
Subjective Task Values (STV)	22.13 (22.64)	5.23 (4.95)	.90 (.90)	.62** (.57**)	-			
Model-2 four-factor solution								
Expectation beliefs (EB)	19.54 (19.94)	4.06 (3.98)	.92 (.92)	-				
Attainment value (AV)	7.43 (7.72)	2.04 (1.95)	.74 (.79)	.55** (.53**)	.88** (.89**)	-		
Intrinsic value (IV)	7.48 (7.60)	2.04 (1.75)	.90 (.87)	.62** (.56**)	.89** (.85**)	.68** (.63**)	-	
Utility value (UV)	7.18 (7.35)	1.97 (1.89)	.85 (.83)	.43** (.40**)	.88** (.89**)	.65** (.70**)	.67** (.62**)	-
Performance	4.46	.70		.42** (.42**)	.28** (.29**)	.22** (.22*)	.39** (.23*)	.16 (.21*)
Gender	.55	.498		.19** (.20**)	.08 (.02)	.05 (-.05)	.11 (.09)	.01 (.02)
Age	15.12	1.21		-.03 (-.03)	-.25** (-.27**)	-.30** (-.30**)	-.18** (-.14*)	-.21** (-.22**)

Note. STV = mean score of AV+IV+UV; Performance = semester mark, spring 2016.
*$p < .05$, two-tailed.
**$p < .01$, two-tailed.

Table 2. Goodness-of-fit measures for measurement models of the Expectancy Value Questionnaire (EVQ). Confirmatory Factor Analysis for Model-1 and Model-2, at two points of assessment T1 and T2. Reliability estimates for T2 are listed in parentheses.

Fit measure	T1 N = 283 Model-1 2-Factors	T1 N = 283 Model-2 4-Factors	T2 N = 272 Model-1 2-Factors	T2 N = 272 Model-2 4-Factors
χ^2 *Satorra Bentler* p-value	265.799 0.00001	129.605 0.00001	219.986 0.00001	103.850 0.00001
$\frac{x^2}{df}$ *Satorra Bentler*	6.18 (Df^3 = 43)	3.41 (Df = 38)	5.12 (Df = 43)	2.73 (Df = 38)
RMSEA *p-value (close fit test)*	0.135 (CI: 0.120-0.151) 0.00001	0.092 (CI: 0.075-0.110) 0.0001	0.123 (CI: 0.107-0.139) 0.00001	0.080 (CI: 0.062-0.098) 0.0001
SRMR	0.067	0.052	0.064	0.048
TLI	0.88	0.94	0.898	0.96
CFI	0.90	0.96	0.92	0.97
$\rho c = \frac{(\sum \lambda)^2}{\left[(\sum \lambda)^2 + \sum(\theta)\right]}$	T1 (T2): Expectation: 0.92 (0.92) Task-Value: 0.89 (0.90)		T1 (T2): Expectation: 0.92 (0.92) Task-AV: 0.72 (0.79) Task-IV: 0.91 (0.89) Task-UV: 0.85 (0.84)	

Note: EVQ = Expectancy-Value Questionnaire measurement model; RMSEA = Root Mean Square Error of Approximation; SRMS = Standardized Root Mean Square Residual; TLI = Tucker-Lewis Index; CFI = comparative Fit Index; Df = degrees of freedom; ρc = composite reliability.

Dimensionality of the EVQ

EFA

The EVQ was assessed in the same sample on two occasions, approximately four weeks apart. Since previous studies have shown that the EVQ dimensionality is unclear, the EVQ items were subjected to EFA. The Kaiser-Meyer-Olkin measure (Tabachnick & Fidell, 2007) of sampling adequacy exceeded the recommended value of .60 (T1 = .895, T2 = .901) and Bartlett's test of Sphericity reached statistical significance ($p < .0001$), supporting the factorability of the correlation matrix for both assessments. The EVQ-factors were expected to be correlated (H_1). Thus, principal component analysis with an oblique promax rotation and Kaiser Normalization was used. Table 3 lists the loadings (cross-loadings), factors and variance explained for both models at both assessments (T1 and T2). Exploratory factor analysis revealed two factors with eigenvalue 1.0 and above. This two-factor-solution

(Model-1) disclosed factor loadings between .42 and .91 and four cross-loadings, explaining 71% of the total variance. However, several studies have shown that the EVQ comprises four factors; therefore, the data were run once more (both T1 and T2) setting the number of factors to four. This four-factor-solution (Model-2) displayed four cross-loadings, factor loadings between .33 and .89, and explained 81% of the variance. Hence, the dimensionality seemed uncertain, and we turned to CFA.

CFA

The two-factor construct: Model-1. The two-factor construct's fit to the observed data (Model-1, T1 and T2) was tested by means of CFA, showing significant t-values for all estimates ($p < .05$), factor loadings (λ) ranging between .93 and .66, with squared multiple correlations (R^2) varying from .87 to .43. The two-factor solution gave a Satorra-Bentler scaled $\chi^2(43) = 265.799$; $p < .00001$ and RMSEA = .135 $p < .00001$, SRMR = .067, CFI = .90 and TLI = .88. Accordingly, Model 1 did not reveal a god fit to our data (Table 2).

The four-factor construct: Model-2. Next, the previous published four-factor solution (framed Model-2) was tested, showing a significantly increased fit at T1 ($\chi^2(38) = 129.605$; $p < .0001$, RMSEA = .092, CI between .075 and .110, close fit $p = .04$, SRMR = .054, CFI = .96 and TLI = .94), and even a better fit at T2 ($\chi^2(38) = 103.85$; $p < 0.0001$, RMSEA = .080, CI between .075 and .110, close fit $p = .0001$, SRMR = .048, CFI = .97 and TLI = .96). Hence, in both assessments (T1 and T2) Model-2 comprising of four factors showed a significantly better fit than Model-1 (Table 2) and presented significant t-values for all estimates ($p < .05$). For the model to be significantly better, the change in χ^2-value should exceed the critical value belonging to the difference in degrees of freedom at the 5% level. The analysis confirmed a significant difference in χ^2 for Model 1 versus Model 2 for both assessments (T1: χ^2diff = 136.19, T2: χ^2diff = 116,136, critical value = 15.09 at 5 df, $p = .01$). Thus, the null-hypothesis of equal fit for Model 1 and Model 2 did not find support. Table 2 lists the estimates for Model-1 and Model-2 at both assessments (T1 and T2).

Table 3. Exploratory Factor Analysis of the Expectancy-Value Questionnaire – Rotated Component Matrix, T1 and T2. Estimates for T2 are listed in parentheses.

	T1 Model-1 (2 factors)		T1 Model-2 (4 factors)			
EVQ 11-items	EVQ-1[1]	EVQ-2[2]	EVQ-1[1]	EVQ-3[3]	EVQ-4[4]	EVQ-5[5]
EVQ1: How good are you in physical education?	.900 (-)	.899)	.889 (.869)	-	-	-
EVQ2: If you give 5 to the best student in PE and 1 to the worst, what you give to yourself?	.872 (-)	((.867)	.864 (.849)	-	-	-
EVQ3: Some kids are better in one subject than in another. For example, you might be better in math than in reading. Compared to most of your other school subjects, how are you doing in PE?	.741 (-)	(.693)	.735 (.541)	-	-	.341 (.714)
EVQ4: How well do you think you are in PE?	.858 (-)	(.905)	.853 (.878)	-	-	-
EVQ5: How well are you keeping yourself physically active in PE?	.700 (-)	.426 (.755)	.635 (.774)	.496	-	-
EVQ6: How important do you think PE is for you?	.421 (.770)	.690 (-)	.333	.597 (.442)	- (.563)	.428 (.410)
EVQ7: Compare to math, reading, and science, how important is it for you to learn PE content?	- (.742)	.682 (-)	-	- (.529)	-	.878 (.623)
EVQ8: In general, how fun do you think your PE classes are?	.351 (.732)	.772 (.361)		.805	.362 (.826)	-
EVQ9: How much do you like your PE classes?	.454 (.729)	.721 (.393)	.344	.798	- (.809)	-
EVQ10: Some things that you learn in school help you do things better outside of school. We call this being useful. For example, learning about plants at school might help you grow a garden at home. How useful do you think the contents you learned in PE are?	- (.834)	.856 (-)	-	.412 (.867)	.812	-
EVQ11: Compared to your other school subjects, how useful are the skills learned in PE?	- (.836)	.826 (-)	.717	-(.819)	.871	-
Cumulative % of total variance explained	56.61 (56.37)	14.53 (15.21)	56.61 (56.37)	14.53 (15.21)	5.85 (6.57)	5.17 (4.68)
Cronbach's Alpha	.92 (.92)	.90 (.90)	.92 (.92)	.74 (.79)	.90 (.87)	.85 (.83)

Note: [1]EVQ-1 = Expectation Beliefs (EB). [2]EVQ-2 = Subjective Tasks Values (STV). [3]EVQ-3 = Attainment value (AV). [4]EVQ-4 = Intrinsic value (IV). [5]EVQ-5 = Utility value (UV). Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Values < 0.32 are suppressed. Model-1: Two components extracted based on Eigenvalue > 1. Total variance explained: 71.14% (71.57%). Rotation converged in 3 (3) iterations. Model-2: Four components extracted. Total variance explained: 82.16% (82.82%). Rotation converged in 6 (6) iterations.

The best fitting model was Model 2 assessed at T2, displaying factor loadings (λ) ranging between .93 and .66, and squared multiple correlations (R^2) varying from .87 to .43. Figure 1 displays Model 2 at T2.

Discussion

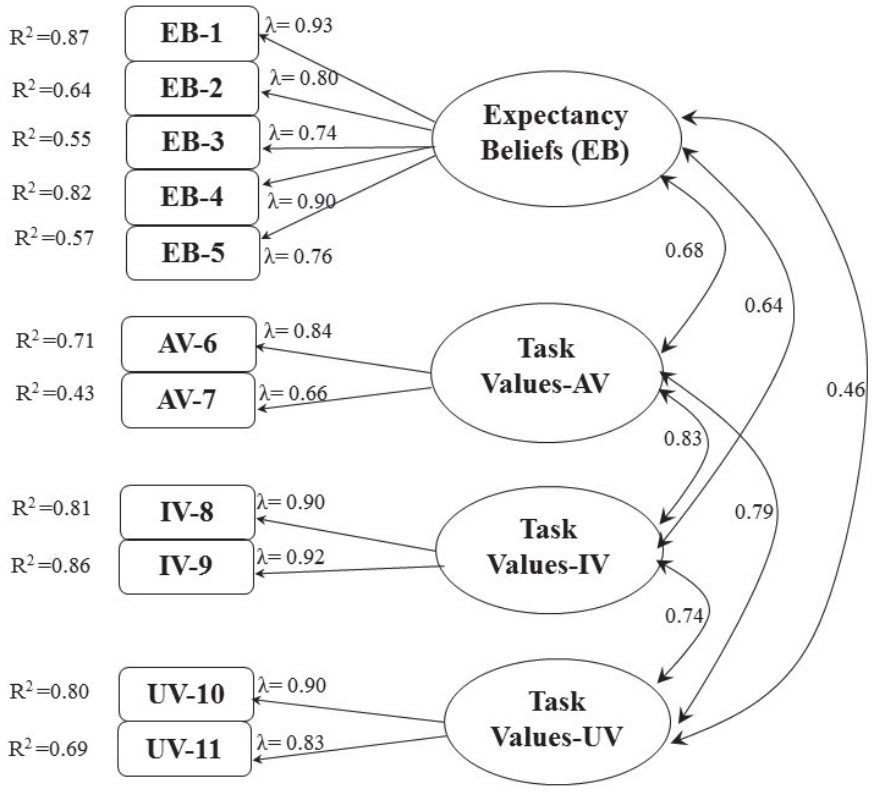
The research question of this study addressed evidence related to dimensionality, reliability, and construct validity of the EVQ questionnaire. The aim was to assess the psychometric properties of the EVQ measure among adolescents in Norway. The research question was two-fold: (1) How well does the two-factor model and the four-factor model of the EVQ fit to the observed data? (2) Does the EVQ questionnaire reveal good reliability and construct validity among Norwegian adolescents?

Dimensionality

In accordance with previous studies (Zhu et al., 2012), the present results indicated that the four-factor model of the EVQ is psychometrically superior to the two-factor model. However, the EFA suggested two factors, whereas CFA discovered that the two-constructs-solution tailored inferior to the observed data. The first factor "Expectancy-related beliefs," including five items, performed as a separate and unique construct. This point seems indisputable. However, the three other factors (Tasks AV, IV and UV) seemed somewhat unclear, revealing highly significant factor correlations indicating that the dimensionality might be questioned; does the EVQ contain four unique constructs?

Due to the developmental characteristics in young adolescents, it is argued that few items and short instruments better generate accurate accounts (Feltz & Chase, 1998). Thus, the shorter the better. However, these three factors (Task AV, Task IV, and Task UV) comprised of only two indicator items, implying these factors to be weak constructs (Hair et al., 2010; Kline, 2011; Mehmetoglu & Jakobsen, 2017). Still, a scrutinizing of the theoretical content of these three constructs supported the plausibility of the suggested four-factor model. The AV-factor focuses on the *importance* of physical education (EVQ6 "how

important do you think physical education is for you" and EVQ7 "compared to math, reading, and science, how important is it for you to learn physical education content?"). Since both of these two items direct the importance of physical education, it seems logical that they belong to each other and represent a factor. The next construct, the IV factor, consists of two items both centering on *enjoyment* in relation to physical education (how fun is PE and how much do adolescents like PE). When young people find something to be fun, it is likely that they enjoy it. Therefore, it is also reasonable that these two items constitute a factor. Looking at the fourth construct, the UV factor, both items concentrate on the *usefulness* of physical education. Therefore, based on theoretical assumptions, the four-construct solution appears to be proper.



Model-2: χ^2 =129.605, df=38, p-value <0.0001, RMSEA=0.092, SRMR=0.052, CFI=0.96, TLI=0.94

Figure 1. CFA Model-2 of the EVQ measurement, T2.

Reliability

Reliability is supported by items in each factor with highly significant standardized factor loadings–preferably greater than 0.7 (Brown, 2006; Hair et al., 2010; Kline, 2011). This was the fact for 10 out of the 11 indicators; one indicator (AV 7) revealed a loading at 0.66. Accordingly, all standardized factor loadings showed good to very good values ranging between 0.93 and 0.66. The square of a standardized loading represents how much variation in an item is explained by the latent factor and is termed the variance extracted of the item (Hair et al., 2010). As loadings fall below 0.7, they can still be considered significant, but more of the variance in the measure is error variance than explained variance. In the present study, this was the fact for only one item. As a result, Cronbach's alpha and composite reliability also revealed good values (Table 2), indicating good internal consistency: values greater than 0.7 are good (Acock, 2013; Hair et al., 2010; Mehmetoglu & Jakobsen, 2017). Hence, in this study the reliability was very well supported.

Construct Validity

Construct validation is a lengthy and ongoing process of learning more about the constructs in focus, making new predictions and then testing them. Each study that supports the theoretical construct serves to strengthen the theory (Netemeyer et al., 2003). Construct validity for the EVQ refers to the assumption that this questionnaire validly measures expectancy-related beliefs and subjective task values among adolescents. The observed data supported that expectancy-related believes and subjective task values positively correlated with each other and with performance in PE (H_1). Boys had higher expectancy-related believes than girls (H_2) and subjective task values declined with age (H_3). Hence, convergent and discriminant validity were supported by significant correlations in the predicted direction with the selected constructs of performance, gender and age. Furthermore, despite three factors in the four-factor model included only two indicators, Model 2 revealed good composite reliability coefficients (ρ) for all the four latent variables, ranging between .92 and .79 (Table 2). Moreover, the factor correlations ranged between .83 and .46. Nevertheless, some correlations showed quite high estimates (Figure 1) indicating some problems with discriminant validity. These were: (1) r = .83 for the relation between Task- AV and Task-IV, (2) r = .79 for Task AV with Task UV, and (3) r = .74 for Task IV with Task UV. Based on these high factor-correlations, construct validity in terms of discriminant validity can be questioned. Revealing a factor correlation of r = 0.83, how much of the factors' variance is

unique? At the same time, the CFA clearly signified that the two-factor model corresponded poorly to the observed data, while the four-factor model exposed a good fit.

Besides, three of the four factors did only consist of two indicator items, implying these factors to be weak. From this, we suggest that including one more item in the three factors comprising only two indicators might strengthen the construct validity of the EVQ.

Taken together, the evidence supports satisfying construct validity of the EVQ construct among adolescents in Norway. Content validity is an obligation both for reliability and construct validity (Mokkink et al., 2010; Potter & Levine-Donnerstein, 1999), and is assessed by judging the relevance and the comprehensiveness of the items, both with regard to relevance for the construct to be measured as well as for the study population. In the present adolescent population, the 11 items appeared to be relevant, signified by the high factor loadings and the high R^2-values.

Strengths and limitations

The participation of 338 adolescents (response rate 93%) from six schools involving three counties in Norway signifies a strength of this study. The present sample represents a diversity of locations in urban and rural areas, reflecting the general adolescent population in Norway. Next, the students' semester marks corresponded with the national average mark for the actual semester, indicating that the present sample do not differ from the general Norwegian adolescent population at the actual ages. The PE teacher administered the data collection at the start of a PE lesson, ensuring anonymity and enough time for the students to fill in the questionnaire. This procedure, using a well known teacher in well known surroundings contributed to students feeling comfortable in the assessment situation, supporting reliable data, represents a strength of this study. The fact that the same sample assessed the EVQ items twice, allowing analysis of two datasets from the same sample, signifies another strength of the present study as the psychometric properties of the EVQ did not vary. Measures of validity and factor dimensionality were substantially consistent from T1 to T2, demonstrating the four-factor model being significantly superior to the two-factor model at both points in time. These results suggest that the Norwegian version of the EVQ is a valid and reliable measure among adolescents.

Nevertheless, some limitations should be taken into consideration. This study of the Norwegian version of the EVQ included adolescents aged 13-17 years old. Thus, the present results cannot be generalized to younger children nor to older adolescents. Also, a pretesting

of the Norwegian version among Norwegian adolescents was not undertaken, which represents a limitation.

Conclusion

This study evaluated the psychometric properties of the Norwegian version of the EVQ among adolescents in secondary school, by assessing the dimensionality, reliability and construct validity. The EVQ demonstrated satisfying reliability and construct validity, while the dimensionality seemed somewhat blurred or indistinct. However, the four-factor model seems superior to the two-factor model. Hence, the Norwegian version appeared to be appropriate and can be used to measure adolescents' expectancy-related believes and subjective task values in PE. However, some further development might be useful to strengthen the construct validity of the EVQ. The three factors measuring the task values (AV, IV and UV) comprising of two indicators each, indicate rather weak and thus uncertain constructs. Therefore, a further development of the EVQ should include at least one more item tapping into these factors, which possibly, might strengthen the EVQ construct validity.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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Appendix A:
EVQ English version

1. How good are you in physical education?
   Very good 5 4 3 2 1 Not good
2. If you give 5 to the best student in PE and 1 to the worst, what you give to yourself?
   Best 5 4 3 2 1 Worst
3. Some kids are better in one subject than in another. For example, you might be better in math than in reading. Compared to most of your other school subjects, how are you doing in PE?
   A lot better 5 4 3 2 1 A lot worse
4. How well do you think you are in PE?
   Very well 5 4 3 2 1 Very poorly
5. How well are you keeping yourself physically active in PE?
   Very well 5 4 3 2 1 Very poorly
6. How important do you think PE is for you?
   Not very important 1 2 3 4 5 Very important
7. Compare to math, reading, and science, how important is it for you to learn PE content?
   Not very important 1 2 3 4 5 Very important
8. In general, how fun do you think your PE classes are?
   Very boring 1 2 3 4 5 Very fun
9. How much do you like your PE classes?
   Don't like it at all 1 2 3 4 5 Like it very much
10. Some things that you learn in school help you do things better outside of school. We call this being useful. For example, learning about plants at school might help you grow a garden at home. How useful do you think the contents you learned in PE are?
    Not useful at all 1 2 3 4 5 Very useful
11. Compared to your other school subjects, how useful are the skills learned in PE?
    Not useful at all 1 2 3 4 5 Very useful

Appendix B:
EVQ Norwegian version

1. Hvor god er du i kroppsøving?
   Veldig god 5 4 3 2 1 Veldig dårlig
2. Dersom du gav karakteren 5 til den beste studenten i kroppsøving og 1 til den dårligste, hvilken karakter ville du gitt deg selv?
   Beste 5 4 3 2 1 Dårligste
3. Noen barn er bedre i et fag/emne enn et annet. Du kan for eksempel være bedre i matematikk enn i lesing. Sammenlignet med de fleste av de andre fagene dine på skolen, hvordan vil du beskrive dine ferdigheter i kroppsøving?
   Mye bedre 5 4 3 2 1 Mye dårligere.
4. Hvor god mener du at du er i kroppsøving?
   Veldig god 5 4 3 2 1 Veldig dårlig.
5. Hvor fysisk aktiv er du i kroppsøving?
   Veldig aktiv 5 4 3 2 1 Lite aktiv.
6. Hvor viktig synes du kroppsøving er for deg?
   Veldig lite viktig 1 2 3 4 5 Veldig viktig.
7. Sammenlignet med matematikk, lesing og naturfag, hvor viktig er det for deg å lære hva kroppsøving består av?
   Veldig lite viktig 1 2 3 4 5 Veldig viktig.
8. Hvor morsomme synes du kroppsøvingstimene er generelt?
   Veldig kjedelige 1 2 3 4 5 Veldig morsomme.
9. Hvor godt liker du kroppsøvingstimene?
   Liker dem ikke i det hele tatt 1 2 3 4 5 Liker dem veldig godt.
10. Noen av tingene du lærer på skolen hjelper deg til å gjøre andre ting på en bedre måte utenfor skolen. Vi kaller disse tingene nyttige. Det du lærer om planter på skolen kan for eksempel hjelpe deg til å dyrke planter hjemme i hagen. Hvor nyttig mener du innholdet du lærte i kroppsøvingstimene er?
    Ikke nyttig i det hele tatt 1 2 3 4 5 Veldig nyttig.
11. Sammenlignet med de andre fagene på skolen, hvor nyttig er det du lærer i kroppsøving?
    Ikke nyttig i det hele tatt 1 2 3 4 5 Veldig nyttig.

Paper VI

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EDUCATIONAL ASSESSMENT & EVALUATION | RESEARCH ARTICLE

The Situational Motivational Scale (SIMS) in physical education: A validation study among Norwegian adolescents

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Abstract: One of the most important variables to consider in physical education (PE) is motivation. The self-determination theory (SDT) represents an essential theoretical perspective to examine and understand adolescents' learning and motivation in PE. Based on this theory, the Situational Motivational Scale (SIMS) measures students' situational motivation related to a subject like PE. The aim of the present study is to examine the dimensionality, reliability, and construct validity of the Norwegian version of the SIMS among adolescents in PE. In total, 318 students from six schools completed the SIMS in their PE classes during the spring of 2016. Explorative and confirmatory factor analyses were conducted, suggesting the fourteen-item version of the SIMS to be superior to the sixteen-item version. The SIMS measurement model of adolescents' situational motivation in PE showed satisfactory reliability and construct validity.

Subjects: Secondary Physical Education; Test Development, Validity & Scaling Methods; Motivation

Keywords: physical education; situational motivation; self-determination; SIMS; factor analysis; dimensionality; reliability; construct validity

1. Introduction

One of the most important variables to consider in physical education (PE) is motivation, as adaptive types of motivation have been associated with intentions to exercise, step count during

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ABOUT THE AUTHORS

Ove Østerlie is an educator and researcher in physical education. Main research areas are didactics and teaching methods in physical education with speciality in flipped learning and physical education as an inclusion arena.

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Gørill Haugan is widely published in various fields such as validation and measurement, health promotion, quality of life, spirituality and wellbeing, and nurse-patient interaction among different populations (adolescents, postnatal women, nursing home residents).

PUBLIC INTEREST STATEMENT

Physical Education (PE) is a significant contributor for people in developing a lifelong healthy lifestyle. For obtaining good learning in PE, adolescents need good motivation. There is a need for validated instrument for measuring motivation and one instrument is the Situational Motivational Scale (SIMS) measuring adolescents' situational motivation in PE. The aim of the present study was to examine the dimensionality, reliability and construct validity of the Norwegian version of the SIMS among adolescents in PE. In total, 318 students from six schools completed the SIMS in their PE classes during the spring 2016. Explorative and confirmatory factor analyses were conducted showing the SIMS to demonstrated good reliability and construct validity.

PE classes and physical activity outside of school (Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011). As a major part of adolescents do not reach the suggested levels of physical activity (Hallal et al., 2012), developing measurement tools to investigate and understand motivation in a PE context is vital. Self-determination theory (SDT) has over the last 40 years become a major theory of human motivation (Gagne & Deci, 2014). The fundamental tenets of SDT suggest that motivation and its determinants, mediators and consequences operate at three levels: global, contextual and situational (Vallerand, 1997, 2001). Motivation at the *global* level echoes how an individual generally interacts with his/her environment (Vallerand & Rousseau, 2001). The *contextual* motivation is a motivational disposition towards a particular context, such as work, sports or education (Vallerand, 1997). The *situational* motivation refers to the "here and now" of motivation, which represents the motivation experienced while engaged in a particular activity (Vallerand, 1997). All three levels can be further refined and described by various constructs, among them the motivational factors proposed by SDT (Deci & Ryan, 1985, 1991): Intrinsic motivation (IM), identified regulation (IR), external regulation (ER) and amotivation (AM), constituting a self-determination continuum from self-determined to non-self-determined motivation. IM comes from within as internal drives that motivate you to behave in certain ways; including your core values, your interests, and your personal sense of morality. IR is the somewhat internal motivation based on conscious values being personally important to an individual. ER is exclusively external motivation and is regulated by compliance, conformity, and external rewards and punishments. In AM, you are completely non-autonomous, has no drive to speak of, and you are likely struggling to have any of your needs met.

To measure a person's situational motivation the Situational Motivation Scale (SIMS)[1] (Appendix B) was developed by Guay, Vallerand, and Blanchard (2000), assessing IM, IR, ER and AM. The SIMS has demonstrated good reliability and factorial validity in both a PE context (Lonsdale et al., 2011; Standage, Treasure, Duda, & Prusak, 2003) and a broader context, including education, interpersonal relationships and leisure (sport) (Guay et al., 2000) among adolescents. Standage et al (2003) re-specified the original 16-item SIMS to a 14-item scale by excluding two items, thereby creating improved absolute and incremental fit indices without loss of internal consistency of the two affected subscales. Internal consistency analyses, as well as single and multi-group confirmatory factor analyses (CFA) have documented support for the reliability and validity of the 14-item SIMS among UK adolescents (Lonsdale et al., 2011).

Traditionally, several aspects determine the construct validity of a measurement scale. In respect to SIMS, the study by Guay et al. (2000) found all factors except AM to be somewhat stable across measurement times and invariant across gender. In AM, a small gender difference turned out to be statistically significant. Further, the researchers reported IM and IR to be associated with behavioral intentions of future persistence towards the activity. Correspondingly, another study (Säfvenbom, Buch, & Aandstad, 2017) found a positive relationship between IM, IR and eagerness for physical activity. Ryan and Deci (2000) established a theoretical proposal for ER and AM to work in the opposite direction compared to IM and IR. However, there is still no empirical evidence to support this proposal either regarding intentions of further persistence towards an activity (Guay et al., 2000) or eagerness for physical activity (Säfvenbom et al., 2017). The self-determination continuum is proposed to have a simplex-like (ordered correlation) structure, whereby adjacent regulations (e.g., intrinsic motivation and identified regulation) should be more strongly and positively related with each other, while more distal regulations (e.g., intrinsic motivation and amotivation) are expected to be unrelated or negatively correlated with each other (Deci & Ryan, 2000; Ryan & Connell, 1989).

Several studies (Erdvik, Øverby, & Haugen, 2014; Säfvenbom, Haugen, & Bulie, 2014) as well as Master's theses (Bulie, 2011; Forfot, 2014; Medic, 2012; Olsen, 2011) have applied a Norwegian version of the SIMS,[2] translated by Lemyre and Roberts (2004) (Appendix A). However, these publications do not describe the SIMS translation process; neither do they refer to a validation of this Norwegian version. All the above mentioned studies refer to validation articles of the English

version by Guay et al. (2000) and/or Standage et al. (2003). To the authors' knowledge, the Norwegian version of the SIMS has not been validated among adolescents in a PE setting. Therefore, this study assesses the psychometric properties of the Norwegian version of the SIMS questionnaire. For comparison, the original, English version of SIMS is included as Appendix B.

1.1. Aims

The aim of the present study is twofold: (1) To examine the psychometric properties of the Norwegian version of the SIMS among adolescents in secondary and upper secondary school PE, and (2) to test if the 14-item model is superior to the 16-item model.

The following hypotheses were tested: The SIMS questionnaire comprises four factors (H_1). The 14-item version of the SIMS four-factor model is superior to the 16-item four-factor version (H_2). The Norwegian version of the SIMS questionnaire shows good reliability and construct validity (H_3). The SIMS factor structure is invariant across time (H_4). There are significant correlations between further intentions of participation in PE and all the four SIMS factors: IM and IR in the positive direction and ER and AM in the negative direction (H_5). The four SIMS factors demonstrate a simplex-like structure (H_6).

2. Methods

2.1. Participants and research context

Twenty schools from three different regions in Norway were invited to participate by the researchers in sending an e-mail to the school authorities. Six schools agreed to participate, with a total of 364 students (Year 8, 9, 10 in lower-secondary school and Year 1 in upper secondary school). Of these, 318 (87.4%) students took part in this study. The schools involved represented both rural and central communities with a normal distribution of immigration and social classes. Gender and age distributions in the present sample were 145 girls with a mean age of 15.31 (SD = 1.31) and 173 boys with a mean age of 15.06 (SD = 1.13). The students' mark awarded for classwork in the second semester of 2016 (girls: 4.45; boys: 4.49) reflected the national average for 10^{th} grade (girls: 4.5; boys: 4.6) for the actual semester (Statistics Norway, 2016). Data were collected two times (T1 and T2), about four weeks apart, during the spring of 2016.

2.2. Variables and measures

In accordance with the standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999; Goodwin & Leech, 2003), the research questions addressed evidence related to the dimensionality, reliability and construct validity, all of which were considered to be interrelated measurement properties.

Dimensionality examines the extent to which the internal components of a test match the defined constructs. Hence, dimensionality is concerned with the homogeneity as well as the internal structure of the included items (Netemeyer, Bearden, & Sharma, 2003). A scale's internal structure (which items are consistent with which other items) reflects the internal consistency and thus reliability. In the present study, we assessed dimensionality by inspecting the factor structure and individual items.

Reliability may be viewed as an instrument's consistency and relative lack of error. One type of reliability is internal consistency, representing the interrelatedness of items or sets of items in a scale. Cronbach's alpha (α) and composite reliability (ρ) are reliability coefficients assessing internal consistency (Netemeyer et al., 2003) which are used in this study. This study assessed reliability by evaluating the factor loadings, squared multiple correlations (R^2) along with the reliability coefficients Cronbach's alpha and composite reliability.

Construct validity refers to how well a measure actually measures the construct it is intended to measure, and is based among other things on the construct's relationships to other variables (Netemeyer et al., 2003). In assessing discriminant validity in the present study, the correlations among the SIMS four factors were investigated to determine if they displayed a simplex-like structure and possible invariances across genders, as well as the stability across measurement times and future intentions of participation in PE.

2.3. Data collection

The participating schools and PE teachers received exact instructions from the researchers in accordance with a written instruction on how to conduct the data collection. The students filled in the SIMS anonymously in paper format at the start of a PE class. There was no time limit. All students had the opportunity to mark their answers without being observed, and to ask questions if something was unclear. To minimize the adolescent's tendency to give socially desirable responses, they were asked to answer as truthfully as they could, along with an assurance that the teacher would not be able to read their responses and that their grades would not be affected by how they responded. Written consent in accordance with the procedure acknowledged by the Norwegian Centre for Research Data (NSD, Project #47604) was given by their parents. The students normally needed approximately 10 to 15 minutes to complete the SIMS. The data collectors immediately put all the SIMS questionnaires into a sealed package. This material was then sent to the researchers for data entry.

3. Statistical analysis

The data were analysed by descriptive statistics and explorative factor analysis (EFA), using IBM SPSS version 24 and CFA by means of Stata 14.1 (StataCorp, 2015). When evaluating a measurement scale, researchers face two important questions: 1) the underlying dimensionality of data, and 2) the adequacy of individual items. In these instances, EFA and CFA can provide complementary perspectives on data, giving different pieces of information (Hurley et al., 1997; Netemeyer et al., 2003). The implicit assumption underlying the use of EFA in the present study is the insecurity with respect to the dimensionality of the SIMS, which has not previously been tested in Norway, nor among adolescents. Therefore, this study intended to gain insight into a potential factor structure of the SIMS and provide a broad perspective on the observed data using EFA followed by the confirmation procedure by means of CFA.

CFA is a sub-model in structural equation modelling (SEM) that deals specifically with measurement models (Brown, 2006), accounting for random measurement error. Thus, the psychometric properties of the scales used are more accurately derived. A high loading of an item indicates that there is much in common between the factor and the respective item (Sharma, 1996). Loadings below .32 are considered poor, ≥ .45 fair, ≥ .55 good, ≥ .63 very good, and above .71 excellent (Sharma, 1996).

The present study assessed model fit adequacy by χ^2-statistics and various fit indices. In line with the "rules of thumb" given as conventional cut-off criteria (Mehmetoglu & Jakobsen, 2017) the following fit indices were used; the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMS), with values below .05 indicating good fit, whereas values smaller than 0.10 are interpreted as acceptable (Mehmetoglu & Jakobsen, 2017). Further, the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) with acceptable fit set at .90 (Mehmetoglu & Jakobsen, 2017) were used. The frequency distribution of the measurements was examined to assess deviation from normality: both skewness and kurtosis were significant, thus the Robust Maximum Likelihood (RML) estimate procedure was applied. When analysing continuous but non-normal endogenous variables, the Satorra-Bentler corrected χ^2 should be reported (Kline, 2011; Satorra & Bentler, 1994).

4. Results

4.1. Descriptive analysis

Table 1 presents the means (M), standard deviations (SD) and Pearson's r and Kendall's tau-b correlation matrix for the SIMS scale estimated at both assessments (T1 and T2) and on both the 14-item and 16-item version. Significant correlations in the predicted direction and structures for SIMS in terms of time, intentions of participation in PE and structure were shown (Table 1).

The alpha levels for the SIMS factors indicated an acceptable inter-item consistency in the measures, with Cronbach's alpha coefficients between .74—.92 (Tables 2 and 4). However, a substantial body of research has indicated that Cronbach's alpha cannot be generally relied on as an estimator of reliability (Raykov, 2001). Thus, composite reliability coefficient (ρ_c) was estimated by means of the formula by Hair et al. (Hair, Black, Babin, & Anderson, 2010), as noted in Table 3. Composite reliability displayed good values (.78—.92): values ≥ 0.7 are considered to be good (Bagozzi & Yi, 1988; Hair et al., 2010; Mehmetoglu & Jakobsen, 2017).

4.2. Dimensionality of the SIMS

4.2.1. Exploratory factor analysis (EFA)

The SIMS was assessed in the same sample twice approximately four weeks apart. Since previous studies have shown that the SIMS dimensionality is unclear, the SIMS items were subjected to exploratory factor analysis (EFA). The Kaiser-Meyer-Olkin measure (Tabachnick & Fidell, 2007) of sampling adequacy exceeded the recommended value of .60 (T1: .898; T2: .901) and Bartlett's test of Sphericity reached statistical significance ($p < .0001$), supporting the factorability of the correlation matrix for both assessments. The SIMS-factors were expected to be correlated (H_1). Thus, principal component analysis with an oblique promax rotation was used. Table 2 lists the loadings, factors and variance explained for the factors extracted from both assessments (T1 and T2). EFA revealed three factors with eigenvalue 1.0 and above. This three-factor-solution disclosed factor loadings between .509 and .906, including one cross loading for item 11 ("Because I don't have any choice") at both T1 and T2, explaining 66 % and 67 % of the total variance, respectively. However, several studies have demonstrated a four-factor-solution of the SIMS. Therefore, the data were run once more (both T1 and T2), setting the number of factors to four. This four-factor-solution displayed factor loadings between .377 and .957, including five cross loadings, explaining 70.5 % of the total variance. Hence, the fourth factor contributed about 4 % of the explanation. Looking at the dimensionality of these two models, the EFA suggested a strong first factor, including eight-nine items. Accordingly, the dimensionality seemed uncertain, and we turned to CFA.

4.2.2. Confirmatory factor analysis (CFA)

4.2.2.1. The three-factor construct suggested by EFA. First, the three-factor construct suggested by the EFA was tested by means of CFA, showing significant t-values for all estimates ($p < .05$), with factor loadings (λ) ranging between .58—.89, with squared multiple correlations (R^2) varying from .33 to .79, at both T1 and T2. This three-factor-solution gave a Satorra Bentler scaled χ^2 (101) = 350.717; $p < .00001$, $\chi^2/df = 3.47$ and RMSEA = .094, $p < .000001$, SRMR = .093, CFI = .90 and TLI = .88. Hence, this three-factor model did not reveal a good fit with our data.

4.2.2.2. The four-factor construct comprising 16 items—model-1. Next, the previously published four-factor solution (framed Model-1) was run, showing a significantly increased fit at T1 (χ^2 (98) = 295.43; $p < .00001$, $\chi^2/df = 3.02$, and RMSEA = .085, $p < .00001$, SRMR = .088, CFI = .92 and TLI = .90), and even a better fit at T2 (χ^2 (98) = 266.59; $p < .00001$, $\chi^2/df = 2.72$ and RMSEA = .081, $p < .00001$, SRMR = .078, CFI = .93 and TLI = .91) (Table 3). This four-factor solution revealed a significantly better fit than the three-factor solution at both T1 and T2. Thus, H_1 suggesting a four-factor construct of the SIMS found support. Nevertheless, the fit indices of Model-1 did not indicate a good fit. A scrutiny of the residuals and the modification indices (MI) disclosed some problems; in particular item 11 ("Because I don't have any choice") was

Table 1. Situational Motivation Scale (SIMS), 16-item and 14-item version, at T1 (T2 in parenthesis) assessments in relation to selected measures: n, means (M), standard deviation (SD) and correlation coefficients for SIMS and its dimensions

				Correlation coefficients Pearson's r^2				
SIMS	***n***	***M***	***SD***	**IM**	**IR**	**ER**	**AM**	**T1→T2**
Model-1 Four-factor solution 16 items								
Intrinsic Motivation (IM)	279 (260)	4.96 (4.90)	1.46 (1.51)	1 (1)	.813** (.756**)	-,288** (−.168**)	−.459** (−.402**)	.660**
Identified Regulation (IR)	279 (260)	5.04 (5.00)	1.40 (1.35)		1 (1)	−.257** (−.183**)	−.461** (−.472**)	.644**
External Regulation (ER)	279 (260)	4.57 (4.54)	1.54 (1.55)			1 (1)	.289** (.202**)	.636**
Amotivation (AM)	279 (260)	2.44 (2.43)	1.24 (1.26)				1 (1)	.568**
Intention of participation[a]				.462** (.342**)	.422** (.373**)	−.203** (−.176**)	−.304** (−.306**)	
Model-2 four-factor solution 14 items								
Intrinsic Motivation (IM)	280 (264)	4.97 (4.91)	1.47 (1.51)	1 (1)	.780** (.762**)	−.167** (−.072)	−.450** (−.399**)	.660**
Identified Regulation (IR)	280 (264)	5.26 (5.20)	1.40 (1.31)		1 (1)	−.027 (.012)	−.473** (−.474**)	.578**
External Regulation (ER)	280 (264)	4.92 (4.88)	1.58 (1.55)			1 (1)	.210** (.144)	.554**
Amotivation (AM)	280 (264)	2.45 (2.42)	1.24 (1.26)				1 (1)	.568**
Intention of participation[a]				.462** (.342**)	.397** (.366**)	−.120* (−.116*)	−.304** (−.306**)	

Note: **significant correlation at the 1% level; *significant correlation at the 5% level (2-tailed, listwise exclusion). [a] = measured with Kendall's tau-b

Table 2. Exploratory Factor Analysis of the SIMS questionnaire—Rotated Component Matrix, T1 (T2 in parenthesis)

	T1 Model-1 (3 factors, 16 items)			T1 Model-2 (4 factors, 16 items)			
SIMS 16-items	**SIMS-1**	**SIMS-2**	**SIMS-3**	**SIMS-1**	**SIMS-2**	**SIMS-3**	**SIMS-4**
SIMS1 Because I think that this activity is interesting	.846 (.875)			.880 (.815)			
SIMS2 Because I am doing it for my own good.	.701 (.509)			.377			−.449 (.859)
SIMS3 Because I am supposed to do it.		.812 (.819)			.775 (.824)		
SIMS4 There may be good reasons to do this activity, but personally, I don't see any.			.675 (.812)			.688 (.792)	
SIMS5 Because I think that this activity is pleasant.	.834 (.906)			.957 (.921)			.364
SIMS6 Because I think this activity is good for me.	.785 (.801)			.614 (.659)			
SIMS7 Because it is something that I have to do		.847 (.887)			.830 (.888)		
SIMS8 I do this activity but I am not sure if it is worth it			.796 (.772)			.811 (.761)	
SIMS9 Because this activity is fun.	.866 (.892)			.894 (.953)			
SIMS10 By personal decision[a].	.733 (.613)			.425 (.320)			−.498 (.549)
SIMS11 Because I don't have any choice[b].	−.419	.548 (.697)			.435 (.694)		.674
SIMS12 I don't know; I don't see what the activity brings to me.			.796 (.738)			.819 (.744)	
SIMS13 Because I feel good when doing this activity.	.794 (.844)			.613 (.823)			
SIMS14 Because I believe this activity is important for me.	.804 (.774)			.510 (.714)			−.410
SIMS15 Because I feel that I have to do it.		.825 (.774)			.851 (.771)		
SIMS16 I do this activity, but I am not sure it is a good thing to pursue it.			.823 (.754)			.833 (.795)	
Cumulative % of total variance explained	41.238 (39.528)	55.969 (55.081)	66.188 (67.386)	41.238 (41.238)	55.969 (55.969)	66.188 (66.188)	70.508 (70.508)
Cronbach's Alpha *(number of items)*	.92 (8)	.80 (4)	.80 (4)	.92 (8)	.74 (4)	.80 (4)	.81 (5)

Note: Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Values < 0.32 are suppressed. Model-1: Three components extracted based on Eigenvalue > 1. Total variance explained: 71.14% (71.57%). Rotation converged in 4 iterations. Model-2: Four components extracted. Total variance explained: 70.51%. Rotation converged in 17 iterations

Table 3. Goodness-of-fit measures for measurement models of the SIMS. Confirmatory Factor Analysis for Model-1 and Model-2, at two points of assessment framed T1 and T2

Fit Measure	T1 Model-1 16 items n = 279	T1 Model-2 14 items n = 280	T2 Model-1 16 items n = 260	T2 Model-2 14 items n = 272	T1(T2) Model-2 Boys n = 151 (146)	T1(T2) Model-2 Girls n = 129 (118)
χ^2 *Satorra Bentler*	295.434	155.517	266.59	152.004	154.731 (156.949)	99.159 (77.804)
p-value	.00001	.00001	.00001	.00001	.00001 (0.0001)	.015 (.271)
$\frac{\chi^2}{df}$ *Satorra Bentler*	3.015 (Df = 98)	2.19 (Df = 71)	2.72 (Df = 98)	2.14 (Df = 71)	2.18 (2.21) (Df = 71)	1.40 (1.10) (Df = 71)
RMSEA	.085 (CI: .074-.096)	.065 (CI: .051-.079)	.081 (CI: .070-.093)	.066 (CI: .052-.081)	.088 (.091)	.055 (.028)
p-value (close fit test)	.000001	.037	.00001	.037	.001 (.0001)	.034 (.826)
SRMR	.088	.046	.078	.045	.069 (.065)	.047 (.047)
TLI	.90	.95	.91	.95	.90 (.89)	.97 (.99)
CFI	.92	.96	.93	.96	.93 (.91)	.97 (.99)
$\rho c \frac{(\sum\lambda)^2}{[(\sum\lambda)^2+\sum(\theta)]}$	IM: .91 IR: .83 ER: .80 AM: .81	IM: .91 IR: .86 ER: .80 AM: .81	IM: .92 IR: .79 ER: .81 AM: .81	IM: .89 IR: .78 ER: .80 AM: .81	.89 (.91) .87 (.72) .77 (.77) .81 (.77)	.92 (.93) .85 (.84) .82 (.83) .82 (.86)

Note. SIMS = Situational Motivation Scale measurement model. RMSEA = Root Mean Square Error of Approximation. SRMS = Standardized Root Mean Square Residual. TLI = Tucker-Lewis Index, CFI = The Comparative Fit Index, Df = Degrees of freedom, pc = Composite reliability.

Table 3. *Goodness-of-fit measures for measurement models of the SIMS. Confirmatory Factor Analysis for Model-1 and Model-2, at two points of assessment framed T1 and T2.*

troublesome, indicating loadings at all four factors and a significant residual, explaining only a minor variance (R^2 = .36). Item 10 ("By personal decision") exposed the same pattern, including significant residual and explained only a little of the variance of its factor (R^2 = .36). The corrected item-total correlation test of the two factors, which these items belonged to, revealed a better internal consistency when the items 10 and 11 were removed, supporting that these items should be considered excluded (Table 4). Hence, items 10 and 11 were disclosed and the four-factor solution was run once more.

4.2.2.3. The four-factor construct comprising 14 items—model-2. This revised version of the four-factor construct framed Model-2 showed a good fit with the observed data at both T1: χ^2 (71) = 155.52; p < .00001, χ^2/df = 2.19, RMSEA = .065, p < .037, SRMR = .046, CFI = .96 and TLI = .95), T2: χ^2 (71) = 152.004; p < .00001, χ^2/df = 2.14, and RMSEA = .066, p < .037, SRMR = .045, CFI = .96 and TLI = .95). Model-2 also revealed good composite reliability with estimates between .78—.91 (Table 3) for both assessments. Model-2 portrayed in Figure 1 was the best fitting model.

5. Discussion

The research question of this study was twofold, addressing evidence related to dimensionality, reliability and construct validity of the SIMS questionnaire. The aim was to assess the psychometric properties of the Norwegian version of the SIMS measure among adolescents in Norway. Six hypotheses (H_1—H_6) were tested. The observed data demonstrated that the Norwegian version of the SIMS questionnaire consisted of four factors (H_1), and that the 14-item version was superior to the 16-item version (H_2). Furthermore, the 14-item four-factor solution displayed good construct validity and reliability (H_3). The SIMS factor structure was invariant across time (H_4). There were correlations in predicted directions between further intentions of participation in PE and the four SIMS factors (H_5). The four SIMS factors demonstrate a simplex-like structure (H_6).

5.1. *Dimensionality*

In accordance with previous studies (Guay et al., 2000; Lonsdale et al., 2011; Standage et al., 2003), the present results indicated that the four-factor model of the SIMS is psychometrically superior to a possible three-factor construct suggested by the EFA in this study. However, some items seemed troublesome; in particular, this was the case for item 10 ("By personal decision") and 11 ("Because I don't have any choice"). These two items revealed cross loadings to all four factors, blurring the dimensionality of the SIMS scale. While responding to the scale, the adolescents were asked why they were currently engaged in the subject physical education. The content of the two troublesome items relate to having a choice/decision regarding the students' participation in physical education at school. As physical education is a mandatory subject in Norway, these two items will naturally be in conflict with their intended purpose of measurement. Consequently, it is rational that they correlate, showing cross loadings. Looking at the wording of

the items, the first factor framed IM includes items covering positive aspects such as "physical education is interesting, pleasant, fun and good". The second factor, IR, indicates that the students participate in physical education for their own good, because it is good and important for them, while item 10 belonging to this factor brings in the perspective of personal decision, seeming to covering another aspect than the rest of this factor. Regarding item 11, a similar situation appears; the third factor framed ER includes aspects involving that the students feel they are supposed to and have to partake in this activity, while item 11 encompasses the dimension of not having a choice. Not having a choice, in this context, logically relates to all factors included in the SIMS scale; not having a choice is relevant, whether this activity is seen to be interesting, fun, good, for one's own good or not. Regardless of these aspects, the students experience that they do not have any choice; their participation is required anyway. In this perspective, item 11 relates to a dimension other than those assessed by the SIMS. Moreover, since both item 10 and 11 concern the dimension of having a choice/deciding by yourself, it is reasonable that these items significantly correlate, blurring the dimensionality. Accordingly, the four-factor model (Model-2) including only 14 of the originally 16 items is psychometrically superior (H_2).

5.2. Reliability

Reliability is supported by items in each factor with highly significant standardized factor loadings —preferably greater than .7 (Brown, 2006; Hair et al., 2010; Kline, 2011). This was the case for eleven out of the fourteen (sixteen) indicators; nevertheless, loadings under .7 were still good (.59, .64 and .67). Accordingly, all standardized factor loadings showed good to very good values ranging between .59—.89. The square of a standardized loading represents how much variation in an item is explained by the latent factor and is termed the variance extracted from the item (Hair et al., 2010). As loadings fall below .7, they can still be considered significant, but more of the variance in the measure is error variance than explained variance. As a result, Cronbach's alpha and composite reliability also revealed good values (Tables 2, 3 and 4), indicating good internal consistency: values greater than .7 are good (Acock, 2013; Hair et al., 2010; Mehmetoglu & Jakobsen, 2017). Hence, this study supported the reliability of the SIMS very well.

5.3. Construct validity

Constructs are latent variables which researchers cannot observe directly, but by means of indicators. Construct validation is a lengthy and ongoing process of learning more about the construct in focus, making new predictions and then testing them. Each study that supports the theoretical construct serves to strengthen the theory (Netemeyer et al., 2003). Construct validity for the SIMS refers to the assumption that this questionnaire validly measures situational motivation for physical education among adolescents.

The observed data supported that IM, IR, ER and AM regarding participating in PE correlated with each other in the expected directions (Figure 1 and Table 1). Figure 1 shows standardised covariances (ϕ), while Table 1 shows Pearson's correlation coefficients (ρ), demonstrating a slight, but acceptable difference. As expected, IM and IR were highly positively correlated (ϕ = .87; ρ = .780), while IR and ER did not demonstrate significant correlation (ϕ = −.065; ρ = −.027). This is reasonable: IM and IR include positive aspects, such as PE is interesting, pleasant, fun, good and important to them, while ER contains experiences of being supposed to and having to participate. Interestingly, ER (to be supposed to/have to participate) and AM (don't see any good reasons/what it brings/not sure if it is worth pursuing) revealed a weak, but significant, factor correlation (ϕ = .27; ρ = .210), indicating these factors to possibly contrast with each other. Probably the experience of being supposed to/have to participate reflects issue other than whether this activity is good for the individual or worth pursuing. Nevertheless, the demonstrated correlations reflect earlier findings (Guay et al., 2000). Moreover, significant correlations in the predicted direction between the selected factors, stability over measurement times, intention of participation, and a simplex-like structure, supported convergent and discriminant validity. Amotivation was the factor demonstrating less stability across measurement times, supporting to some extend the findings of Guay et al. (2000). To investigate a possible invariance

Table 4. Corrected item-total correlations and Cronbach's alpha for the Situational Motivation Scale (SIMS) items over four factors at T1 (T2 in parenthesis)

SIMS factor	α	Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Intrinsic Motivation (IM)	.901 (.906)	1	14.84 (14.49)	20.25 (21.29)	.797 (.791)	.866 (.878)
		5	15.02 (14.67)	19.80 (20.73)	.807 (.835)	.862 (.863)
		9	14.74 (14.52)	19.93 (20.93)	.834 (.809)	.853 (.872)
		13	14.99 (14.76)	20.78 (21.06)	.685 (.726)	.907 (.903)
Identified Regulation (IR)	.817 (.792)	2	14.92 (14.62)	19.87 (19.31)	.636 (.556)	.772 (.763)
		6	14.69 (14.47)	19.33 (18.30)	.717 (.698)	.740 (.703)
		10	15.82 (15.46)	17.57 (15.88)	.525 (.572)	.844 (.769)
		14	15.21 (15.08)	17.93 (17.34)	.732 (.621)	.725 (.731)
External Regulation (ER)	.797 (.817)	3	12.89 (12.80)	24.89 (24.68)	.577 (.626)	.763 (.776)
		7	13.27 (13.25)	21.97 (23.14)	.729 (.716)	.689 (.736)
		11	14.66 (14.53)	22.87 (22.30)	.513 (.597)	.802 (.795)
		15	13.60 (13.45)	22.46 (23.53)	.642 (.627)	.730 (.775)
Amotivation (AM)	.803 (.793)	4	7.27 (7.35)	15.60 (14.19)	.521 (.581)	.799 (.756)
		8	7.24 (7.33)	14.43 (14.68)	.649 (.645)	.738 (.721)
		12	7.37 (7.54)	13.93 (14.87)	.730 (.689)	.699 (.703)
		16	7.16 (7.25)	15.01 (15.85)	.578 (.514)	.773 (.785)

Note: α = Cronbach's alpha

across gender the TLI (Boys: .90; girls: .97) and the CFI (Boys: .93; girls: .97) were assessed revealing a small variance (Table 3). Fit is considered adequate if the CFI and TLI values are > .90, better if they are > .95 (Kline, 2011; Mehmetoglu & Jakobsen, 2017). Hence, the SIMS factor structure did not show stability across gender, not supporting the findings of Guay et al. (2000), although they reported a small but statistically significant gender difference on the AM factor. Reasons why the SIMS structure differs among girls and boys is indistinguishable in our data other than the observation that SIMS demonstrates a better fit among girls than boys. Thus, this should be further investigated.

Taken together, the evidence supports satisfactory construct validity of the SIMS factors among adolescents in Norway. Content validity is an obligation both for reliability and construct validity (Mokkink et al., 2010; Potter & Levine-Donnerstein, 1999), and is assessed by judging the relevance and comprehensiveness of the items; both with regard to relevance for the construct to be measured as well as for the study population. In the present adolescent population, the fourteen (sixteen) items appeared to be relevant, signified by the high factor loadings and the high R^2-values.

6. Strengths and limitations

The participation of 318 adolescents (response rate 87.4 %) from six schools involving three regions in Norway signifies a strength of this study. The present sample represents a diversity of locations in urban and rural areas, reflecting the general adolescent population in Norway. Next, the students' semester marks corresponded with the national average grade for the actual semester, indicating that the present sample does not differ from the general Norwegian adolescent population in terms of actual age. The PE teacher administered the data collection at the start of a PE lesson, ensuring anonymity and enough time for the students to fill in the questionnaire. This procedure using a well-known teacher in well-known surroundings contributed to making the students feel comfortable in the assessment situation, supporting reliable data. This represents a strength of this study. The fact that the same sample assessed the SIMS twice, allowing analysis of two datasets from the same sample signifies another strength of the present study. These results suggest that the Norwegian translation of the SIMS is a valid and reliable measurement model among adolescents.

Nevertheless, some limitations should be taken into consideration. This study of the Norwegian version of the SIMS included adolescents 13–17 years old. Thus, the present results cannot be generalized to younger children nor to older adolescents.

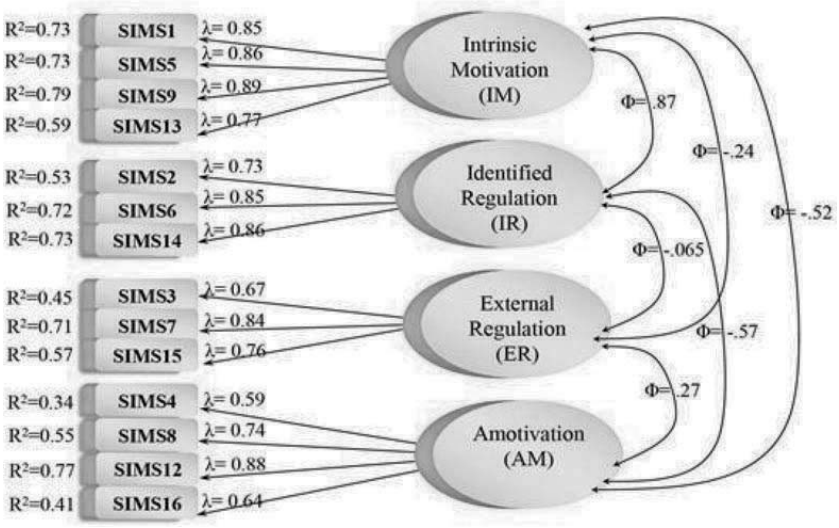

Figure 1. SIMS measurement Model-2 including 14 items, T1. R^2 = Bentler-Raykov squared multiple correlation coefficient, λ = factor loading, ϕ (phi) = factor correlation. n = 280. Fit indices: χ2 = 155.517 (χ2/df = 2.19), RMSEA = .065, SRMR = .046, TLI = .95, CFI = .96.

7. Conclusion

This study evaluated the psychometric properties of the Norwegian version of the SIMS among adolescents in secondary school, by assessing the dimensionality, reliability and construct validity. The SIMS demonstrated satisfactory reliability and construct validity, while the dimensionality seemed somewhat blurred or indistinct. However, dismissing item 10 and 11 resulted in a good fitting model which included 14 of the original 16 items. Hence, the Norwegian version of the SIMS seemed appropriate and can be used to measure situational motivation among adolescents. The two dismissed items might represent another factor related to having a choice/personal decision. Thus, a further development of the SIMS might include more items which would tap into this possible factor—representing a fifth factor.

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Notes

1. From "On the Assessment of Situational Intrinsic and Extrinsic Motivation: The Situational Motivation Scale (SIMS)" by Guay, Frédéric, Vallerand, Robert and Blanchard, Céline, 2010, *Motivation and Emotion*, 24, p. 175–213, Appendix. Copyright [2010] by the authors. Reprinted with permission by Guay, Frédéric (personal communication, 3 September 2018).
2. From "Overtraining and Athlete Burnout: a Self-Determination Theory Perspective" by Lemyre, Pierre-Nicolas and Roberts, Glyn C., 2004, Paper presented at the Association for the Advancement of Applied Psychology Conference, Minneapolis MN, USA. Copyright [2004] by the authors. Reprinted with permission by Lemyre, Pierre-Nicolas (personal communication, 14 December 2018).

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Appendix A. The Situational Motivation Scale (SIMS), Norwegian version

Hvorfor deltar du egentlig i kroppsøvingstimene på skolen? Kryss av for om du er enig i utsagnene som er listet under. (Ett kryss for hvert utsagn)	**Fullstendig uenig**				**Fullstendig enig**		
	1	**2**	**3**	**4**	**5**	**6**	**7**
1. Fordi jeg synes denne aktiviteten er interessant.....	□	□	□	□	□	□	□
2. Fordi jeg gjør det for min egen skyld.....	□	□	□	□	□	□	□
3. Fordi det er forventet at jeg skal gjøre det.....	□	□	□	□	□	□	□
4. Det er kanskje mange gode grunner til å gjøre denne aktiviteten, men personlig ser jeg ingen.....	□	□	□	□	□	□	□
5. Fordi jeg synes denne aktiviteten er trivelig.....	□	□	□	□	□	□	□
6. Fordi jeg tror denne aktiviteten er bra for meg.....	□	□	□	□	□	□	□
7. Fordi det er noe jeg må gjøre.....	□	□	□	□	□	□	□
8. Jeg gjør denne aktiviteten, men jeg er ikke sikker på om det er verdt det.....	□	□	□	□	□	□	□
9. Fordi denne aktiviteten er artig/morsom.....	□	□	□	□	□	□	□
10. Fordi jeg har valgt det selv[a].....	□	□	□	□	□	□	□
11. Fordi jeg ikke har noe valg[b].....	□	□	□	□	□	□	□
12. Jeg vet ikke. Jeg ser ikke helt hva denne aktiviteten gir meg.....	□	□	□	□	□	□	□
13. Fordi det føles godt å gjøre denne aktiviteten.....	□	□	□	□	□	□	□
14. Fordi jeg mener denne aktiviteten er viktig for meg	□	□	□	□	□	□	□
15. Fordi jeg føler at jeg må gjøre det.....	□	□	□	□	□	□	□
16. Jeg driver med denne aktiviteten nå, men jeg er ikke sikker på om det er riktig å fortsette.....	□	□	□	□	□	□	□

Note: Items 10 og 11 (påskrift [a] og [b]) er utelatt i 14-item versjonen.
Indre motivasjon (IM): Items 1, 5, 9, 13; Identifisert regulering (IR): Items 2, 6, 10, 14; Ytre regulering (YR): Items 3,7, 11, 15; Amotivasjon (AM): Items 4, 8, 12, 16.

Appendix B. The original 16-item version of the Situational Motivation Scale (SIMS)[1]

Why are you currently engaged in this activity?
***Instructions*: Read each item carefully. Using the scale below, please indicate the number that best describes the reason why you are currently engaged in this activity. Answer each item according to the following scale: 1 = does not correspond at all, 2 = corresponds very little; 3 = corresponds a little; 4 = corresponds moderately; 5 = corresponds a lot; 7 = corresponds exactly.**

	Not at all						Exactly
	1	2	3	4	5	6	7
1. Because I think that this activity is interesting.	□	□	□	□	□	□	□
2. Because I am doing it for my own good.	□	□	□	□	□	□	□
3. Because I am supposed to do it.	□	□	□	□	□	□	□
4. There may be good reasons to do this activity, but personally, I don't see any.	□	□	□	□	□	□	□
5. Because I think that this activity is pleasant.	□	□	□	□	□	□	□
6. Because I think this activity is good for me.	□	□	□	□	□	□	□
7. Because it is something that I have to do.	□	□	□	□	□	□	□
8. I do this activity but I am not sure if it is worth it.	□	□	□	□	□	□	□
9. Because this activity is fun.	□	□	□	□	□	□	□
10. By personal decision[a].	□	□	□	□	□	□	□
11. Because I don't have any choice[b].	□	□	□	□	□	□	□
12. I don't know; I don't see what the activity brings to me.	□	□	□	□	□	□	□
13. Because I feel good when doing this activity.	□	□	□	□	□	□	□
14. Because I believe this activity is important for me.	□	□	□	□	□	□	□
15. Because I feel that I have to do it.	□	□	□	□	□	□	□
16. I do this activity, but I am not sure it is a good thing to pursue it.	□	□	□	□	□	□	□

Note: Items 10 and 11 (superscripts [a] and [b]) are omitted in the 14-item measure.
Intrinsic motivation (IM): Items 1, 5, 9, 13; Identified regulation (IR): Items 2, 6, 10, 14; External regulation (ER): Items 3,7, 11, 15; Amotivation (AM): Items 4, 8, 12, 16.
[1]From "On the Assessment of Situational Intrinsic and Extrinsic Motivation: The Situational Motivation Scale (SIMS)," by Guay, Frédéric, Vallerand, Robert and Blanchard, Céline, 2010, *Motivation and Emotion*, 24, p. 175–213, Appendix. Copyright [2010] by the authors. Reprinted and translated with permission by Guay, Frédéric (personal communication, 3 September 2018).

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Appendix I - XIII

Appendix I

Omvendt undervisning i kroppsøving på ungdomsskolen

Et prosjekt for å:

- **Øke motivasjonen for å delta i kroppsøving**
- **Øke mengden aktivitet i kroppsøvingstimene hos alle**
- **Øke kunnskapsnivået hos elevene på de teoretiske temaene i faget**

Hei, og takk for at du deltar!

Hva innebærer prosjektet og hva skal du gjøre?

- Jeg har laget 3 videoressurser som skal gis som lekse i faget kroppsøving i forkant av 3 økter som jeg har laget og som du da skal gjennomføre med klassen. De tre temaene er *utholdenhet*, *styrke*, og *koordinasjon*. Når de ulike øktene gjennomføres bestemmer du selv, eller i samarbeid med meg om jeg skal delta/observere.
- I forkant av hver økt skal elevene ha fått som lekse å se videoen om det aktuelle tema for uka. F.eks. *utholdenhet*. Videoen ligger på nettsiden http://youtu.be/mCkiU6uOF_s. Leksa må gis på ukeplan samt at det minnes om denne i dagene før den praktiske økta, slik at så mange som mulig ser videoen. Videoen passer godt til å se på smarttelefon eller på nettbrett. Det er viktig at du som lærer også har sett videoene slik at du kan diskutere innholdet med elevene i etterkant av den praktiske økta.
- Du gjennomfører den aktuelle økta så godt det lar seg gjøre med tanke på tid og utstyr. Om det er aktiviteter du er usikker på så ta kontakt med meg på 92058388 så kan jeg forklare.
- I etterkant av økta skal elevene, og kroppsøvingslærer, svare på spørreskjema som tilhører aktuell økt. Alle besvarte skjema sendes pr post (Ove Østerlie, HiST, Rotvoll Allé 1, 7053 Ranheim) eller skannes og sendes på e-post til ove.osterlie@hist.no.
- Det kan være aktuelt for meg å samle inn data fra deg som lærer om du har flere grupper slik at man kan sammenligne effekten prosjektet har opp mot grupper som ikke deltar. Dette kan være i form av intervju og registrering av karakterer/vurderinger.

Prosjektet er i samarbeid med Folkehelsesenteret.

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Ove Østerlie
Høgskolen i Sør-Trøndelag

Appendix II

Omvendt undervisning i kroppsøving på ungdomsskolen

Et prosjekt for å:

- **Øke motivasjonen for å delta i kroppsøving**
- **Øke mengden aktivitet i kroppsøvingstimene hos alle**
- **Øke kunnskapsnivået hos elevene på de teoretiske temaene i faget**

Informasjon til heimene:

Hei!
Ditt barn skal dette skoleåret delta i et prosjekt som har de tre målsetningene over. Prosjektet vil ikke samle inn noen personopplysninger og det er helt anonymt. Under er det listet opp det som deltagelse i prosjektet innebærer:

- Prosjektet vil være 3 økter i kroppsøving fordelt ut over året.
- Før hver av de 3 timene får elevene i lekse å se en video som blir publisert på internett. Det vil komme fram av ukeplan eller lekseplan hvor videoen ligger. Videoene er godt egnet for å se på nettbrett eller smarttelefon.
- I påfølgende kroppsøvingstime skal elevene jobbe med det tema som videoen omhandler ut fra et ferdig opplegg som lærer i faget vil presentere. De tre temaene er *utholdenhet*, *styrke*, og *koordinasjon*. Det kreves ikke noen forberedelse fra elevenes side unntatt å gjøre leksa som er å se videoen.
- I etterkant av hver økt skal elevene svare på et spørreskjema. Dette tar ca 3 min og omhandler hvordan eleven opplevde leksa og den praktiske gjennomføringa.

Prosjektet er i samarbeid med Folkehelsesenteret (http://folkehelsesenteret.no/)
Skulle det være spm omkring prosjektet og deltagelse så ta gjerne kontakt på mail ove.osterlie@hist.no eller telefon 73 41 26 18

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Høgskolen i Sør-Trøndelag

Prosjekt omvendt undervisning i kroppsøving på ungdomsskolen

Spørreskjema 1 «Utholdenhet»

I forkant av disse spørsmålene har du gjennomført en time i kroppsøving der fokus har vært på utholdenhet. Les spørsmålene under og kryss av for hva du mener er riktigst. Dette spørreskjemaet er anonymt.
Når du er ferdig leverer du skjemaet til læreren.

Elevskjema

1. Kjønn: ☐ jente ☐ gutt
2. Trinn: ☐ 8.trinn ☐ 9.trinn ☐ 10.trinn
3. Så du videoen som var gitt i lekse før denne timen? ☐ Ja, hele videoen ☐ ja, noe ☐ nei

Her skal du krysse av det du mener stemmer best med hvert utsagn:

	Helt uenig	Litt uenig	hverken enig eller uenig	Litt enig	Helt enig	Vet ikke
4. Jeg ble mer motivert for å delta i kroppsøvingstimen etter å ha sett videoen.						
5. Jeg lærte mer om utholdenhet av å se videoen enn om jeg ikke hadde sett den.						
6. Jeg var mer fysisk aktiv i denne timen enn jeg er til normalt i kroppsøving der vi jobber med utholdenhet.						
7. Jeg var andpusten og svett i over halvparten av tiden i denne timen.						
8. Jeg opplevde mer mestring i denne timen enn jeg gjør til vanlig i kroppsøving der vi jobber med utholdenhet.						
9. Jeg økte mine ferdigheter i å trene utholdenhet ved å se videoen og å delta i den praktiske økta.						
10. Jeg syns det er interessant å lære om teori i kroppsøving.						
11. Jeg tror det er en god ide å ha flere slike timer der vi får video-lekse i forkant.						

Takk for at du så videoen, deltok i kroppsøvingstimen og for svarene!

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Ove Østerlie
Høgskolen i Sør-Trøndelag

Prosjekt omvendt undervisning i kroppsøving på ungdomsskolen

Spørreskjema 2 «Styrke»

I forkant av disse spørsmålene har du gjennomført en time i kroppsøving der fokus har vært på styrke. Les spørsmålene under og kryss av for hva du mener er riktigst. Dette spørreskjemaet er anonymt.
Når du er ferdig leverer du skjemaet til læreren.

Elevskjema

1. Kjønn: ☐ jente ☐ gutt
2. Trinn: ☐ 8.trinn ☐ 9.trinn ☐ 10.trinn
3. Så du videoen som var gitt i lekse før denne timen? ☐ Ja, hele videoen ☐ ja, noe ☐ nei

Her skal du krysse av det du mener stemmer best med hvert utsagn:

	Helt uenig	Litt uenig	hverken enig eller uenig	Litt enig	Helt enig	Vet ikke
4. Jeg ble mer motivert for å delta i kroppsøvingstimen etter å ha sett videoen.						
5. Jeg lærte mer om styrke av å se videoen enn om jeg ikke hadde sett den.						
6. Jeg var mer fysisk aktiv i denne timen enn jeg er til normalt i kroppsøving der vi jobber med styrke.						
7. Jeg ble sliten i musklene i store deler av denne timen						
8. Jeg opplevde mer mestring i denne timen enn jeg gjør til vanlig i kroppsøving der vi jobber med styrke.						
9. Jeg økte mine ferdigheter i å trene styrke ved å se videoen og å delta i den praktiske økta.						
10. Jeg syns det er interessant å lære om teori i kroppsøving.						
11. Jeg tror det er en god ide å ha flere slike timer der vi får video-lekse i forkant.						

Takk for at du så videoen, deltok i kroppsøvingstimen og for svarene!

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Høgskolen i Sør-Trøndelag

Prosjekt omvendt undervisning i kroppsøving på ungdomsskolen

Spørreskjema 3 «Koordinasjon»

I forkant av disse spørsmålene har du gjennomført en time i kroppsøving der fokus har vært på koordinasjon. Les spørsmålene under og kryss av for hva du mener er riktigst. Dette spørreskjemaet er anonymt.
Når du er ferdig leverer du skjemaet til læreren.

Elevskjema

1. Kjønn: ☐ jente ☐ gutt
2. Trinn: ☐ 8.trinn ☐ 9.trinn ☐ 10.trinn
3. Så du videoen som var gitt i lekse før denne timen? ☐ Ja, hele videoen ☐ ja, noe ☐ nei

Her skal du krysse av det du mener stemmer best med hvert utsagn:

	Helt uenig	Litt uenig	hverken enig eller uenig	Litt enig	Helt enig	Vet ikke
4. Jeg ble mer motivert for å delta i kroppsøvingstimen etter å ha sett videoen.						
5. Jeg lærte mer om koordinasjon av å se videoen enn om jeg ikke hadde sett den.						
6. Jeg var mer fysisk aktiv i denne timen enn jeg er til normalt i kroppsøving der vi jobber med koordinasjon.						
7. Jeg føler jeg fikk utfordret min koordinasjon i store deler av denne timen						
8. Jeg opplevde mer mestring i denne timen enn jeg gjør til vanlig i kroppsøving der vi jobber med koordinasjon.						
9. Jeg økte mine ferdigheter i å trene koordinasjon ved å se videoen og å delta i den praktiske økta.						
10. Jeg syns det er interessant å lære om teori i kroppsøving.						
11. Jeg tror det er en god ide å ha flere slike timer der vi får video-lekse i forkant.						

Takk for at du så videoen, deltok i kroppsøvingstimen og for svarene!

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Høgskolen i Sør-Trøndelag

Prosjekt omvendt undervisning i kroppsøving på ungdomsskolen

Spørreskjema 1 «Utholdenhet»

I forkant av disse spørsmålene har du undervist en time i kroppsøving der fokus har vært på utholdenhet. Les spørsmålene under og kryss av for hva du mener er riktigst. Det er også mulig at disse spørsmålene blir gjort som intervju.

Lærerskjema

1. Kjønn: ☐ kvinne ☐ mann
2. Trinn du underviste på: ☐ 8.trinn ☐ 9.trinn ☐ 10.trinn

Her skal du krysse av det du mener stemmer best med hvert utsagn:

	Helt uenig	Litt uenig	hverken enig eller uenig	Litt enig	Helt enig	Vet ikke
3. Jeg ble mer motivert for å undervise påfølgende kø-time etter å ha sett videoen og øktplanen.						
4. Jeg mener elevene viste via samtalen på slutten av økta at de hadde lært noe konkret om utholdenhet av videoen og økta.						
5. Elevene var mer fysisk aktiv i denne timen enn de er til normalt i kroppsøving der vi jobber med utholdenhet.						
6. Elevene var andpusten og svett i over halvparten av tiden i denne timen.						
7. Jeg tror elevene opplevde mer mestring i denne timen enn de gjør til vanlig i kroppsøving der vi jobber med utholdenhet.						
8. Jeg tror elevene fikk økt sine ferdigheter i å trene utholdenhet ved å se videoen og å delta den praktiske økta.						
9. Jeg tror elevene syns det er interessant å lære om teori i kroppsøving.						
10. Jeg tror det er en god ide å ha flere slike timer der elevene får video-lekse i forkant.						
11. Jeg kunne selv tenkt meg å jobbe på denne måten i flere økter i kroppsøving.						

Takk for din deltagelse!

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Ove Østerlie
Høgskolen i Sør-Trøndelag

Prosjekt omvendt undervisning i kroppsøving på ungdomsskolen

Spørreskjema 2 «Styrke»

I forkant av disse spørsmålene har du undervist en time i kroppsøving der fokus har vært på styrke. Les spørsmålene under og kryss av for hva du mener er riktigst. Det er også mulig at disse spørsmålene blir gjort som intervju.

Lærerskjema

1. Kjønn: ☐ kvinne ☐ mann
2. Trinn du underviste på: ☐ 8.trinn ☐ 9.trinn ☐ 10.trinn

Her skal du krysse av det du mener stemmer best med hvert utsagn:

	Helt uenig	Litt uenig	hverken enig eller uenig	Litt enig	Helt enig	Vet ikke
3. Jeg ble mer motivert for å undervise påfølgende kø-time etter å ha sett videoen og øktplanen.						
4. Jeg mener elevene viste via samtalen på slutten av økta at de hadde lært noe konkret om styrke av videoen og økta.						
5. Elevene var mer fysisk aktiv i denne timen enn de er til normalt i kroppsøving der vi jobber med styrke.						
6. Elevene var slitne i musklene i store deler av denne timen						
7. Jeg tror elevene opplevde mer mestring i denne timen enn de gjør til vanlig i kroppsøving der vi jobber med styrke.						
8. Jeg tror elevene fikk økt sine ferdigheter i å trene styrke ved å se videoen og å delta den praktiske økta.						
9. Jeg tror elevene syns det er interessant å lære om teori i kroppsøving.						
10. Jeg tror det er en god ide å ha flere slike timer der elevene får video-lekse i forkant.						
11. Jeg kunne selv tenkt meg å jobbe på denne måten i flere økter i kroppsøving						

Takk for din deltagelse!

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Høgskolen i Sør-Trøndelag

Prosjekt omvendt undervisning i kroppsøving på ungdomsskolen

Spørreskjema 3 «Koordinasjon»

I forkant av disse spørsmålene har du undervist en time i kroppsøving der fokus har vært på koordinasjon. Les spørsmålene under og kryss av for hva du mener er riktigst. Det er også mulig at disse spørsmålene blir gjort som intervju.

Lærerskjema

1. Kjønn: ☐ kvinne ☐ mann
2. Trinn du underviste på: ☐ 8.trinn ☐ 9.trinn ☐ 10.trinn

Her skal du krysse av det du mener stemmer best med hvert utsagn:

	Helt uenig	Litt uenig	hverken enig eller uenig	Litt enig	Helt enig	Vet ikke
3. Jeg ble mer motivert for å undervise påfølgende kø-time etter å ha sett videoen og øktplanen.						
4. Jeg mener elevene viste via samtalen på slutten av økta at de hadde lært noe konkret om koordinasjon av videoen og økta.						
5. Elevene var mer fysisk aktiv i denne timen enn de er til normalt i kroppsøving der vi jobber med koordinasjon.						
6. Elevene fikk utfordret sin koordinasjon i store deler av denne timen						
7. Jeg tror elevene opplevde mer mestring i denne timen enn de gjør til vanlig i kroppsøving der vi jobber med koordinasjon.						
8. Jeg tror elevene fikk økt sine ferdigheter i å trene koordinasjon ved å se videoen og å delta den praktiske økta.						
9. Jeg tror elevene syns det er interessant å lære om teori i kroppsøving.						
10. Jeg tror det er en god ide å ha flere slike timer der elevene får video-lekse i forkant.						
11. Jeg kunne selv tenkt meg å jobbe på denne måten i flere økter i kroppsøving						

Takk for din deltagelse!

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Ove Østerlie

Høgskolen i Sør-Trøndelag

Appendix V

Spørsmål om forventning, verdi og kostnad i kroppsøving.

Sett kryss etter hvor enig du er i utsagnene. (Ett kryss for hvert utsagn)

	Veldig dårlig 1	2	3	4	Veldig god 5
1. Hvor god er du i kroppsøving?.....	☐	☐	☐	☐	☐
	Dårligste 1	2	3	4	Beste 5
2. Dersom du gav karakteren 5 til den beste eleven i kroppsøving og 1 til den dårligste, hvilken karakter ville du gitt deg selv?.....	☐	☐	☐	☐	☐
	Mye dårligere 1	2	3	4	Mye bedre 5
3. Noen elever er bedre i et fag enn et annet. Du kan for eksempel være bedre i matematikk enn i lesing. Sammenlignet med de fleste av de andre fagene dine på skolen, hvor god er du i kroppsøving?.....	☐	☐	☐	☐	☐
	Veldig dårlig 1	2	3	4	Veldig god 5
4. Hvor god mener du at du er i kroppsøving?.....	☐	☐	☐	☐	☐
	Lite aktiv 1	2	3	4	Veldig aktiv 5
5. Hvor fysisk aktiv er du i kroppsøving?.....	☐	☐	☐	☐	☐
	Veldig lite viktig 1	2	3	4	Veldig viktig 5
6. Hvor viktig synes du kroppsøving er for deg?.....	☐	☐	☐	☐	☐
7. Sammenlignet med matematikk, lesing og naturfag, hvor viktig er det for deg å lære hva kroppsøving består av?.....	☐	☐	☐	☐	☐
	Veldig kjedelige 1	2	3	4	Veldig morsomme 5
8. Hvor morsomme synes du kroppsøvingstimene er generelt?.....	☐	☐	☐	☐	☐
	Liker dem ikke i det hele tatt 1	2	3	4	Liker dem veldig godt 5
9. Hvor godt liker du kroppsøvingstimene?	☐	☐	☐	☐	☐
	Ikke nyttig i det hele tatt 1	2	3	4	Veldig nyttig 5
10. Noen av tingene du lærer på skolen hjelper deg til å gjøre andre ting på en bedre måte utenfor skolen. Vi kaller disse tingene nyttige. Det du lærer om planter på skolen kan for eksempel hjelpe deg til å dyrke planter hjemme i hagen. Hvor nyttig mener du innholdet du lærte i kroppsøvingstimene er?...	☐	☐	☐	☐	☐
11. Sammenlignet med de andre fagene på skolen, hvor nyttig er det du lærer i kroppsøving?.....	☐	☐	☐	☐	☐
12. Er det noe i kroppsøving du ikke liker og hvorfor?					
13. Tenk deg at faget kroppsøving var frivillig. Ville du valgt det? Hvorfor/hvorfor ikke?					

Appendix VI

NTNU
Fakultet for lærer- og tolkeutdanning

Fødselsdato: ___ /___ 20___ **Kjønn**: jente☐ gutt☐ **Navn:**_____

Spørsmål om motivasjon for kroppsøving

Sett kryss etter hvor enig du er i utsagnene. (Ett kryss for hvert utsagn)

Hvorfor deltar du egentlig i kroppsøvingstimene på skolen? Kryss av for om du er enig i utsagnene som er listet under. (Ett kryss for hvert utsagn)	Fullstendig uenig 1	2	3	4	5	6	Fullstendig enig 7
1. Fordi jeg synes denne aktiviteten er interessant……	☐	☐	☐	☐	☐	☐	☐
2. Fordi jeg gjør det for min egen skyld……..	☐	☐	☐	☐	☐	☐	☐
3. Fordi det er forventet at jeg skal gjøre det……..	☐	☐	☐	☐	☐	☐	☐
4. Det er kanskje mange gode grunner til å gjøre denne aktiviteten, men personlig ser jeg ingen……..	☐	☐	☐	☐	☐	☐	☐
5. Fordi jeg synes denne aktiviteten er trivelig……..	☐	☐	☐	☐	☐	☐	☐
6. Fordi jeg tror denne aktiviteten er bra for meg……..	☐	☐	☐	☐	☐	☐	☐
7. Fordi det er noe jeg må gjøre……..	☐	☐	☐	☐	☐	☐	☐
8. Jeg gjør denne aktiviteten, men jeg er ikke sikker på om det er verdt det……..	☐	☐	☐	☐	☐	☐	☐
9. Fordi denne aktiviteten er artig/morsom……	☐	☐	☐	☐	☐	☐	☐
10. Fordi jeg har valgt det selv……..	☐	☐	☐	☐	☐	☐	☐
11. Fordi jeg ikke har noe valg……..	☐	☐	☐	☐	☐	☐	☐
12. Jeg vet ikke. Jeg ser ikke helt hva denne aktiviteten gir meg……..	☐	☐	☐	☐	☐	☐	☐
13. Fordi det føles godt å gjøre denne aktiviteten…….	☐	☐	☐	☐	☐	☐	☐
14. Fordi jeg mener denne aktiviteten er viktig for meg……	☐	☐	☐	☐	☐	☐	☐
15. Fordi jeg føler at jeg må gjøre det……..	☐	☐	☐	☐	☐	☐	☐
16. Jeg driver med denne aktiviteten nå, men jeg er ikke sikker på om det er riktig å fortsette……..	☐	☐	☐	☐	☐	☐	☐

Appendix VII

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Fødselsdato: ___ /___ 20___ **Kjønn**: jente☐ gutt☐ **Navn:**_____

Spørsmål om dine teorikunnskaper i kroppsøving

Sett kryss bak det du mener er riktig svar. Det kan være ett eller flere riktige svar på hvert spørsmål

1. Hva betyr utholdenhet?	
Det som bestemmer hvor langt og raskt du klarer å løpe	
Det som bestemmer hvor tungt du kan løfte	
Hvor lenge du klarer å sitte helt i ro	
Hvor god balanse du har	
3. Hva er puls?	
Hvor mye blod du har i kroppen	
Hvor mye blod hjertet slår for hvert slag	
Puls er det samme som hjerteslag	
Puls er det samme som svette	
5. Hvor lages energi i kroppen?	
Leveren	
Mitokondriene	
Lungene	
7. Hva er gode aktiviteter for å trene utholdenhet?	
Jogging, løping og gå raskt i motbakke	
Klatring i trær	
Dansing	
Å svømme 200 meter	
9. Hva er et annet navn på ei muskelcelle?	
Muskeltråd	
Muskelbunt	
Muskelfiber	
11. Hvorfor blir man sterkere når man trener styrke?	
Hjernen blir klokere	
Fordi det blir mer blod i kroppen	
Det blir bedre koblinger mellom nervene og musklene	
Man får større muskelfiber	
13. Hva er gode aktiviteter for å trene styrke?	
Styrkeøvelser	
Jogging	
Klatring	
15. Hva er koordinasjon?	
Det samme som kondisjon (kondis)	
Evnen du har til å samordne bevegelser	
Å kunne gjøre ulike bevegelser rett etter hverandre	
Evnen til å løfte tunge ting	
17. Hvordan kan du trene koordinasjonen?	
Gjøre styrkeøvelser	
Sjonglere	
Gjøre bevegelser/aktiviteter som føles vanskelig å få til	
Øve på å treffe basketkurva med en ball	
19. Når bør man trene koordinasjon i ei treningsøkt?	
Tidlig i ei økt, før man er sliten	
Sent i ei økt når man er sliten	
Spiller ingen rolle	

2. Hvorfor er god utholdenhet bra for helsa di?	
Man får økt arbeidskapasitet	
Man blir garantert ikke syk	
Man takler stress bedre	
God utholdenhet er egentlig ikke bra for helsa	
4. Hva forandres i kroppen når utholdenheten din blir bedre?	
Lungene blir større	
Hjertet slår mer blod for hvert slag	
Det blir flere små blodårer (kapillærer) i musklene	
Musklene blir større	
6. Hvorfor øker pulsen når du trener utholdenhet	
På grunn av at kroppen blir varmere når vi trener	
Fordi musklene trenger mer oksygen og da må hjertet slå raskere	
Fordi man blir nervøs av å trene utholdenhet	
8. Hva er styrke?	
Hvor mye kraft en muskel kan lage	
Hvor raskt du løper 3kilometer	
Hvor tungt du kan løfte	
Hvor høyt du kan hoppe	
10. Hva er musklenes viktigste oppgaver?	
Å skape bevegelse	
Å holde kroppen varm og beskytte indre organer	
Å sende nervesignaler	
12. Hvorfor er god styrke bra for helsa di?	
Det er lettere å utføre arbeid gjennom hele livet	
Man får sterkere lunger og hjerte	
Det er lettere å unngå skader. F.eks. i ryggen	
Man blir aldri trist når man er sterk	
14. Hvordan skal man gjøre en dynamisk styrkeøvelse?	
Ca. 2 repetisjoner i 10 serier	
Ca. 10-12 repetisjoner i 3 serier	
Ca. 50 repetisjoner i 4 serier	
16. Hvorfor er god koordinasjon viktig for helsa?	
Gjør deg bedre rustet til å unngå å falle og skade seg	
For å få bedre lunger	
For å få sterkere hjerte	
Koordinasjon er ikke viktig for helsa	
18. Hva skjer i kroppen når man trener koordinasjon?	
Det blir laget motoriske programmer	
Utholdenheten blir bedre	
Muskelfibrene blir tykkere	
Sansene våre blir bedre ved slik trening	
Hvilke av disse egenskapene er del av vår koordinasjon?	
Balansen	
Utholdenheten	
Romorienteringsevnen	

Spørsmålene er laget ut fra kompetansemål fra hovedområde «trening og livsstil» etter 10.trinn:

- *praktisere og forklare grunnleggjande prinsipp for trening*
- *forklare samanhengen mellom fysisk aktivitet, livsstil og helse*

Appendix VIII

Semistrukturert fokusgruppe-intervju

«Omvendt undervisning i kroppsøving på ungdomsskolen»

1. Rammesetting

- Uformell samtale (2-5 minutter)
- Informasjon om prosjektet og problemstillingen (5-10 minutter)
    - Bakgrunn og formål for samtalen
    - Forklar hva intervjuet skal brukes til
    - Avklar spørsmål rundt anonymitet og taushetsplikt
    - Spør om respondenten har spørsmål eller om noe er uklart
    - Informer om lydopptak hvis aktuelt, sørge for samtykke er gitt
    - Informere om at barna må tenke på sin situasjon den siste tiden når de svare.
    - **Start lydopptak**

2. Erfaringer

- Avklar og ta utgangspunkt i respondentens erfaring med eller kjennskap til temaet/problemstillingen fra tidligere (om metoden f.eks er brukt i andre fag)
- Dersom det er relevant / passende, be respondenten fortelle litt om sine erfaringer.

3. Fokusering

- Nøkkelspørsmål/tema
    - Så du leksa
        - Hvorfor, hvorfor ikke
    - Opplevelse av innholdet i de praktiske øktene
    - Motivasjon for å delta i timen etter å ha sett leksa
        - Økte, minket? Hvorfor?
    - Mestringsforventning
    - Forventninger
    - Verdi av deltagelse
    - Kostnad av deltagelse
    - Teoretisk kunnskap
- Oppfølgingsspørsmål
    - Opplevelse av metoden generelt

4. Tilbakeblikk

- Oppsummering (10-15 minutter)
    - Intervjuer oppsummerer muntlig og går gjennom de viktige punktene som kom frem i løpet av intervjuet.
- Avklaring
    - Avklare misforståelser, spørre om man har forstått riktig dersom noe er uklart.
- ”Er det noe mer dere ønsker å legge til?”

Stopp lydopptak

Appendix IX

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Øktplan «Utholdenhet»

Økta er lagt opp med 60-70 min. Tilpass lengden på hver aktivitet i hoveddelen slik at det passer med oppsatt tid på timeplanen din. Oppvarming og avslutning gjennomføres som oppsatt. Om du er usikker på noen av aktivitetene så ring meg på 92058388

Om elevene tilhører Gruppe (1) så har de sett videolekse og man går rett på denne økta. Det samme gjør elevgruppe (3)
Elever i Gruppe (2) skal få ca. 5 min teoriundervisning om dagens tema før man starter.

10 min	Oppvarming
	• Dansesura
	  ○ La 2 eller 3 elever ha sura. Når sura tar noen så skal sura gi den eleven som ble tatt en bevegelse som denne da må stå og utføre til noen kommer og speiler bevegelsen i 5 sekunder. Da er man fri og kan være med igjen. Man kan ikke bli tatt mens man frir noen. Bytt på hvem som har sura hvert 2.min.
	• Stiv heks
	  ○ La 2 eller 3 elever ha sura. Blir man tatt står man med spredde ben slik at noen kan passere under. Da er man fri og kan være med igjen. Man kan ikke bli tatt mens man frir noen. Bytt på hvem som har sura hvert minutt.

45-55 min	Hoveddel
	• «Svartedauen»
	  ○ Avgrens et aktivitetsområde og lag sykehus ved hjelp av en matte, kjegler eller lignende. Velg ett barn som skal være «Pesta». Pesta skal forsøke å ta de andre barna og smitte hele bygda (de andre barna) med svartedauden. Ved berøring smittes de andre barna av pest og må legge seg ned på bakken. De som ikke er blitt tatt, kan bære de smittede barna til sykehuset. Da blir de syke friske igjen, og er igjen med på leken. «Friske» barn kan ikke bli tatt mens de bærer «syke» barn til sykehuset. Det kan ikke være flere enn 2-3 som bærer en elev.
	• Ballsura
	  ○ La litt under halvparten av klassen holde i en ball. En person (uten ball) har sura. Den som har sura holder en vest for å vises bedre. Bare de som holder en ball kan bli tatt. Blir du tatt får du sura og gir da ballen du holdt til den som gav deg sura samtidig som du får vesten du skal holde. Elever som holder ball kan bli kvitt sin ball ved å ta noen som ikke har ball. De må da overta ballen og står da i fare for å bli tatt av den som har sura. Det er ikke lov å kaste fra seg ballen eller kaste ballen på noen for å bli kvitt ballen.
	• Parsisten
	  ○ To og to holder hverandre i hendene og man leker vanlig sisten. Et par starter med å ha den og når de berører et annet par har dette paret sisten fra nå av. Paret som har sisten kan gjerne holde en vest for å vises bedre.
	• Kjeglekrig med baller og skjul (ev neste aktivitet uten baller og skjul)
	  ○ Elevene hjelper til med å fordele hindre/skjul utover salen (bukker, kasser, matter, tjukkaser på høykant ol.). Ca 10 softballer fordeles også utover salen. To lag med hver sine 4 kjegler bak sin baklinje. Poenget er å komme seg over til baklinjen bak det andre laget og ta en kjegle. Du kan bli skutt på tur over. Blir man skutt må man jogge tilbake og krysse egen baklinje før man er med igjen. Man kan ikke bli skutt når du har tatt en kjegle til motstanderen. Da er du fri til å bringe den til eget lag der den plasseres sammen med de andre kjeglene. Hold på til det er tomt hos ett lag (da er det 1 poeng til det laget som har alle) Fordel kjeglene på nytt og start ny runde. Avslutt leken med at elevene rydder på plass alt unntatt kjeglene.
	• Kjeglekrig uten baller og skjul (om tid)
	  ○ Lignende lek som den over men uten hindre og uten baller. Her må man bruke f.eks linjene i volleyballbanen på golvet. Hvert lag sin halvdel med 3-4 kjegler bak sin egen baklinje. Man kan bli tatt når man er på motstanderen sin halvdel i forsøk på å komme over til den andre siden. Man tar en person ved å berøre denne. Da må den som ble berørt jogge tilbake og krysse egen baklinje før man er med i leken igjen. Når man over til den andre siden, altså bak motstanderens baklinje, kan man ikke bli tatt. Her tar man da opp ei kjegle og venter på åpning for å løpe tilbake til sin egen halvdel. Man er da «safe» når man krysses midtlinja og kan da plassere kjegla bak egen baklinje. Hold på til det er tomt bak ett lag (poeng og fordel kjeglene på nytt). Her må det tenkes litt taktikk i forhold til angrep og forsvar av egne kjegler.

5 min	Avslutning (om tid) • Uttøyning i sirkel ○ Bakside legg, bakside lår, framside lår, hofteleddsbøyere, setemuskler, mage og rygg.

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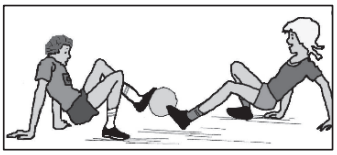
Øktplan «Styrke»

Økta er lagt opp med 60-70 min. Tilpass lengden på hver aktivitet i hoveddelen slik at det passer med oppsatt tid på timeplanen din. Oppvarming og avslutning gjennomføres som oppsatt. Om du er usikker på noen av aktivitetene så ring meg på 92058388

Om elevene tilhører Gruppe (1) så har de sett videolekse og man går rett på denne økta. Det samme gjør elevgruppe (3) Elever i Gruppe (2) skal få ca. 5 min teoriundervisning om dagens tema før man starter.

10 min	Oppvarming • Stiv heks (variant ***Planken***) o La 2 eller 3 elever ha sura. Blir man tatt står man i «planken» (med strake armer og rompa litt opp) slik at noen kan passere under. Da er man fri og kan være med igjen. Man kan ikke bli tatt mens man frir noen. Bytt på hvem som har sura hvert minutt. • Ballsura o La litt under halvparten av klassen holde i en ball. En person (uten ball) har sura. Den som har sura holder en vest for å vises bedre. Bare de som holder en ball kan bli tatt. Blir du tatt får du sura og gir da ballen du holdt til den som gav deg sura samtidig som du får vesten du skal holde. Elever som holder ball kan bli kvitt sin ball ved å ta noen som ikke har ball. De må da overta ballen og står da i fare for å bli tatt av den som har sura. Det er ikke lov å kaste fra seg ballen eller kaste ballen på noen for å bli kvitt ballen.
45-55 min	Hoveddel • Rytmebasis o Basisøvelser i takt med musikk (om man har mulighet for å sette på musikk). 4-5 elever i sirkel og hver elev bestemmer en øvelse som skal gjøres på tur. 6 repetisjoner for hver øvelse og 3 runder. Alle elevene gjør alle øvelsene. La elevene få øve litt på sine øvelser og ha gjerne en kort framvisning. *(Man kan også sette sammen alle gruppene sine øvelser til et «klasseprogram» som hele klassen gjennomføres sammen)* • Krabbefotball (Sittefotball) o Del inn i små lag (4-6) og avgrens spilleflaten med benker etc. Bruk innebandy-mål eller kjegler for å markere mål. Man skal spille fotball men hele tiden bevege seg med både føtter og hender i bakken med rumpa ned som vist på figur.  • Trillebår o To og to sammen krysser salen på tvers. Hver elev skal ha vært trillebår 3 ganger. • Sirup-tjukkas o Gå/løp/hopp på en tjukkas. 30 sek på og 30 sek av (aktiv pause) Gjenta 5-6 ganger. o Variasjon: - Gå i hockey-stilling - Hold armene inntil kroppen - Dytte de andre ut av tjukkasen samtidig som man går i hockeystilling - Balansere ett eller annet samtidig som man går rundt • Klassetrim o Hele klassen samlet i en stor sirkel og lærer gjør øvelser som elevene følger på telling. 30 sek arbeid og 30 sek pause på hver øvelse, 4 serier ▪ Situps med beina i været (90° i hofte og kne) ▪ Hoftepress (se bilde) 
5 min	Avslutning (om tid) • Uttøyning i sirkel. o Bakside legg, bakside lår, framside lår, hofteleddsbøyere, setemuskler, armbøyere, armstrekkere, mage og rygg.

Appendix IX

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Øktplan «Koordinasjon»

Økta er lagt opp med 60-70 min. Tilpass lengden på hver aktivitet i hoveddelen slik at det passer med oppsatt tid på timeplanen din. Oppvarming og avslutning gjennomføres som oppsatt. Om du er usikker på noen av aktivitetene så ring meg på 92058388

Om elevene tilhører Gruppe (1) så har de sett videolekse og man går rett på denne økta. Det samme gjør elevgruppe (3) Elever i Gruppe (2) skal få ca. 5 min teoriundervisning om dagens tema før man starter.

10 min	Oppvarming • Rokkering-basket. 4-5 på hvert lag i flere baner. Vanlige regler som i basketball, men man scorer ved å sentre ballen til hverandre med en stusspasning. Pasningen må stusse i rokkeringen
45-55 min	Hoveddel (Stasjonsarbeid etter vedlagt stasjonskort) Lærer gir signal etter ca 10 min for rullering mellom stasjonene. 1. Balanse • Rullende bevegelser på ett bein (som vist i video-leksa) Prøv begge bein. • Stå på en fot, først med åpne øyne (tell rolig til 5), så med lukkede øyne(tell rolig til 5). Bytt fot • Gå langs en strek i salen, gå først forover så vend og gå bakover uten å tråkke utenfor. • Gå på smalsiden av en benk. Prøv også her å vend og gå baklengs • Sitt på golvet og hold balansen på bare rumpa • Ta sats og hopp litt framover og land på en fot, prøv å holde balansen mens du teller til 5. Prøv begge beina • Stå, ta sats og hoppe rundt 180 grader, lande og stå. Først land på begge bein, så prøv å lande på ett bein. Prøv begge beina. • Stå, ta sats og hoppe rundt 360 grader, lande og stå på begge bein. Prøv med 1 bein. • To sammen. Finn balansestillinger sammen (se fig. på stasjonskort) Prøv også med 3 eller 4 sammen. 2. Rytme og tilpasset kraftinnsats • To og to (ev tre) lager en klappeserie sammen. F.eks håndflater-lår-lår-håndflater (4 takter). Lag 2 ulike serier med 8 takter(klapp). Sett de to sammen til en serie på 16 takter(klapp). • To og to (ev tre) lager en trinn/steg-serie sammen. Lag 2 ulike serier med 8 takter(steg). Sett de to sammen til en serie på 16 takter(steg) • Sitt to og to med ryggen mot hverandre. Prøv å reis dere uten å bruke armene, kun med kontakt rygg mot rygg. • Kast ball mot en rokkering som ligger på bakken. Prøv fra ulike avstander og se om du treffer direkte. Bruk baller med ulik vekt. 3. Romorientering og reaksjon • Stå rett med en hånd pekende rett fram og lukk øynene. Roter 360 grader og stans. Åpne øynene og se om du peker i samme retning. Prøv også å rotere 2 eller 3 runder. • Spill 10-trekk med to lag på et lite, avgrenset område. Om noen berører en annen spiller må begge sette seg ned og telle rolig til 10 før de kan bli med igjen. • Alle står i en ring. En elev sier bilmerker. Når eleven sier Volvo skal alle hoppe opp og rotere 180 grader. Fortsett å ramse opp bilmerker og hopp/roter kun på Volvo. Her gjelder det å reagere raskt. • To og to står sammen og en elev bak paret. Når den bak klapper skal de to som står foran sette seg ned. På nytt klapp skal de reise seg. På neste klapp skal de løpe noen meter framover. Ruller på å stå bak og klappe. 4. Øye-hånd- og øye-fot-koordinasjon • Spill 10-trekk med to lag på et avgrenset område. Vanlige regler. 4 kjegler/hatter avgrenser området. • Spill innsidepasninger til hverandre • Før en ball med beina mellom 4 oppsatte kjegler/hatter. Først prøver du for deg selv, så gjør dere «hermegåsa» der elevene fører på tur i et bestemt mønster.
5 min	Avslutning (om tid) • Uttøyning i sirkel ○ Bakside legg, bakside lår, framside lår, hofteleddsbøyere, setemuskler, armbøyere, armstrekkere, mage og rygg.

Stasjonskort 1

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Balanse

Utstyr som trengs på stasjonen:

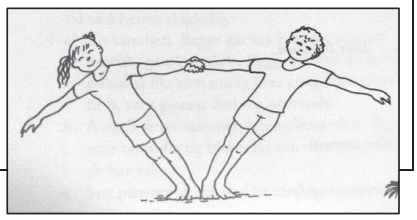
- 1 eller 2 benker

Info om stasjonen:

- Prøv å rekke alle aktivitetene på ca 10 minutter. Læreren sier fra når tida er ute og dere skal skifte til neste stasjon. Om dere rekker alle aktivitetene og har tid igjen så prøv noen aktiviteter flere ganger.

Aktiviteter:

1. Stå på en fot, først med åpne øyne (tell rolig til 5), så med lukkede øyne (tell rolig til 5). Bytt fot
2. Gå langs en strek i salen, gå først forover så vend og gå bakover uten å tråkke utenfor.
3. Gå på smalsiden av en benk. Prøv også her å vend og gå baklengs
4. Sitt på golvet og hold balansen på bare rumpa
5. Ta sats og hopp litt framover og land på en fot, prøv å holde balansen mens du teller til 5. Prøv begge beina
6. Stå, ta sats og hoppe rundt 180 grader, lande og stå. Først land på begge bein, så prøv å lande på ett bein. Prøv begge beina.
7. Stå, ta sats og hoppe rundt 360 grader, lande og stå på begge bein. Prøv med 1 bein.
8. To sammen. Finn balansestillinger sammen Prøv også med 3 eller 4 sammen.



Stasjonskort 2

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Rytme og tilpassa kraftinnsats

Utstyr som trengs på stasjonen:

- 3 basketballer
- 3 lettere baller (skumball eller volleyball)
- 4 rokkeringer

Info om stasjonen:

- Prøv å rekke alle aktivitetene på ca 10 minutter. Læreren sier fra når tida er ute og dere skal skifte til neste stasjon. Om dere rekker alle aktivitetene og har tid igjen så prøv noen aktiviteter flere ganger.

Aktiviteter:

1. To og to (ev tre) lager en klappeserie sammen. F.eks håndflater-lår-lår-håndflater (4 takter). Lag 2 ulike serier med 8 takter(klapp). Sett de to sammen til en serie på 16 takter(klapp). Tell taktene høyt.

2. To og to (ev tre) lager en trinn/steg-serie sammen. Lag 2 ulike serier med 8 takter(steg). Sett de to sammen til en serie på 16 takter(steg). Tell takten høyt når dere gjennomfører.

3. Sitt to og to med ryggen mot hverandre. Prøv å reis dere uten å bruke armene, kun med kontakt rygg mot rygg.

4. Kast ball mot en rokkering som ligger på bakken. Prøv fra ulike avstander og se om du treffer direkte. Bruk baller med ulik vekt.

Stasjonskort 3

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Romorientering og reaksjon

Utstyr som trengs på stasjonen:

- 1 håndball
- 4 kjegler/hatter

Info om stasjonen:

- Prøv å rekke alle aktivitetene på ca 10 minutter. Læreren sier fra når tida er ute og dere skal skifte til neste stasjon. Om dere rekker alle aktivitetene og har tid igjen så prøv noen aktiviteter flere ganger.

Aktiviteter:

1. Stå rett med en hånd pekende rett fram. Husk hva du nå peker på. Lukk øynene. Roter 360 grader og stans. Åpne øynene og se om du peker i samme retning. Prøv også å rotere 2 eller 3 runder.

2. Spill 10-trekk med to lag på et lite, avgrenset område. Om noen berører en annen spiller må begge sette seg ned og telle rolig til 10 før de kan bli med igjen.

3. Alle står i en ring. En elev sier bilmerker. Når eleven sier Volvo skal alle hoppe opp og rotere 180 grader. Fortsett å ramse opp bilmerker og hopp/roter kun på Volvo. Her gjelder det å reagere raskt.

4. To og to står sammen og en elev bak paret. Når den bak klapper skal de to som står foran sette seg ned. På nytt klapp skal de reise seg. På neste klapp skal de løpe noen meter framover. Ruller på å stå bak og klappe.

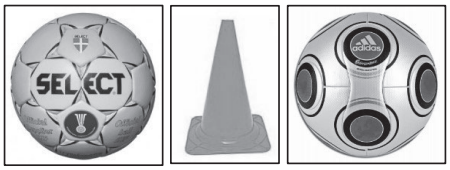
Stasjonskort 4

NTNU
Fakultet for lærer- og tolkeutdanning

Øye-hånd- og øye-fot-koordinasjon

Utstyr som trengs på stasjonen:

- 1 håndball
- 4 kjegler/hatter
- 6 fotballer (en til hver på gruppa)



Info om stasjonen:

- Prøv å rekke alle aktivitetene på ca 10 minutter. Læreren sier fra når tida er ute og dere skal skifte til neste stasjon. Om dere rekker alle aktivitetene og har tid igjen så prøv noen aktiviteter flere ganger.

Aktiviteter:

1. Spill 10-trekk med to lag på et avgrenset område. Vanlige regler og bruk en håndball. 4 kjegler avgrenser området.

2. Spill innsidepasninger til hverandre. Varier avstand slik at det ikke blir for lett. Gi 10 pasninger med hvert bein.

3. Før en ball med beina mellom 4 oppsatte kjegler. Først prøver du for deg selv, så gjør dere «hermegåsa» der elevene fører på tur i et bestemt mønster mellom kjeglene.

Appendix X

Lærerveiledning til videoressurs «Utholdenhet»

Denne undervisningsressursen består av 3 deler.

- Denne lærerveiledningen.
- En film som skal gis som lekse til elevene i forkant av kø-timen.
- En øktplan som beskriver aktiviteten i kø-timen som følger etter leksa er gitt.

Arbeidsmetoden som undervisningsressursen er basert på heter «omvendt undervisning». I korte trekk går metoden ut på at elevene får se en film i lekse som omhandler den teoretiske delen i et gitt tema for så å jobbe med samme tema på skolen i nær ettertid. Dette har flere mål ved seg.

- Økt læringsutbytte med utgangspunkt i kompetansemålene. Både teoretisk og praktisk
- Mindre bruk av tid til teoretisk undervisning i timene
- Økt motivasjon for elevene til å delta, samt økt aktivitet, i timene

Med utgangspunkt i kompetansemålene blir elevenes mål for ressursen:

- bruke lek og ulike treningsformer for å utvikle egen kropp og helse
- praktisere og forklare grunnleggende prinsipp for trening
- forklare sammenhengen mellom fysisk aktivitet, livsstil og helse

Link til videoen http://youtu.be/mCkiU6uOF_s

Denne videoressursen kan brukes som ei enkeltstående kø-økt, men kan også brukes i en sammenheng der man jobber med utholdenhet i en periode (både med egentrening og gjennomføring på skolen) der elevene kan teste sin utholdenhet før og etter perioden og jobbe med ulike måter å forbedre utholdenheten sin på. Da bør man informere godt om målene for perioden og hvordan elevene vurderes. Vurderingen bør da både bestå av elementer fra planlegging og gjennomføring og av de teoretiske emner som filmen omhandler. Man bør ikke trekke resultater fra ev tester inn i vurderingen da de bør brukes som måleredskap og faktor for motivasjon.

Om øktplanen ikke passer med tanke på tid så kan man justere varigheten av de ulike aktivitetene. Det er viktig at samtalen til slutt ikke tas bort. Det er her elevene får en fin mulighet for muntlig å vise den kompetansen de har tilervet seg ved å se film-leksa. Om noen av aktivitetene er ukjente så kan man ta kontakt med meg på mail eller telefon for en forklaring. Eventuelt så kan man skifte ut enkelte aktiviteter så lenge man holder seg til aktiviteter som utfordrer utholdenheten.

Spørsmål om bruk av ressursen og innhold kan rettes til:
Ove Østerlie, HiST.
mail: ove.osterlie@hist.no
Tlf: 92058388

Appendix X

Lærerveiledning til videoressurs «Styrke»

Denne undervisningsressursen består av 3 deler.

- Denne lærerveiledningen.
- En film som skal gis som lekse til elevene i forkant av kø-timen.
- En øktplan som beskriver aktiviteten i kø-timen som følger etter leksa er gitt.

Arbeidsmetoden som undervisningsressursen er basert på heter «omvendt undervisning». I korte trekk går metoden ut på at elevene får se en film i lekse som omhandler den teoretiske delen i et gitt tema for så å jobbe med samme tema på skolen i nær ettertid. Dette har flere mål ved seg.

- Økt læringsutbytte med utgangspunkt i kompetansemålene. Både teoretisk og praktisk
- Mindre bruk av tid til teoretisk undervisning i timene
- Økt motivasjon for elevene til å delta, samt økt aktivitet, i timene

Med utgangspunkt i kompetansemålene blir elevenes mål for ressursen:

- bruke lek og ulike treningsformer for å utvikle egen kropp og helse
- praktisere og forklare grunnleggende prinsipp for trening
- forklare sammenhengen mellom fysisk aktivitet, livsstil og helse

Link til videoen: http://youtu.be/LB7eXmoXsFk

Denne videoressursen kan brukes som ei enkeltstående kø-økt, men kan også brukes i en sammenheng der man jobber med styrke i en periode (både med egentrening og gjennomføring på skolen) der elevene kan teste sin styrke i utvalgte øvelser før og etter perioden og jobbe med ulike måter å forbedre styrken sin på. Da bør man informere godt om målene for perioden og hvordan elevene vurderes. Vurderingen bør da både bestå av elementer fra planlegging og gjennomføring og av de teoretiske emner som filmen omhandler. Man bør ikke trekke resultater fra ev tester inn i vurderingen da de bør brukes som måleredskap og faktor for motivasjon.

Om øktplanen ikke passer med tanke på tid så kan man justere varigheten av de ulike aktivitetene. Det er viktig at samtalen til slutt ikke tas bort. Det er her elevene får en fin mulighet for muntlig å vise den kompetansen de har tilervet seg ved å se film-leksa. Om noen av aktivitetene er ukjente så kan man ta kontakt med meg på mail eller telefon for en forklaring. Eventuelt så kan man skifte ut enkelte aktiviteter så lenge man holder seg til aktiviteter som utfordrer styrken.

Spørsmål om bruk av ressursen og innhold kan rettes til:
Ove Østerlie, HiST.
mail: ove.osterlie@hist.no
Tlf: 92058388

Appendix X

Lærerveiledning til videoressurs «Koordinasjon»

Denne undervisningsressursen består av 3 deler.

- Denne lærerveiledningen.
- En film som skal gis som lekse til elevene i forkant av kø-timen.
- En øktplan som beskriver aktiviteten i kø-timen som følger etter leksa er gitt. Her følger også 4 stasjonskort med.

Arbeidsmetoden som undervisningsressursen er basert på heter «omvendt undervisning». I korte trekk går metoden ut på at elevene får se en film i lekse som omhandler den teoretiske delen i et gitt tema for så å jobbe med samme tema på skolen i nær ettertid. Dette har flere mål ved seg.

- Økt læringsutbytte med utgangspunkt i kompetansemålene. Både teoretisk og praktisk
- Mindre bruk av tid til teoretisk undervisning i timene
- Økt motivasjon for elevene til å delta, samt økt aktivitet, i timene

Med utgangspunkt i kompetansemålene blir elevenes mål for ressursen:

- bruke lek og ulike treningsformer for å utvikle egen kropp og helse
- praktisere og forklare grunnleggende prinsipp for trening
- forklare sammenhengen mellom fysisk aktivitet, livsstil og helse

Link til videoen http://youtu.be/jxPtkR0hDBQ

Denne videoressursen kan brukes som ei enkeltstående kø-økt, men kan også brukes i en sammenheng der man jobber med koordinasjon i en periode (både med egentrening og gjennomføring på skolen) der elevene kan teste sin koordinasjon i utvalgte øvelser før og etter perioden og jobbe med ulike måter å forbedre koordinasjonen sin på. Da bør man informere godt om målene for perioden og hvordan elevene vurderes. Vurderingen bør da både bestå av elementer fra planlegging og gjennomføring og av de teoretiske emner som filmen omhandler. Man bør ikke trekke resultater fra ev tester inn i vurderingen da de bør brukes som måleredskap og faktor for motivasjon.

Læreren må passe på tiden og signalisere etter ca 10 min arbeid på en stasjon. Gruppene rullerer mellom alle stasjonene og gjør de aktivitetene som er beskrevet på hvert stasjonskort. Disse kortene må skrives ut og plasseres på egnet sted i salen der hvor aktivitetene skal foregå. Følg med på gruppene og oppmuntre til at de rekker gjøre alle aktivitetene som er beskrevet på kortene. Om noen blir fort ferdig så kan de gjøre noen deler flere ganger. Om øktplanen ikke passer med tanke på tid så kan man justere varigheten av de ulike aktivitetene. Det er viktig at samtalen til slutt ikke tas bort. Det er her elevene får en fin mulighet for muntlig å vise den kompetansen de har tilervet seg ved å se film-leksa. Om noen av aktivitetene er ukjente så kan man ta kontakt med meg på mail eller telefon for en forklaring. Eventuelt så kan man skifte ut enkelte aktiviteter så lenge man holder seg til aktiviteter som utfordrer koordinasjonen.

Spørsmål om bruk av ressursen og innhold kan rettes til:
Ove Østerlie, HiST.
mail: ove.osterlie@hist.no
Tlf: 92058388

Appendix XI

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK midt	Karoline Bjørstad Berget	73597509	12.06.2014	2014/1027/REK midt
			Deres dato:	**Deres referanse:**
			10.06.2014	

Vår referanse må oppgis ved alle henvendelser

Ove Østerlie
HIST

2014/1027 omvendt undervisning i kroppsøving på ungdomsskolen

Vi viser til innsendt fremleggingsvurderingsskjema datert 10.06.2014. Henvendelsen ble behandlet av komiteens leder på fullmakt med hjemmel i helseforskningsloven § 2, forskningsetikkloven § 4 og forskrift om behandling av etikk og redelighet i forskning § 10.

Prosjektomtale
Dette er et pilotprosjekt som starter høsten 2014. Det heter «Økt læringsutbytte i kroppsøvingsfaget blant ungdomsskoleelever ved hjelp av omvendt undervisning». Det blir laget tre videoer som skal gis som lekse i forkant av tre ulike kroppsøvingstimer. Etter gjennomført kroppsøvingstime vil elevene fylle ut et spørreskjema.
Formålet med studien er å finne ut om denne type undervisningsopplegg fungerer, slik at det fører til:

- *Øke motivasjon for deltagelse i kroppsøving (hindre frafall)*
- *Økt aktivitet i kroppsøvingstimene*
- *Økt opplevelse av mestring i kroppsøving*
- *Økt kunnskap om sentrale emner i kroppsøvingsfaget (både teoretisk og praktisk)*

Vurdering
Vurderingen er gjort på grunnlag av de innsendte dokumenter. Vi gjør oppmerksom på at dersom det gjøres vesentlige endringer i prosjektplanen, må det sendes inn en ny fremleggingsvurdering.

Prosjektet fremstår som forskning, men ikke som medisinsk eller helsefaglig forskning. Prosjektet omfattes derfor ikke av helseforskningslovens saklige virkeområde, og kan gjennomføres uten nærmere etisk vurdering av REK. Komiteen har vurdert forespørsel om fremleggelsesplikt med hjemmel i helseforskningsloven § 10, jfr. forskningsetikkloven § 4.

Vi minner imidlertid om at dersom det skal registreres personopplysninger, må prosjektet meldes til Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Vedtak
Prosjektet er ikke fremleggingspliktig for Regional komité for medisinsk og helsefaglig forskningsetikk.

Klageadgang
Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK midt. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK midt, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Besøksadresse:
Det medisinske fakultet
Medisinsk teknisk
forskningssenter 7489
Trondheim

E-post: rek-midt@medisin.ntnu.no
Web: http://helseforskning.etikkom.no/

Appendix XI

Med vennlig hilsen

Sven Erik Gisvold
Dr.med.
Leder, REK midt

Karoline Bjørstad Berget
Seniorkonsulent

Appendix XII

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK midt	Marit Hovdal Moan	73597504	10.02.2016	2016/229/REK midt
			Deres dato:	**Deres referanse:**
			08.02.2016	

Vår referanse må oppgis ved alle henvendelser

Ove Østerlie
NTNU

2016/229 Omvendt undervisning i kroppsøving på ungdomsskolen - oppfølgingsstudie

Vi viser til innsendt fremleggingsvurderingsskjema datert 08.02.2016. Henvendelsen ble behandlet av komiteens leder.

Prosjektomtale
Komiteen oppfatter prosjektet som en studie designet for å undersøke hvilken virkning bruk av metoden omvendt undervisning har på motivasjon for deltagelse i undervisningen og teoretisk læringsutbytte i faget kroppsøving på ungdomsskolen. Dette er en oppfølgingsstudie til en pilotstudie med samme navn.

Vurdering
Komiteen mener at prosjektet ikke framstår som medisinsk og helsefaglig forskning, men som annen type forskning. Prosjektet er iht. helseforskningslovens § 2 og § 4 ikke framleggingspliktig, og kan derfor gjennomføres og publiseres uten godkjenning fra REK. Vi minner imidlertid om at dersom det skal registreres personopplysninger, må prosjektet meldes til Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Merknad
Vi minner om at vurderingen er gjort med bakgrunn i de innsendte dokumenter og kun er å betrakte som veiledende, jf. forvaltningsloven § 11. Dersom du ønsker at det skal fattes et formelt enkeltvedtak etter forvaltningsloven, må du sende inn en full prosjektsøknad til REK. En prosjektsøknad blir komitébehandlet iht. oppsatte frister.

Med vennlig hilsen

Sven Erik Gisvold
Dr.med.
Leder, REK midt

Marit Hovdal Moan
Seniorrådgiver

Kopi til: ruth.gruters@ntnu.no; rek-midt@ntnu.no

Besøksadresse:
Det medisinske fakultet
Medisinsk teknisk
forskningssenter 7489
Trondheim

Telefon: 73597511
E-post: rek-midt@medisin.ntnu.no
Web: http://helseforskning.etikkom.no/

Appendix XII

Ove Østerlie
Institutt for grunnskolelærerutd. 1-7 og bachelor i arkiv og samlingsforvaltning NTNU

7491 TRONDHEIM

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Vår dato: 14.04.2016 Vår ref: 47604 / 3 / AGL Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 24.02.2016. Meldingen gjelder prosjektet:

47604	*Omvendt undervisning i kroppsøving på ungdomsskolen*
Behandlingsansvarlig	*NTNU, ved institusjonens øverste leder*
Daglig ansvarlig	*Ove Østerlie*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering 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, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. 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, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 30.06.2016, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Kjersti Haugstvedt

Audun Løvlie

Kontaktperson: Audun Løvlie tlf: 55 58 23 07
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 47604

Utvalget informeres skriftlig om prosjektet og samtykker til deltakelse. Informasjonsskrivet er godt utformet, men vi ber om at dato for prosjektslutt tilføyes informasjonsskrivet.

Ifølge prosjektmeldingen skal det innhentes skriftlig samtykke basert på muntlig og skriftlig informasjon om prosjektet og behandling av personopplysninger. Foreldre samtykker for sine barn der de er under 15 år. Personvernombudet finner informasjonsskrivene til lærere, elever og foresatte tilfredsstillende utformet i henhold til personopplysningslovens vilkår.

Selv om foreldre/foresatte samtykker til barnets deltakelse, minner vi om at barnet også må gi sin aksept til deltakelse. Barnet bør få tilpasset informasjon om prosjektet, og det må sørges for at de forstår at deltakelse er frivillig og at de når som helst kan trekke seg dersom de ønsker det. Dette kan være vanskelig å formidle, da barn ofte er mer autoritetstro enn voksne. Frivillighetsaspektet må derfor særlig vektlegges i forhold til barn, og spesielt når forskningen foregår på eller i tilknytning til en organisasjon som barnet står i et avhengighetsforhold til, som for eksempel skole. Forespørselen må derfor alltid rettes på en slik måte at de forespurte ikke opplever press om å delta, gjerne ved å understreke at det ikke vil påvirke forholdet til skolen hvorvidt de ønsker å være med i studien eller ikke. Videre bør det planlegges et alternativt opplegg for de som ikke deltar. Dette er særlig relevant ved utfylling av spørreskjema i skoletiden.

Personvernombudet legger til grunn at du etterfølger NTNU sine interne rutiner for datasikkerhet.

Forventet prosjektslutt er 30.06.2016. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:
- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)
- slette digitale lyd-/bilde- og videoopptak

Appendix XIII

NTNU
Fakultet for lærer- og tolkeutdanning

Informasjon til skoleledelsen angående forskningsprosjektet:

OMVENDT UNDERVISNING I KROPPSØVING

BAKGRUNN OG HENSIKT

En eller flere kroppsøvingslærere ved din skole er invitert til å delta i et forskningsprosjekt som skal undersøke hvilken virkning bruk av metoden omvendt undervisning har på motivasjon for deltagelse i undervisningen og teoretisk kunnskap i faget kroppsøving. Perioden med omvendt undervisning vil gå over ca. 3 uker og hver uke inneholder et nytt tema. Temaene er «utholdenhet», «styrke» og «koordinasjon».

HVA INNEBÆRER STUDIEN FOR SKOLENE SOM DELTAR?

Deltagelse i prosjektet innebærer følgende for elevene:

- Svare på et spørreskjema om motivasjon og kunnskap 2 ganger. Hver gang tar ca. 15 min og gjennomføres i skoletiden.
- Delta i den praktiske undervisningen samt se en video-lekse i forkant av hver time. Video-leksen tar ca. 15 min å se.
- Noen elever kan bli spurt om å delta i et intervju som foregår i gruppe på 4. Dette skjer i skoletiden etter avtale med involverte lærere

Elevene får tildelt et informasjonsskriv og en muntlig orientering om prosjektet. Elever under 15 år må få foresattes signatur for å kunne delta.

Deltagelse i prosjektet innebærer følgende for involverte lærere:

- Samle inn samtykkeerklæringer og overlevere prosjektleder
- Organisere og gjennomføre den praktiske undervisningen etter en oppsatt øktplan utarbeidet av prosjektleder
- Gjennomføre runde 2 av spørreskjema om motivasjon og kunnskap, samt sende inn resultatene til prosjektleder. Runde 1 gjennomføres av prosjektleder så langt det lar seg gjøre.

ANNEN INFORMASJON

Prosjektet er godkjent av REK (Regionale komiteer for medisinsk og helsefaglig forskningsetikk) og meldt til SND Norsk samfunnsvitenskapelig datatjeneste. Skolen blir ikke belastet med noen kostnad knyttet til deltagelse. Resultatene av prosjektet vil bli publisert i en vitenskapelig artikkel og alle data vil være på gruppenivå slik at ingen elever eller skoler kan gjenkjennes.

Vi setter stor pris på at skolen bidrar inn i prosjektet og med dette hjelper oss å drive skolerelatert forskning som er meget viktig for både lærerutdanningen og framtidens skole med tanke på kvalitet og utvikling. Takk ☺

For spørsmål omkring prosjektet: Prosjektleder Ove Østerlie, NTNU (ove.osterlie@ntnu.no, 92058388)

Mvh, Ove Østerlie

Appendix XIII

NTNU
Fakultet for lærer- og tolkeutdanning

Informasjon til lærer i undersøkelsen:

OMVENDT UNDERVISNING I KROPPSØVING PÅ UNGDOMSSKOLEN

BAKGRUNN OG HENSIKT

Du inviteres med dette til å delta i et forskningsprosjekt som skal undersøke hvilken virkning bruk av metoden omvendt undervisning har på motivasjon for deltagelse i undervisningen og teoretisk kunnskap i faget kroppsøving på ungdomsskolen. Perioden med omvendt undervisning vil gå over ca. 3 uker og hver uke inneholder et nytt tema. Temaene er «utholdenhet», «styrke» og «koordinasjon». Undervisningen gjennomføres for alle klasser, men det er ønskelig at en gruppe (1) får se video i lekse, en gruppe (2) får 5 min teoretisk undervisning i starten av økta og en gruppe (3) får bare den praktiske undervisningen. De to siste gruppene vil fungere som kontrollgrupper.

HVA INNEBÆRER STUDIEN FOR DEG SOM LÆRER?

Følgende må du gjøre, og i denne rekkefølgen:

1. Du må dele ut et informasjonsskriv til elevene og samle inn igjen signerte samtykkeerklæringer. (Elever over 15 år kan signere selv).
2. Registrere deg som lærer på campus.inkrement.no og delta i «klassen» som jeg har opprette for deg. Det er bare elevene i gruppe (1) som skal ha tilgang til campus.inkrement.no Jeg registrerer elevene (om jeg får navneliste med mailadresser) på nettstedet og informerer de om hvordan de skal logge på og hvordan nettstedet fungerer. Elevene får en link de følger for selv å legge seg til riktig fag på nettstedet. Underveis i videoene er det noen kontrollspørsmål som elevene svarer på. Hva de svarer kan du se i etterkant.
3. Gjennomføre spørreskjema om motivasjon og kunnskap (alle grupper) samt gi lekse på ukeplanen for gruppe (1). Det er viktig at så mange som mulig i gruppe (1) gjør leksa! Jeg kan også via mail minne på leksa om jeg har tilgang til navneliste med epostadresser.
4. Gjennomføre de tre undervisningsøktene etter de oppsatte økt-planene for alle grupper (ei økt hver uke, med tilhørende lekse i forkant for gruppe (1)).
5. Siste 5 min av økt 3 brukes til å gjennomføre spørreskjema om motivasjon for andre gang.
6. Etter ca. 4 uker gjennomføre spørreskjema om kunnskap for andre gang.
7. Sende inn all informasjon til prosjektleder i vedlagt, frankert konvolutt.

Du vil få tilsendt alle skjema og øktplaner som skal benyttes, men du må oppgi antall. Skjemaene er merket som i diagrammet på neste side med farge og kode. Det er veldig viktig at riktig skjema blir brukt på riktig gruppe. Du kan henvende deg til prosjektleder Ove Østerlie ved NTNU (ove.osterlie@ntnu.no, 92058388) om du har spørsmål til prosjektet.

Mvh, Ove Østerlie

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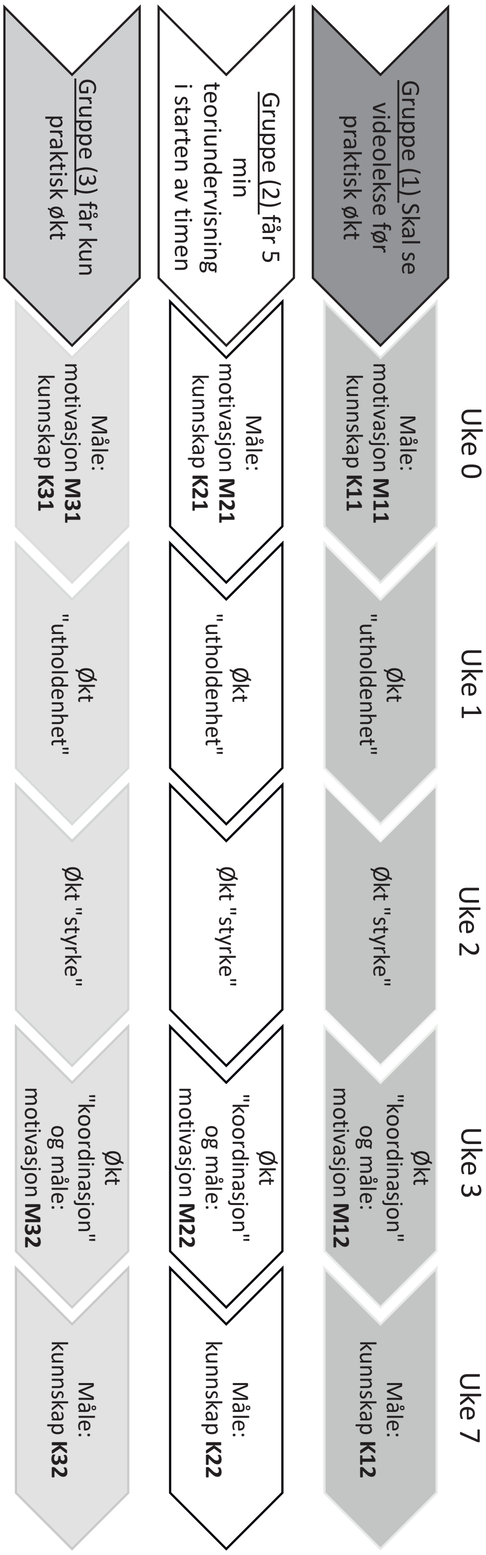

Appendix XIII

NTNU
Fakultet for lærer- og tolkeutdanning

Invitasjon til deltagelse i undersøkelsen:

OMVENDT UNDERVISNING I KROPPSØVING PÅ UNGDOMSSKOLEN

BAKGRUNN OG HENSIKT

Du inviteres med dette til å delta i et forskningsprosjekt som skal undersøke hvilken virkning bruk av metoden omvendt undervisning har på motivasjon for deltagelse i undervisningen og teoretisk kunnskap i faget kroppsøving på ungdomsskolen. Perioden med omvendt undervisning vil gå over ca. 3 uker og hver uke inneholder et nytt tema. Temaene er «utholdenhet», «styrke» og «koordinasjon». Undervisningen gjennomføres for alle i klassen, uavhengig om du vil delta i denne undersøkelsen eller ikke.

HVA INNEBÆRER STUDIEN?

Deltagelsen innebærer at du svarer på et spørreskjema om motivasjon to ganger. En gang før perioden med omvendt undervisning starter og en gang rett i etterkant. Du må også svare på noen spørsmål som skal måle din kunnskap om utholdenhet, styrke og koordinasjon. En gang før perioden starter og en gang ca. fire uker etter perioden. Det du svarer blir ikke en del av din vurdering i faget. Alle skjema besvares i skoletiden.

MULIGE FORDELER OG ULEMPER

Det er ingen kostnader knyttet til deltagelse i studien. Du vil få delta i den planlagte undervisningen, som gjennomføres etter prinsippet omvendt undervisning, om du deltar i denne undersøkelsen eller ikke.

HVA SKJER MED INFORMASJONEN OM DEG?

All informasjon som blir samlet inn vil bli lagret på sikker måte ved NTNU, og etter at studien er ferdig (30.06.2016) vil alle personopplysninger (navn, fødselsdato og kjønn) som er samlet inn bli anonymisert. Det vil ikke bli publisert noe fra denne studien som kan knytte deg til resultatene. Alle resultat blir presentert på gruppenivå og anonymt.

DELTAKELSE

Det er frivillig å delta i prosjektet du kan når som helst og uten å oppgi noen grunn kan trekke seg fra prosjektet uten at dette får noen konsekvenser. Du kan henvende deg til prosjektleder Ove Østerlie ved NTNU (ove.osterlie@ntnu.no, 92058388) om du ønsker å trekke seg eller har spørsmål til prosjektet. Er du under 15 år må dine foresatte samtykke til deltakelsen.

Mvh, Ove Østerlie

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Samtykkeerklæring

For undersøkelsen: ***omvendt undervisning i kroppsøving på ungdomsskolen.***

Jeg/vi har lest informasjonsskrivet og har hatt anledning til å stille spørsmål.

Jeg/vi samtykker i at _____ (elevens navn) deltar i undersøkelsen.

Dato:_____/_____2016

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Elev (hvis du er over 15 år) foresatte (hvis eleven er under 15 år)

Samtykkeerklæringen signeres og leveres elevens kroppsøvingslærer.

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NTNU
Fakultet for lærer- og tolkeutdanning

Invitasjon til deltagelse i undersøkelsen:

OMVENDT UNDERVISNING I KROPPSØVING PÅ UNGDOMSSKOLEN

BAKGRUNN OG HENSIKT

Du inviteres med dette til å delta i et forskningsprosjekt som skal undersøke hvilken virkning bruk av metoden omvendt undervisning har på motivasjon for deltagelse i undervisningen og teoretisk kunnskap i faget kroppsøving på ungdomsskolen. Perioden med omvendt undervisning vil gå over ca. 3 uker og hver uke inneholder et nytt tema. Temaene er «utholdenhet», «styrke» og «koordinasjon». Undervisningen gjennomføres for alle i klassen, uavhengig om du vil delta i denne undersøkelsen eller ikke.

HVA INNEBÆRER STUDIEN?

Deltagelsen innebærer at du svarer på et spørreskjema om motivasjon to ganger. En gang før perioden med omvendt undervisning starter og en gang rett i etterkant. Du må også svare på noen spørsmål som skal måle din kunnskap om utholdenhet, styrke og koordinasjon. En gang før perioden starter og en gang ca. fire uker etter perioden. Det du svarer blir ikke en del av din vurdering i faget. Alle skjema besvares i skoletiden.

Du skal se en video som ligger på internett som lekse før hver av de tre kroppsøvingstimene (ca 15 min for hver gang). For å kunne se de videoene må du registrere deg på nettsiden campus.inkrement.no og melde deg på den klassen som din kroppsøvingslærer oppretter. Dette får du mer informasjon om av din lærer.

Du kan også bli spurt om å bli med på et intervju som gjennomføres i gruppe på 4 elever. Dette intervjuet vil vare ca. 45 minutter og gjennomføres i skoletiden. De som blir spurt er tilfeldig plukket ut.

MULIGE FORDELER OG ULEMPER

Det er ingen kostnader knyttet til deltagelse i studien. Du vil få delta i den planlagte undervisningen, som gjennomføres etter prinsippet omvendt undervisning, om du deltar i denne undersøkelsen eller ikke. Det som kan oppleves som ekstra «arbeid» er at du må se noen videoer i lekse før hver kroppsøvingstime i denne perioden på 3 uker.

HVA SKJER MED INFORMASJONEN OM DEG?

All informasjon som blir samlet inn vil bli lagret på sikker måte ved NTNU, og etter at studien er ferdig (30.06.2016) vil alle personopplysninger (navn, fødselsdato og kjønn) som er samlet inn bli anonymisert. Det vil ikke bli publisert noe fra denne studien som kan knytte deg til resultatene. Alle resultat blir presentert på gruppenivå og anonymt.

DELTAKELSE

Det er frivillig å delta i prosjektet du kan når som helst og uten å oppgi noen grunn kan trekke seg fra prosjektet uten at dette får noen konsekvenser. Du kan henvende deg til prosjektleder Ove Østerlie ved NTNU (ove.osterlie@ntnu.no, 92058388) om du ønsker å trekke seg eller har spørsmål til prosjektet. Er du under 15 år må dine foresatte samtykke til deltakelsen.

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Dato:_____/_____2016

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Elev (hvis du er over 15 år) foresatte (hvis eleven er under 15 år)

Samtykkeerklæringen signeres og leveres elevens kroppsøvingslærer.