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Sami Kalaja

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A Fundamental Movement Skills Intervention

JYVÄSKYLÄN YLIOPISTO

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UNIVERSITY OF JYVÄSKYLÄ

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ABSTRACT

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The aim of the study was to analyze changes in students' fundamental movement skills (FMS), self-reported physical activity (PA), and motivation toward PE through one academic-year PE intervention directed toward developing students' FMS during PE lessons. The intervention design was quasi-experimental, including experimental and control groups, assessed at four measurement points (baseline, middle, post, and retention measurements). Additional aim of the study was to investigate associations between students' FMS, self-reported PA, and motivational variables in the baseline measurement of the study at Grade 7. The participants of the study comprised 446 Finnish Grade 7 students. The experimental group comprised 199 students (110 girls and 89 boys), representing nine PE classes in one school, taught by four PE teachers. The control group consisted of 247 students (120 girls and 127 boys), representing 13 PE classes in two schools, taught by six teachers. Participants completed seven tests analyzing FMS, and responded to a multi-sectional questionnaire incorporating Finnish versions of the self-reported PA, the Sport Motivation Scale, the Sport Competence subscale, the Motivational Climate in School Physical Education Questionnaire, and the Sport Enjoyment scale. After the intervention there were differences between the experimental and control groups in static and dynamic balance as well as FMS sum-score. The experimental group showed more positive development in these variables compared to the control group. Additionally, during the intervention, the experimental group slightly increased in self-reported PA, whereas the control group's PA decreased. Girls scored higher in static balance and rope jumping tests, whereas boys scored higher in dynamic balance, leaping, accuracy throwing, and dribbling tests as well as in perceived PA competence and ego-involving motivational climate. Perceived PA competence was the only significant predictor of PA engagement. FMS and self-determined motivation toward PE were non-significant predictors of activity. The results also supported the four-stage motivational sequence model and showed that task-involving motivational climate was a strong predictor of perceived PA competence and self-determined motivation toward PE. Three cluster groups of students were found in Finnish Grade 7 PE; 1) students with low skills and low motivation, 2) students with high skills and low motivation, and 3) students with high skills and high motivation. Cluster 3 had significantly higher self-reported engagement in PA than the other two clusters. This study demonstrated that in secondary school PE there is a need to emphasize teaching of students' FMS. Improved skills might be one factor to prevent the typical decline of PA within adolescence.

Key words: physical education, physical activity, fundamental movement skills, motivation

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How to learn and teach motor skills? This question has interested me for a long time. As gymnastics coach and physical education teacher I often wondered what would be the best way to teach skills. I knew that there must be a better way than monotonous repetitions after repetitions. With this project I think I have found some answers. In the year 2007 Professor Jarmo Liukkonen asked me to participate in a Motor Learning Conference. During the Conference Professor Liukkonen and Docent Timo Jaakkola suggested that I should start doctoral studies with the theme of teaching fundamental movement skills. This process has been extremely fascinating. There is no coming back to my old way of teaching and coaching physical education and sport.

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ORIGINAL ARTICLES

This dissertation is based on the following original papers, which are referred to in the text by their roman numerals:

I Kalaja, S., Jaakkola, T., Liukkonen, J. & Watt, A. (2010). The role of gender, enjoyment, perceived physical activity competence, and fundamental movement skills as correlates of the physical activity engagement of Finnish physical education students. Scandinavian Sport Studies Forum 1(1), 69–87.

II Kalaja, S., Jaakkola, T., Watt, A., Liukkonen, J. & Ommundsen, Y. (2009). The associations between seventh grade Finnish students' motivational climate, perceived competence, self-determined motivation, and fundamental movement skills. European Physical Education Review 5(3), 315-335.

II Kalaja, S., Jaakkola, T., Liukkonen, J. & Watt, A. (2010). Fundamental movement skills and motivational factors influencing engagement in physical activity. Perceptual and Motor Skills 111(1), 115-128.

IV Kalaja, S., Jaakkola, T., Liukkonen, J. & Digelidis, N. (2011). Development of junior high school students' fundamental movement skills and physical activity in a naturalistic physical education setting. Physical Education & Sport Pedagogy, iFirst article 1-18, DOI: 10.1080/17408989.2011.603124.

CONTENTS

1 INTRODUCTION

The links between PA and health are clearly shown in many studies (Bouchard, Blair & Haskell 2007; Malina, Bouchard & Bar- Or 2004). Although the fact of the association between PA and health is recognized, the majority of individuals in many developed populations are not sufficiently active. The same trend is also recognized within the samples of young people (Currie, Gabhainn, Godeau, Roberts, Smith, Picket, Richter, Morgan & Barnekow 2008). In many countries, an important focus of research on the health and well-being of children and adolescents has been to gather information regarding the possible reasons for inactivity (McKenzie 2007). More specifically, researchers have continued working toward identifying the physical, psychological, and social antecedents of childhood and adolescence engagement in PA.

There is evidence showing that FMS and PA are related with each other (e.g., McKenzie, Sallis, Broyles, Zive, Nader, Berry & Brennan 2002). Studies have, for example, shown that childhood motor skills influence adolescent PA (Barnett, Van Beurden, Morgan & Beard 2008a). Therefore, sufficient FMS are considered as one of the most important antecedents of PA and can facilitate participation and success in many sport and exercise activities. A review of the literature in secondary school samples, however, does not reveal any longitudinal or intervention studies of FMS and PA, either separately, or in relation to each other. An FMS intervention study in secondary school students might reveal important information about how it is possible to develop students FMS still in adolescence, when PA declines, and whether there exist any causative or other links between FMS and PA.

It is also widely believed that exercise motivation is one crucial element in the adoption of a physically active lifestyle (Malina et al. 2004). The quality of children's experiences while exercising in school, sport clubs, or when involved in self-initiated PA in their leisure time might be crucial for their future activity patterns (McKenzie 2007).

Motivational research has examined a broad range of cognitive, affective, and behavioral outcomes resulting from personal and environmental motivational conditions and processes. Review of the research regarding PA and the variables that affect participation highlights that only few studies have investigated factors, such as motor skill proficiency and exercise motivation involving secondary school samples (e.g., Okely, Booth & Patterson 2001). Examining the relationship between motivational factors and FMS levels in the context of secondary school PE would seem important because students in this age group are potentially sensitive to motivational loss emanating from lowering in perceived physical and motor competence (Barnett et al. 2008b; Stodden, Goodway, Langendorfer, Roberton, Rudisill, Garcia & Garcia 2008). There is a need, therefore, to study PA and the associated motivational and movement skill antecedents at secondary school level.

PA levels decline markedly after the age of 12 in both frequency of PA engagement and actual participation time in sport (Telama & Yang 2000). It can then be argued that secondary school years are an important time period for the development of later activity patterns. Overall, schools represent important institutions promoting PA as they reach all age cohorts of adolescents. Particularly, school PE plays an important role in motivating students toward a physically active lifestyle, it is the context to teach students' FMS and support their motivation toward PA. An important focus of research on the health and well-being of children and adolescents, therefore, is to gather information regarding possible reasons for the decline in PA and the role that schools may play in facilitating engagement (McKenzie 2007).

The main purpose of this study is to plan, implement, and evaluate the FMS intervention for Finnish Grade 7 students in school PE. More specifically, the aim of this study was to examine the effects of the intervention on students' FMS, self-reported PA, and motivational variables. Additionally, the aim of the study is to investigate cross-sectional associations among students' FMS, self-reported PA, and motivational variables in the baseline measurement of the study at Grade 7. This doctoral dissertation includes four published articles and the review based on them.

2 REVIEW OF THE LITERATURE

2.1 Physical activity

World Health Organization (2011) defines PA as any bodily movement produced by skeletal muscles that requires energy expenditure. It can be seen as a continuum from physical inactivity to extreme activity. The essential parts of PA are intensity, frequency, and duration (Shephard 2003). The intensity of PA can be described for example in the form of absolute energy expenditure or as a value relative to maximal or peak performance. The PA frequency is usually expressed as the number of times a given activity is performed a week. The duration of PA normally indicates the total number of active minutes accumulated during a week. (Malina et al. 2004; Shephard 2003.)

PA during adolescence is affected by many social, psychological, biological, cultural, and environmental variables (Buckworth & Dishman 2002). The opportunities to an adolescent to be physically active in their everyday life are the active transport to and from the school, PE classes, recesses, intramural activities, PA in the academic classroom, and school sport (Pate, Davis, Robinson, Stone, McKenzie & Young 2006). In leisure time these elements involve participation in sports and unorganized PA (Pate et al. 2006; Shephard 2003).

Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally. Regular moderate to vigorous intensity PA – such as walking, cycling, or participating in sports – has significant benefits for health. For instance, it can reduce the risk of cardiovascular diseases, diabetes, colon and breast cancer, and depression. Moreover, adequate levels of PA will decrease the risk of, for example, hip or vertebral fracture and help controlling weight (WHO 2011). There is also evidence that sedentary lifestyle in adulthood and all-cause mortality, cardiovascular disease, obesity, and adverse metabolic profiles are related to each other. There are also similar findings within the samples of young people (Dunstan, Barr, Healy, Salmon, Shaw, Balkau, Magliano, Cameron, Zimmet & Owen 2007;

Hu, Li, Colditz, Willet & Manson 2003; Katzmarzyk, Church, Graig & Bouchard 2009).

Many international researchers have detailed recommendations that children should participate in moderate to vigorous PA at least 60 minutes per day (Andersen, Harro, Sardinha, Froberg, Ekelund, Brage & Anderssen 2006; Biddle, Sallis & Cavill 1998; Strong, Malina, Blimkie, Daniels, Dishman, Gutin, Hergenroeder, Must, Nixon, Pivarnik, Rowland, Trost & Trudeau 2005). However, several major international organizations have stated that children's PA rarely meets the health recommendation of participation in moderate to vigorous PA for at least 60 min. per day (e.g., Currie, Roberts, Morgan, Smith, Settertobulte, Samdal & Rasmussen 2004). In Finland, it is recommended that elementary school students should participate in moderate to vigorous PA 90 -120 minutes per day. In secondary school the recommendation is 60 – 90 minutes per day (Tammelin & Karvinen 2008). Findings regarding Finnish school children's engagement in PA have also shown that their participation rates fail to achieve recommendations (Currie et al. 2004; Laakso, Telama, Nupponen, Rimpelä & Pere 2008; Samdal, Tynjälä, Roberts, Sallis, Villberg & Wold 2007).

Studies have indicated that childhood and adolescence are important periods for adopting physically active lifestyle later in adulthood (Dumith, Gigante, Domingues & Kohl 2011; Malina 2001; Telama, Yang, Viikari, Välimäki, Wanne & Raitakari 2005; Trudeau, Shephard, Arsenault & Laurencelle 2003). Additionally, research has demonstrated that boys are physically more active than girls (Caspersen, Pereira & Curran 2000; Currie et al. 2008; Duncan, Duncan, Strycker & Chaumeton 2007; van der Horst, Paw, Twisk & van Mechelen 2007; Nader, Bradley, Houts, McRitchie & O'Brien 2008). The same findings on tracking of PA engagement and gender differences in engagement have also been found in Finland (Nupponen, Halme, Parkkisenniemi, Pehkonen & Tammelin 2010; Tammelin, Ekelund, Remes & Näyhä 2007; Telama & Young 2000). PA level is also recognized to decline markedly after the age of 12 in both frequency of PA engagement and actual participation time in sport. This decline is seen both with girls and boys. (Telama & Yang 2000.) Therefore, the transition period from elementary school to secondary school seem to be an important time for the development of later PA patterns.

In this study PA was operationalized as daily 60 minutes moderate to vigorous PA as described in the Health Behavior in School-Aged Children study (HBSC) commissioned by the World Health Organization (Booth, Okely, Chey & Bauman 2001).

2.2 Fundamental movement skills

Fundamental movement skills (FMS) consist of locomotor, manipulative, and balance skills. Locomotor skills refer to a body moving from one point to another in a vertical or horizontal dimension. Activities, such as walking, running, jumping, hopping, skipping, galloping, sliding, leaping, and climbing are representative examples of locomotor movement skills (Gallahue & Cleland-Donnelly 2007). Manipulative skills include either gross motor or fine motor movements. Gross motor manipulative skills involve movements that give force to objects or receive force from objects. Throwing, catching, kicking, trapping, striking, volleying, bouncing, rolling, and punting are examples of fundamental gross motor manipulative skills. Fine motor manipulative skills refer to small object-handling activities that emphasize motor control, precision, and accuracy of movement. Balance refers to both the body remaining in place but moving around its horizontal or vertical axis (Gallahue & Cleland-Donnelly 2007) and the process for maintaining postural stability (Westcott, Lowes & Richardson 1997). More specifically, Westcott and others defined static balance as "the ability to maintain a posture, such as balancing in a standing or sitting position", and dynamic balance as "the ability to maintain postural control during other movements, such as reaching for an object or walking across a lawn" (p. 630). According to Gallahue and Cleland-Donnelly (2007), axial movements, such as bending, stretching, twisting, turning, swinging, body inversion, body rolling, and landing/stopping are all considered as balance skills.

In the motor learning literature there are two hypotheses describing skill acquisition. One is the transfer hypothesis, which implies to the influence of previous practice or performance of a skill or skills on the learning of a new skill (Magill 2007). The other is the specificity hypothesis which suggests that abilities are specific to the task or goal of the activity and not transferable (Henry 1958). According to O'keeffe, Harrison and Smyth (2007), researchers have typically applied either transfer or specificity hypothesis as theoretical framework of studies concerning motor learning and only few studies have utilized both perspectives concurrently. Therefore, these hypotheses are rather contradictory in the motor learning research and have created a debate among scientists. Another finding that O'keeffe et al. (2007) have presented is that there is a scarcity of empirical evidence on any of these two hypotheses in practical learning/teaching situations. This suggests that conclusions made by many practitioners when selecting methods of learning and teaching may not have a strong scientific basis. O'keeffe et al. (2007) also found that only few researchers have tried to combine the transfer and specificity hypotheses (Cratty 1966; Sharp 1992). According to these assumptions novices can use basic motor skills with some degree of success. However, when a learner adopts more skills, the technique becomes more distinctive and practice must be specific.

An example of research supporting both the transfer and the specificity hypotheses is reported by O'keeffe et al. (2007). They implemented an intervention for 46 senior high school students (mean age 15.8 years) and found that students who were taught fundamental over-arm throw improved in that throwing skill, but also in badminton overhead clear and javelin throw. These results support the transfer hypothesis. The group who were taught badminton overhead clear improved in this specific skill but not in over-arm or javelin throw. These results imply the specificity hypothesis. Altogether, the results of the study of O'keeffe et al. (2007) show that adolescents learn motor skills in both ways; by practicing FMS, and by rehearsing specific skills.

The motor development literature has typically utilized the transfer hypothesis suggesting that movement skill level during childhood represents a far transfer effect when an individual acquires general skills that can be used later in more specific situations related to PA engagement (Haywood & Getchell 2009). Therefore, researchers supporting the transfer hypothesis have recommended that PE curricula should include plenty of activities in which students have the possibility to develop their FMS (McKenzie 2007).

In this study, the transfer hypothesis was applied because the participants of the study are relatively young without years of experience in practicing a wide variety of motor skills. In other words, they have not yet reached the level of skills when techniques are becoming more distinctive and practice must be specific (Cratty 1966; Sharp 1992).

The present literature suggests that the sensitive learning period for the development of FMS is between two and seven years of age (Gallahue & Cleland-Donnelly 2007). However, as suggested by Martin, Rudisill and Hastie (2009) it is important to recognize that do not acquire these skills as a result of the maturation process but rather through teacher's instruction and practice. After the sensitive learning period, children naturally move to a specialized movement skill phase, which starts around the age of seven years. In this period, they begin to develop an interest toward a wide variety of sport and physical activities. However, they need to acquire an appropriate level of FMS before they can learn specific sport skills. Failure to take advantage of this sensitive movement skill phase in childhood makes it more difficult to attain higher levels of motor skills later in their life (Gallahue & Cleland-Donnelly 2007).

Research has revealed that many children demonstrate mature patterns of motor skill development by the age of 10 (Ulrich 2000). However, review of the norms proposed by Ulrich showed that for many of the fundamental movement tasks proposed by the Test of Gross Motor Development (Ulrich 2000), approximately 30 to 40 % of children had not reached the mature pattern of motor skills. In Finland large scale studies revealed that 14-year-old students had better FMS compared with 11-year-old students (Nupponen 1997; Nupponen, Soini & Telama 1999; Nupponen & Telama 1998) which implies that in secondary school it is still possible to improve students' FMS such as leaping, running, balancing, dribbling, and throwing.

Previous literature has detailed that mastery of FMS (i.e., balance, locomotion, manipulation) is a critical element of effective participation in PA (Haywood & Getchell 2009; Stodden et al. 2008). Youth with more developed motor proficiencies may find it easier to be physically active and may be more likely to pursue a wider variety of sport and exercise interests than peers who have lower motor skill competence (Stodden et al. 2008). Okely et al. (2001) reported that FMS significantly predicted time in organized PA within a sample of 13- to 15-yr.-old Australian students. Additionally, Wrotniak, Epstein, Dorn, Jones and Kondilis (2006) stated that motor proficiency was positively associated with PA and inversely associated with sedentary activity in a sample of 8 to 10 year-old students. Despite the limited investigation of the relation between motor skills and PA engagement, from the overall pattern of findings one may infer that satisfactory motor skill competence in childhood and adolescence may be predictive of continuing involvement in PA in adulthood (Sallis, Prochaska & Taylor 2000). FMS competency increases also the likelihood of children participating in different physical activities throughout their lives (Haywood & Getchell 2005; Stodden et al. 2008). Indeed, studies have shown that childhood motor skill proficiency influences adolescent PA and fitness, mediated by perceived sports competence (Barnett et al. 2008a; Barnett et al. 2008b).

Gender differences have been reported for each of the three areas of FMS. Boys have been found to perform better in manipulative movement skills (Castelli & Valley 2007; Junaid & Fellowes 2006; Okely et al. 2001). Okely et al. (2001) studied a sample of 2,026 boys and girls, aged 13 and 15 years, who completed fundamental movement tasks involving throwing and catching skills, and reported boys having significantly higher scores for both tasks at each age level. Gender differences have been found to be less consistent when evaluating children's balance skills. Fjørtoft (2000) and Sääkslahti (2005) found that 3- to 6-year-old girls are better than boys of the same ages in balance skills. This finding was also supported in the Toole and Kretzschmar's (1993) meta-analysis. Junaid and Fellowes (2006), however, found no gender differences in balance skills for children aged seven and eight. Wieczorek and Adrian (2006) detailed the Eurofit balance test scores for 615 Polish 11- to 15-year-olds and highlighted variations across age groups which suggested that children mature physically, gender differences in relation to balance are smaller. Existing evidence indicates that 12- and 14-year-old boys are better in locomotor skills, such as leaping and running, possibly due to the higher strength level of the boys (Nupponen & Telama 1998). Overall, the findings concerning gender differences in movement skills are interesting because they may be related to the reported higher levels of PA of boys (e.g., Aarnio, Winter, Peltonen, Kujala & Kaprio 2002; Castelli & Valley 2007; Riddoch, Andersen, Wedderkopp, Harro, Klasson-Heggebo, Sardinha, Cooper & Ekelund 2004).

Although childhood and adolescence are crucial time periods for developing FMS, the review of the literature indicates that most motor skill interventions have been implemented within adapted PE (Pless & Carlsson 2000) and in kindergarten or preschool settings (Martin et al. 2009, Sääkslahti, Numminen, Niinikoski, Rask-Nissilä, Viikari, Tuominen & Välimäki 1999). Although research has been conducted on the relationship of PA to FMS among adolescents (Hands, Larkin, Parker, Straker & Perry 2009; Okely et al. 2001; Raudsepp & Liblik 2002), there is a lack of research with motor skill interventions implemented within that age group. This is a clear shortcoming because it is evident that FMS are linked with PA also in secondary school aged students (Barnett et al. 2008a). Therefore, it is important to study if and how FMS can be developed in secondary school PE by designing a special intervention and how possible improvements in FMS are associated with students' PA.

2.3 Exercise motivation

2.3.1 The definition of motivation

Understanding and enhancing motivation have played a central role in the history of psychological research (Deci & Ryan 1985). Motivation and its effect on achievement behavior have been investigated based on two different aspects that are energization and direction. It has been suggested that theories of motivation are not true theories unless they address these two aspects of achievement behaviors (Roberts 2001). In motivation literature, the question "why" plays an important role when considering the nature of human motivation and achievement behavior (Deci & Ryan 2000; Roberts 2001).

Social-cognitive approach in understanding motivation represents a dynamic process incorporating cognitive, affective, and value related variables which are assumed to mediate the choice and attainment of achievement goals. Expectations and values that individuals attach to different goals and activities play a crucial role in social-cognitive perspective (Roberts 2001). In this study, three social-cognitive motivational theories are applied. There are the self-determination theory (Deci & Ryan 1985), the perceived competence theory (Harter 1978), and the achievement goal theory (Nicholls 1989).

2.3.2 The regulation of motivation

According to the self-determination theory, the regulation of motivation reflects a continuum comprising different levels of self-determination ranging from amotivation to true intrinsic motivation (Deci & Ryan 2000). Four different types of extrinsic motivation exist within the continuum, these being external regulation, introjected regulation, identified regulation, and integrated regulation (Deci & Ryan 2000; Ryan & Connell 1989).

Intrinsic motivation involves pursuing an activity out of interest and enjoyment without external contingencies (Deci & Ryan 2000). External regulation is occurring if an activity is done because of external factors like rewards, constraints, or fear of punishment. Motivational forces within introjected regulation are partially internalized but self-esteem oriented pressure still regulates behaviors. These include avoidance of guilt and shame, or concerns about self- and other approval (Ryan & Connell 1989). Identified regulation occurs when an individual has recognized and accepted the underlying behavior values or goals (Deci & Ryan 2000). The behavior then typically takes the form of 'I want' (Ryan & Connell 1989). The most self-determined form of extrinsic motivation is integrated regulation. It is the most complete form of internalization of extrinsic motivation. Integrated regulation involves the identification of the importance of behaviors, but also integrates those identifications with other aspects of the self. In integrated regulation a person has fully accepted behavior by bringing it into harmony or coherence with other aspects of their goals and values (Deci & Ryan 2000). Amotivation is defined as a state in which a person lacks the intention to behave, and thus lacks motivation (Deci & Ryan 2000). Amotivated individuals experience feelings of incompetence, expectancies of uncontrollability, and perform activities without purpose.

According to the self-determination theory, self-determined forms of regulation promote adaptive cognitive, affective, and behavioral functioning by facilitating enhanced learning, improved performance, higher interest, and greater effort. Less self-determined forms of regulation, in contrast, are negatively related to these outcomes (Grolnick & Ryan 1987; Williams, Grow, Freedman, Ryan & Deci 1996).

In PE, studies have revealed links between perceived competence and self-determination, and a task-involving climate and self-determined motivation link that is mediated by enhanced competence perceptions (e.g., Ommundsen & Eikanger-Kvalo 2007; Standage, Duda & Ntoumanis 2006). Research has also shown that students who are intrinsically motivated, are more persistent in their PA at school PE (Jaakkola, Liukkonen, Ommundsen & Laakso 2008; Lonsdale, Sabiston, Raedeke, Ha & Sum 2009), outside of school (Ommundsen & Eikanger-Kvalo 2007), and at their leisure time (Chatzisarantis & Hagger 2009; Hagger, Chatzisarantis, Barkoukis, Wang & Baranowski 2005). Most studies have shown amotivation or external forms of extrinsic motivation having negative or no relationship with the PA (Lonsdale et al. 2009). Research in Finnish secondary school PE has also shown contradictory results about the gender differences in self-determined motivation toward PE. Jaakkola (2002) found no gender differences in Grade 9 students' self-determined motivation toward PE, whereas Jaakkola et al. (2008) recognized that the boys rather than the girls at Grade 9 had higher self-determined motivation toward PE.

Despite a lot of research based on self-determination theory being conducted in school PE (e.g., Ntoumanis 2005; Ommundsen & Eikanger-Kvalo 2007; Standage et al. 2006), the role of intrinsically regulated motivation in the development of motor skills has yet to be investigated.

2.3.3 Perceived competence

The concept of perceived physical competence has been used to describe the perception a person has of their abilities resulting from cumulative interactions with the environment (Harter 1978). Fox (1997) defines perceived competence as 'the statement of personal ability that generalizes across a domain, such as sport, scholarship, or work' (Fox 1997, p. xii.). Within a multidimensional and hierarchically organized model of self-perception (Shavelson & Bolus 1982), an important tenet is that general self-esteem results from self-perceptions of different specific domain competencies. These include competencies in the physical, academic, social, and emotional domains. If considered personally important, high perceived competencies in a particular life domain can affect young peoples' global self-esteem. Furthermore, an individual with high perceived physical competence in a particular domain may perceive being competent as personally valuable, thus, enhancing their self-esteem (Fox 1997).

According to Harter's (1978) competence motivation theory, highly competent individuals will persist longer in certain activities compared with individuals of low perceived competence. Additionally, individuals in achievement situations seek activities that provide feelings of competence and avoid those with a probability of failure. Sonstroem (1978) suggested that positive perception of physical competence leads to more positive attitudes toward PA. Indeed, studies have shown that perceived physical competence is associated with self-determined motivation (e.g., Ntoumanis 2005; Standage et al. 2003b), and higher levels of physical activities in general (Sallis et al. 2000), in PE (Gao 2008), outside of the school environment, and at leisure time (Halvari, Ulstad, Bagoien & Skjesol 2009; Ommundsen & Eikanger-Kvalo 2007). Additionally, perceived competence has been linked with motor competence (e.g., Castelli, Woods, Normeyer, Valley & Graber 2007; Raudsepp & Liblik 2002), and motor skill performance (Ebbeck & Becker 1994; Sonstroem, Harlow & Salisbury 1993). Previous international studies have also shown that the boys have demonstrated higher levels of perceived competence in PE comparing with the girls (Biddle, Page, Ashford, Jennings, Brooke & Fox 1993; Wang, Lim, Aplin, Chia, McNeill & Tan 2006). However, in the Finnish Grade 9 PE such findings have not been found (Jaakkola 2002).

2.3.4 Motivational climate

Motivational climate refers to a situational psychological perception of the activity that directs the goals of action (Ames 1992). A motivational climate influences the achievement-related cognitions, affective responses, and behaviors in an activity, such as in PE (e.g., Standage, Duda & Ntoumanis 2003a). According to the achievement goal theory (Nicholls 1989) two motivational climates are proposed to exist, specifically a task-involving climate and an ego-involving climate. In a task-involving climate, students are rewarded for effort, and they concentrate on cooperation, learning and task mastery (Ames 1992). In an ego-involving climate teachers typically emphasize performance outcomes, competition and social comparison between students. Empirical studies in PE have revealed that a task-involving climate is positively associated with perceived competence (Cox & Williams 2008) and intrinsically regulated motivation (Standage et al. 2003b). Additionally, research has shown links between task-involving motivational climate and increased PA in PE lessons (Parish & Treasure 2003), participation in sports (Christodoulidis, Papaioannou & Digelidis 2001), and positive leisure time PA intentions (Standage et al. 2003). An ego-involving climate, instead, has been found to be unrelated or negatively related with intrinsically regulated motivation and perceived competence (Brunel 1999; Cury, Biddle, Famose, Goudas, Sarrazin & Durand 1996; Standage et al. 2003), PA in various contexts (Christodoulidis et al. 2001; Parish & Treasure 2003; Standage et al. 2003), but positively associated with amotivation (Ommundsen & Eikanger-Kvalo 2007). Although an ego-involving motivational climate has not typically been found to be negatively related to perceived competence and intrinsically regulated motivation (Standage et al. 2003b), it has been proposed that they are thwarted in environments which include social and normative comparison and the provision of rewards contingent on performance (Deci & Ryan 2000).

Associations between motivational climates and motor skills have also been demonstrated. Theeboom, de Knop and Weiss (1995) implemented a three-week intervention for 119 children aged 8–12 years who participated in an organized sports program. Results revealed that those in the task-involving group exhibited better motor skills than those in the ego-involving group. Martin et al. (2009) conducted a six-week intervention for 64 kindergarten children and observed that the high task-involving group improved significantly in locomotor and object control skills compared with the low task-involving group. Despite these findings, research on the role of social and personal motivational prerequisites for fundamental motor skill learning in the PE context have not yet been reported. Previous Finnish studies have also reported gender differences in students' perception of ego-involving motivational climate but not in task-involving motivational climate (Kokkonen 2003; Soini 2006).

2.3.5 The four-stage motivational sequence model of the teacher–student relationship

A viable way to combine tenets from the achievement goal theory and the self-determination perspective in the study of FMS is to make use of the four-stage causal sequence model of motivation put forward by Vallerand and co-workers (Mageau & Vallerand 2003; Vallerand & Losier 1999). This model holds that contextual factors, such as motivational climates, influence the regulation of motivation, mediated by needs satisfaction, one being the need for competence. In turn, the regulation of motivation is hypothesized to impact on cognitive, affective and behavioral consequences. This study adopted an approach akin to the motivational sequence identified in the four-stage sequential model of motivation (social factors – psychological mediators – types of motivation – consequences) proposed by Vallerand and colleagues. While Mageau and Vallerand (2003) also proposed a role for the need for autonomy and relatedness as mediators, it is chosen to include only perceived competence in this study, given that fuelling the need for physical competence would seem the most important when examining motor skills as outcome. The hypothesized model of the association among study variables in this study (hypothesized model represents theoretical framework of the study two in this dissertation) is presented in Figure 1.

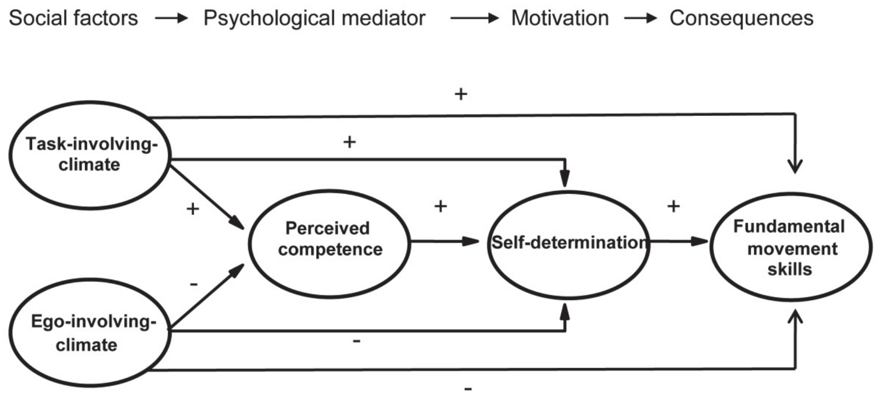

FIGURE 1 The hypothesized sequential pattern of associations among variables in this study.

In the sequential model, social factors, such as motivational class climate represent the most distal factor, followed by the mediator, with the regulation of motivation as the most proximal determinant of the hypothesized consequences in the sequence. In PE the proposed motivational sequence has previously been investigated focusing on a variety of cognitive, affective and behavioral consequences, such as boredom, effort, intention for future participation, concentration, positive and negative affect, enjoyment, leisure time PA and sport participation, and preference for challenging tasks (Ntoumanis 2005; Ommundsen & Eikanger-Kvalo 2007; Standage et al. 2003b, 2005, 2006). These consequences have shown to be positive in task-involving climate and negative in ego-involving climate. The sequence has not yet studied in studies incorporating FMS as consequence of motivational process.

2.3.6 Enjoyment

The concept of enjoyment has been defined as a multidimensional construct consisting of factors associated with excitement, affect, competence, attitude, and cognition (Crocker, Bouffard & Gessaroli 1995; Wankel 1997). According to Scanlan and Simons (1992) enjoyment is an important factor in participation in sport that may lead to greater involvement in the activity. Research has also shown that enjoyment is an antecedent of PA. Rowland and Freedson (1994) stated that providing enjoyable experiences is a potential strategy for increasing PA levels in youth. Wallhead and Buckworth (2004) found that enjoyment in school PE was related to the motivational factors associated with the adoption of a physically active lifestyle outside school hours. Additionally, enjoyment has been linked with PA engagement in PE (Kremer, Trew & Ogle 1997; Wallhead & Buckworth 2004). Soini (2006) found gender differences in enjoyment in his sample of 15-year-old Finnish PE students. The boys in Soini's (2006) study rated PE as a more enjoyable experience than the girls.

2.3.7 The nature of Finnish physical education

Children start school at the age of seven years in Finland. Students have two weekly hours of obligatory PE in elementary school, including grades one to six. In elementary school there are two 45-minute lessons every week. The minimum amount of PE is two weekly hours in secondary school, including grades seven to nine. PE in secondary school is usually taught weekly in one 90-minute lesson. During secondary school years, PE remains compulsory but the students select from a set of elective units that are developed according to the local school curriculum. Throughout grades 7-9, the participation in PE classes is based on separate gender groups. After secondary school, students may choose to continue their studies in vocational schools or upper secondary schools (grades 10-12). Upper secondary school education includes two compulsory PE units, involving a total of 76 hours. Students may also decide to complete a maximum of three additional elective units within their three academic years of upper secondary school. In vocational school, students have one 28-hour compulsory PE unit. Besides that they can complete a maximum of four elective units in PE over the three-year period.

The Finnish National Board of Education designs the core curriculum goals and contents for PE at all school levels. At the basic education level (grades 1-9), the main emphasis is in learning a wide variety of motor skills (The Finnish National Board of Education 2004). In upper secondary school, the curriculum emphasizes adopting a healthy and physically active lifestyle as well as acquiring an understanding of how PA positively affects students' physical, psychological, and social well-being (The Finnish National Board of Education 2003). In vocational school, the main goal of PE is to promote students' healthy and active lifestyle. Students are advised to plan and implement a personal PA program in vocational school (The Finnish National Board of Education 2001). In elementary school the classroom teachers teach PE, whereas in secondary school PE is taught by specialized PE teachers.

Annersted (2008) conducted a qualitative study in which values, content, and meaning of PE in the Scandinavian countries were examined. He reported that PE pedagogy in Scandinavia is rather similar in its values, goals, and content, and therefore, it deviates from other countries even inside Europe. In practice, the curriculum is similar to other Western countries, with the dominance of activities, such as ball games, gymnastics, fitness training, and track and field. The main differences are related to the inclusion of activities representative of the Scandinavian culture, such as skiing, skating, orienteering, and outdoor education, with the emphasis on well-being and the environment. Furthermore, the aims of Scandinavian PE, compared to other Western countries are more related to cooperation, socialization, and team effort than physiology, competitions, and results. Health is a critical aspect of the PE curricula in Scandinavian countries, supported by continuing attention to the skills and knowledge associated with lifelong engagement in PA. These variations in relation to pedagogical approaches allow for the possibility that Scandinavian PE teachers' experiences and perceptions of different teaching styles might lead to differences in the preferred teaching practices of teachers from other Western countries.

3 PURPOSE OF THE STUDY

The main purpose of the study was to plan, implement, and evaluate FMS intervention for Finnish Grade 7 students' in school PE. More specifically, the aim of the study was to examine whether the intervention affected on students' FMS, self-reported PA, and motivational variables. The intervention was quasi-experimental in its design including experimental and control groups assessed at four measurement points (baseline, middle, post, and retention measurements). Additionally, the aim of the study was to investigate cross-sectional associations among students' FMS, self-reported PA, and motivational variables in the baseline measurement of the study at Grade 7.

The results of the intervention are presented in study 4. The first three studies of this dissertation present the analysis of the associations among FMS, self-reported PA, and motivational variables.

During this research project, a FMS test-battery was also developed. The battery was piloted before the intervention project started and it is published in Finnish (Kalaja, Jaakkola & Liukkonen 2008). Because that report is published in Finnish, it is not included as part of this dissertation.

The specific aims of this study were:

1. to examine gender differences in FMS, self-reported PA, and motivational variables of Finnish Grade 7 PE students (additional results, not presented before).

2. to analyze the relationships between enjoyment, perceived PA competence, FMS, and PA engagement of Grade 7 students participating in Finnish PE (study 1).

Hypothesis: enjoyment, perceived PA competence, and FMS are related to the level of PA engagement

3. to combine tenets of the achievement goal theory and the self-determination theory using the four-stage causal sequence model of motivation to examine the relationships among motivational climates, perceived PA competence, motivation toward PE, and FMS (static balance skill, dribbling skill, and leaping skill) within a sample school PE students at Grade 7 (study 2).

Hypothesis 1: perception of task-involving climate, high PA competence and high self-determined motivation predict positively and sequentially balance, manipulative and locomotor skills

Hypothesis 2: perception of ego-involving climate, low PA competence and low self-determined motivation predict negatively and sequentially balance, manipulative and locomotor skills

Hypothesis 3: proximal antecedents account for more variance in FMS than more distal antecedents

4. to identify cluster groups developed on the basis of children's observed FMS, perceived PA competence, and self-determined motivation toward PE at Grade 7(study 3).

5. to examine how the cluster groups formulated as an outcome of the fourth research aim vary in their current self-reported PA (study 3).

6. to examine the development of FMS and self-reported PA of Finnish Grade 7 students as an outcome of a specific intervention (study 4).

Hypothesis: the intervention has a positive association on students' locomotor, manipulative, and balance skills as well as their level of self-reported PA engagement

7. to examine the development of perceived PA competence, self-determined motivation, enjoyment, task- and ego-involving motivational climate of Finnish Grade 7 students as an outcome of a specific intervention (additional results, not presented before).

4 METHOD

4.1 Participants of the study

The participants of the study consisted of 446 Finnish Grade 7 students (~13-year-old). The experimental group consisted of 199 students (110 girls and 89 boys) of one school, from nine classes, taught by four PE teachers. The teaching experience of the experimental group teachers varied from two to ten years. One of them was working in his first school, whereas others had been working in two or three different schools. The control group consisted of 247 students (120 girls and 127 boys) from two schools (13 classes in total), taught by six teachers. Teachers' teaching experience in the control group varied from five to 15 years. All teachers of control schools had teaching experience from two or three different schools. Regarding demographics, these three schools represent a typical Finnish secondary school sample concerning students' population and class size. All students represented the region of Central Finland. In order to collect data, convenience sample procedures were followed based on the distance of the school from the University. The data collection procedure required altogether 150 visits at schools, and therefore the participating schools were chosen from proximal location of the University. The number of participants varied among four studies because the variables of each report were different. For example, all students did not complete all scales or tests, and outliers of each study were different. The number of participants of each reports of the study is presented in Table 1.

TABLE 1 The number of participants in the studies 1-4.

	Girls	Boys	All
Study 1	210	194	404
Study 2	189	181	370
Study 3	162	154	316
Study 4	230	216	446

4.2 Data collection and procedures

There were four waves of measurements almost every four months: a) baseline measurement was carried out before the start of the intervention in August 2007; b) the middle measurement was held in January 2008, c) the post measurement was done at the end of the intervention in May 2008, and d) the retention test was carried out in December 2008. The data of studies 1-3 was collected at the first measurement of the project in August 2007. Study 4 included the data from all four measurement waves (baseline, middle, post, and retention tests). The phases of the research project are presented in Table 2. The students responded to the PA instrument under the presence of one of the researchers. All FMS tests were conducted in the indoor sport facilities of each school. The researchers co-ordinated the testing sessions and recruited assistance from the PE teaching staff whenever it was required. Each measurement period started with a warm-up phase. The measurement protocol lasted approximately 90 minutes. Students participated voluntarily, and their parents' informed consent was acquired based on the guidelines of the Ethical Committee of the University of Jyväskylä. The Ethical committee of the University of Jyväskylä has approved the study plan. The Parental consent letter is presented in Appendix E (in Finnish).

TABLE 2 Phases of the research project.

March – April 2007	Pilot study, FMS test battery building Intervention planning
May 2007	PE teacher seminars and workshops Intervention planning
August 2007	Baseline measurement, beginning of intervention Intervention planning
January 2008	Middle measurement PE teacher workshop
May 2008	Post measurement, the end of intervention teacher interviews
December 2008	Retention measurement

4.3 Movement skill intervention design

The intervention lasted one academic year starting in the middle of August 2007 and lasted until the end of May 2008. The intervention consisted of three phases: a) educational phase (PE teacher seminars and workshops), b) planning phase (teachers in conjunction with the research team planned the lessons for FMS training sessions), and c) implementation phase (running the intervention) (Table 2). The purpose of the intervention was to develop students' FMS within the intervention year. Teachers participated in the intervention voluntarily. At first, teachers were interviewed in order to clarify their level of interest to participate in the intervention. Before the start, they were also informed about the goals, methods, and procedures of the intervention.

Prior to the intervention, a team of academics organized a set of seminars and workshops for the teachers in the experimental group, which included: a) seminar on FMS; b) workshop about planning the intervention content and the use of the spectrum of teaching styles (Mosston & Ashworth 2002). Altogether four sessions were organized starting with a two-day seminar and continuing with two four-hour workshops. Additionally, in the middle of the intervention a three-hour workshop was also organized in order to discuss the experiences on the first phase of the intervention and to check the plans of the second half of the intervention.

In the planning phase researcher and teachers of the experimental group designed together curriculum contents, which would be realistic and feasible in naturalistic PE settings. The researcher was responsible for transferring the theoretical background of FMS in the intervention. However, the planning of the intervention represented a cooperative process with PE teachers being actively involved in the planning of PE lessons. Based on the cooperative planning process, the researcher drew up the final lesson plans, which were delivered to the intervention teachers at least one week prior to each class. All PE lesson plans were standardized to guarantee that all four teachers participating in the intervention implemented the same content and had the same learning objectives. Although the lesson plans were standardized, the four teachers did not run the class at the same time.

The intervention included FMS training sessions, which focused on developing one dimension of FMS at each time (locomotion, manipulation, or balance). Each FMS training session lasted 25 minutes. The FMS training sessions were scheduled at the beginning of the PE class and, therefore, were marketed to the students as prolonged warm-up periods. The FMS sessions included activities and exercises, the purposes of which were to develop students' FMS individually and/or privately, which is reflective of the style B (Mosston & Ashworth 2002, 94). Activities within the FMS sessions were planned to include plenty of differentiation in order to enable students with different skill levels to participate. Examples of each FMS training session are presented in Appendices C-D. After each FMS training session, PE teachers in the experimental group followed the guidelines stemming from the Finnish National Core Curriculum. After each intervention session PE teachers still had approximately 60 minutes for practicing sport skills, such as volleyball, orienteering, and skiing, which are determined in the Finnish National Core Curriculum. Therefore, all content defined in the Finnish National Core Curriculum were conducted despite of the intervention.

The intervention lasted 33 weeks, which covers almost the whole academic year. The curriculum was organized and divided into 11 blocks. Each block lasted two to three weeks and focused on one of the FMS (locomotion, manipulation, and balance). So, to sum up, there were 11 weeks for locomotive skills, 11 for manipulation skills, and 11 for balance skills. In the FMS training sessions, teachers were asked to use the practice style of teaching, representing style B in the continuum of teaching cycles of Mosston and Ashworth (2002). Although the practice style was used, the teachers guided and encouraged students to be active by themselves. The students were given plenty of autonomy when selecting practices matching their skill level. This implies also the use of the inclusive style of teaching (style E: Mosston & Ashworth 2002) where students make choices over task difficulty.

PE teachers in the control group followed the guidelines stemming from the Finnish national curriculum. In Finland, students in the secondary school (grades 7-9) have one PE lesson weekly, comprising of two consecutive 45-minute lessons. Thus, the amount of obligatory PE was the same for all three schools.

4.4 Treatment validity of the intervention

The treatment validity was confirmed through monitoring of the implementation of the intervention by one of the researchers and by interviewing PE teachers who participated in the intervention. Because the lesson plans were designed by the teachers in conjunction with the research team and were standardized, the monitoring of the implementation of the intervention was possible. One of the researchers observed every fifth lesson of each teacher and compared the class content with the lesson plan. Additionally, all intervention teachers reported weekly to the researcher if the lesson was executed as planned or if the plan was not implemented. Through these procedures, the researchers ensured that the teachers had implemented the intervention lesson plans as they were designed. Teachers did not report remarkable deviances between planned and implemented lessons through the intervention.

4.5 Instrumentation

In order to examine intervention effects on students' FMS, the following tests were chosen by the researchers based on the content of PE lesson plans and the learning outcomes of the intervention plan: a) Flamingo standing test, b) rolling test, c) leaping test, d) shuttle-run test, e) rope jumping test, f) accuracy throwing test and g) Figure-8 dribbling test. The students in the intervention group did not have any practice for the specific tests prior to the measurements. In order to measure PA and motivational variables, self-reports were used.

4.5.1 Fundamental movement skill tests

Flamingo standing test. Static balance was measured using the Flamingo standing test (EUROFIT 1988). In this test procedure, the participant balances for 30 seconds on one leg on a 50 cm long, 4 cm high, and 3 cm wide wooden beam. The free leg is bent backwards and the back of the foot is gripped with the hand of the same side. No practicing time before the test is allowed. Each time that the participant loses his/her balance by releasing the free leg or touches the floor with any part of the body, stopwatch is stopped. After each fall, the same procedure starts again. The number of attempts required to complete the 30 seconds time period is the participant's final score. The test is executed twice (2 x 30 seconds), first with the right leg and then with the left leg, and the scores are summed up. The researcher announces time limits and records the attempts. Nupponen (1997) reported test-retest correlations of .53 for the boys and .59 for the girls for the Flamingo standing test. Tsigilis, Douda, and Tokmakidis (2002) examined the reliability of Flamingo standing test with university students. In their study, the test-retest correlation for the Flamingo standing test was .73. These two previous studies showed that the Flamingo standing test has demonstrated moderate reliabilities.

Rolling test. Dynamic balance was analyzed by the rolling test, which was implemented on a 6-meter long gymnastic mat. The starting position is lying on the mat face down and arms extended. The task is to roll a 5-meter distance over the end line and back to the starting line as fast as possible. If the subject moves away from the mat, the researcher asks him to move back on the centerline and continue rolling, while the stopwatch continues the timing procedure. Two warm-up turns are allowed before the actual test. Finnish PE studies have demonstrated rolling test to be a reliable tool for measuring secondary school students' balance skills. Kalaja, Jaakkola, and Liukkonen (2008) recognized that the test-retest correlation of the rolling test was .71, indicating adequate reliability of the test.

Leaping test. The leaping test was used to measure one component of students' locomotor skills. The leaping test is widely used in Finnish PE because it is included in the Finnish Fitness Test Package, which PE teachers normally implement at least once a year in secondary schools (Nupponen, Soini & Telama 1999). In the leaping test, the task is to leap five times consecutively starting from the initial leaping position with both legs parallel. After the first jump the leaping sequence is a leap with the preferred leg followed by a leap with the opposite leg until the sequence of five leaps is completed. The test is performed on a 6 cm thick gymnastics mat. The final landing is also completed with both legs parallel. The result is calculated from measuring the total length of the five leaps. The participants are allowed to practice three times before the actual test, which is implemented once. Nupponen and Telama (1998) analyzed the reliability of the leaping test with 548 Grade 8 Finnish students and reported a test-retest correlation of .95 for boys and .93 for girls.

Shuttle-run test. A modified shuttle-run test was used to measure one component of students' locomotor skills (Nupponen & Telama 1998). This specific shuttle-run test is also widely used in Finnish PE because it is also part of the Finnish Fitness Test Package. In this modified shuttle-run test the aim is to run as fast as possible 10 times over a five meter distance, alternating between the forwards and backwards direction. The participant always faces at the same side, and both legs should pass the five-meter marker line at each turn. The result is the total running time for 10 shuttles. No practicing is allowed before the test. This test is a modification of a widely used shuttle-run test, where the participants run forward all the time. Research has demonstrated that this shuttle-run test is a reliable tool to analyze children's locomotor skills (Fjørtoft 2000; Houwen, Visscher, Hartman & Lemmink 2006). Additionally, Kalaja, Jaakkola and Liukkonen (2008) recognized that the test-retest correlation of the modified shuttle run test was .78, indicating adequate reliability of the test.

Rope jumping test. In this test, subjects are asked to jump rope on one leg as many times as possible in 30 seconds. Five test trials with each leg before the actual execution is allowed. The length of the rope is adjusted so that the rope touches the floor when elbows are in a 90-degree angle. The subject decides about the starting leg. After 15 seconds, the researcher gives a "change" signal, and the jumping leg changes. The researcher counts the total number of successful jumps in 30 seconds. Studies in Finnish PE have demonstrated rope jumping test to be reliable. Kalaja, Jaakkola and Liukkonen (2008) revealed that the test-retest correlation of the rope jumping test was .84, indicating satisfactory reliability for the test. Additionally, they found that the results of the rope jumping test correlated positively and significantly with leaping and shuttle-run test scores, indicating the validity of the test.

Accuracy throwing test. The accuracy throwing test was used to analyze a component of students' manipulative skills. The task is a part of the APM-Inventory, a Finnish test developed for assessing preschool children's perceptual and FMS (Numminen 1995) as it was modified by Kalaja, Jaakkola, and Liukkonen (2008). The target is a wooden circle hanging vertically on the wall. The center of the target is set at average eye-level height for children of this age (150cm boys/145 cm girls). The diameter of the three-point area is 20 cm, two-point area 40 cm, and the one-point area 60 cm. The throwing distance to the target is five meters. The throwing object is a tennis ball. The participants are allowed two practice attempts with each hand. Only overarm throws are allowed. The score is the total number of points from ten throws (five with right hand and five with left hand). The researcher stands by the throwing target recording students' scores. In cases where the throw is between two different scores, higher score is given. Accuracy throwing test has been found to be a reliable tool to measure young children's manipulative skills (Sääkslahti et al. 1999). However, Kalaja, Jaakkola and Liukkonen (2008) recognized that the test-retest correlation of the accuracy throwing test was .46, demonstrating only moderate reliability of the test within Grade 7 students in Finnish PE.

Figure-8 dribbling test. Manipulative skills were assessed using the Figure-8 dribbling test in which the task is to dribble volleyball around a Figure-8 track, first using the feet (30 sec.), and then using the hands (30 sec.). The participants are allowed to execute two practice trials. The test starts with the participants standing behind the starting line, and following the "go" signal they start to dribble the ball with their feet along the Figure-8 track. The track is marked with arrows indicating the dribbling direction. Both the participant and the ball have to go around the marker cones. After 30 seconds the researcher gives a "change" instruction, and the manipulation style is switched to hand-dribbling. In the hand-dribbling test, the ball is not allowed to pass the cones. Changing of the dribbling hand is allowed. The total dribbling time is one minute. If the ball leaves the test area (i.e., ringed zone constructed of wooden gymnastic benches) the stopwatch is not stopped. The final result is the total number of crossed lines in one minute. The dribbling test is a part of the widely used Finnish Fitness Test Package (Nupponen, Soini & Telama 1999). Nupponen (1997) reported the test-retest correlation of .70 for the boys and .60 for the girls for a large sample of Finnish school students. These correlations demonstrate moderate reliability of the Figure-8 dribbling test.

4.5.2 Physical activity self-report

PA was examined using a two-item self-report scale originally developed by Prochaska, Sallis and Long (2001). The Finnish version of the scale has been modified by Vuori, Ojala, Tynjälä, Vilberg, Välimaa and Kannas (2004). The stem for the items was: "In the next two questions PA means all activities which raise your heart rate or momentarily gets you out of breath for example in doing exercise, playing with your friends, going to school, or in school PE. PA also includes for example jogging, intensive walking, roller skating, cycling, dancing, skating, skiing, soccer, basketball, and baseball." The items were: "Think about your typical week. How many days did you exercise for at least 60 min. during which you got out of breath" and "Think about your last 7 days. How many days did you exercise for at least 60 min. during which you got out of breath?". Both items are presented using an eight-point response scale (0 to 7 days in a week). A sum-scale of PA is computed by calculating a mean score for the two items. This scale has shown acceptable levels of internal consistency with teenagers (Prochaska, Sallis & Long 2001; Vuori et al. 2004) and it was chosen for reasons of suitability due to the size of the sample.

4.5.3 Motivation questionnaires

Sport Motivation Scale. The contextual self-determined motivation toward PE was measured by the Finnish version of the Sport Motivation Scale (SMS; Pelletier, Fortier, Vallerand, Tuson, Brière & Blais 1995). The SMS consists of seven subscales, comprising three types of intrinsic motivation which are IM to accomplish things ('Because I feel a lot of personal satisfaction while mastering certain difficult training techniques'), IM to know ('For the pleasure it gives me to know about the sport skills that I practice') and IM to experience stimulation ('For the pleasure I feel in living exciting experiences'), three forms of extrinsic motivation including identified regulation ('Because, in my opinion, it is one of the best ways to get acquainted with other students'), introjected regulation ('Because it is absolutely necessary to do sports if one wants to be in shape') and external regulation ('Because it allows me to be well regarded by people I know'), and amotivation ('I often asked myself; I cannot seem to achieve the goals that I have set for myself'). Each dimension consists of four items. Each item was rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The SMS used in this study had the individual item stem of 'Why I'm currently participating in PE'. Subscale scores were calculated for amotivation, external regulation, introjected regulation, identified regulation and intrinsic motivation. When calculating the subscale for intrinsic motivation it was combined all 12 items, measuring three different types of intrinsic motivation. This is the normal procedure before calculating the Relative Autonomy Index (RAI) as suggested by Vallerand (1997). The next step was to formulate the RAI which can be done by weighting the scores of the subscales so as to derive a single score. The various motivation types are theoretically posited to lie on a continuum of self-determination from intrinsic motivation to amotivation. Weights are given based on the position of the particular motivation type on the continuum (Vallerand 1997). This was done by weighting intrinsic motivation (+2) and identified regulation (+1) positively. Then introjected regulation and external regulation were summed up and weighted –1. Amotivation was weighted –2. The value of the RAI can be either positive or negative. An increasingly positive index score is reflective of an increasingly self-determined form of motivation for the given activity. This index has been shown to indicate the amount of self-determination in an activity. The Finnish version of the SMS has demonstrated high levels of reliability and validity. In the study by Jaakkola et al. (2008), the Cronbach's alpha coefficients of the SMS subscales were above .70, indicating satisfactory internal consistency. Additionally, the indices of confirmatory factor analysis demonstrated satisfactory construct validity. Subsequently, correlation analysis of the Finnish version of the SMS has supported existing motivational continuum and, thus, the formulation of RAI index. Subscales that are adjacent to each other along the continuum correlated more positively than those further from each other (Jaakkola & Liukkonen 2006).

Physical Activity Competence. Perceived PA competence was analyzed using the Finnish version of the sport competence subscale of the Physical Self-Perception Profile (PSPP; Fox 1990; Fox & Corbin 1989). Each item was rated on a five-point Osgood scale from 'I'm among the best when it comes to athletic ability' (1) to 'I'm not among the best when it comes to athletic ability' (5) (scale scores reversed in analyzes). The Sport Competence Scale used in this study had the individual item stem of 'What am I like?' Scale score was calculated by summing item scores. Research has shown that the Sport Competence Scale has demonstrated satisfactory reliability and validity (Fox & Corbin 1989; Wang et al. 2008).

Motivational Climate. Motivational climate was measured by using the Motivational Climate in School Physical Education Scale (MCSPES), which consists of four subscales comprising autonomy support, social relatedness, task- and ego-involving climate factors (Soini, Liukkonen & Jaakkola 2004). For this study purpose only task-involving and ego-involving subscales of the MCSPES were used. The task-involving climate factor consists of five items (e.g., 'It is important for the students to try their best during PE lessons') and the ego-involving factor includes four items (e.g., 'During PE lessons students compare their performance mainly to that of others'). Each item was rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The MCSPES had the individual item stem of 'In my PE class . . .' Research has demonstrated satisfactory reliability and validity for the MCSPES (Soini et al. 2004).

Enjoyment. In the present study the Finnish version of the sport enjoyment subscale of the Sport Commitment Model was used (Scanlan, Carpenter, Schmidt, Simons & Keeler 1993). This version of the subscale includes four items to evaluate the themes of enjoyment, pleasure, fun, and happiness, modified to reflect a PE context (i.e., "In my PE class…") and rated on a five point Likert scale (1 = strongly agree to 5 = strongly disagree). The Finnish version of the sport enjoyment subscale has been found to be a valid and reliable tool in Finnish sport psychology research (Soini 2006).

All measures were translated from English to Finnish by a panel of experts in sport psychology and later back into English by a translator whose first language is English and was skilled in Finnish. The back-translated English version was compared with the original version for consistency. The panel of experts discussed items that were shown to have number of possible meanings in Finnish in order to redraft them to minimize any confusion regarding meaning. The scales are presented in Appendices A and B.

4.6 Data preparation

The EM data imputation method was used in order to replace missing values. The percentage of missing values per variable was less than 5%. Also, univariate and multivariate outliers were excluded according to procedures described by Tabachnick and Fidell (2007, pp. 72-77) in order to prevent extreme values from distorting statistical analyses. Those outliers are considered to be exceptional assessments or performances of for example highly skilled adolescents that probably had higher participation in sport activities or were athletes and therefore did not represent the average scores of the population. Kolmogorov-Smirnov tests were also conducted to examine the normality of the distributions.

4.7 Data analyses

Descriptive statistics and Pearson's product moment correlation coefficients were analyzed in order to examine the mean level of measured variables and to investigate associations among variables. Independent samples t-tests with effect sizes (Cohen's d) were conducted to examine possible gender differences in measured study variables the FMS test scores. The d value is interpreted based on guidelines of .20. .50., and .80 as small, moderate, and high, respectively (Cohen 1988).

The validity and reliability of the questionnaire s were analyzed by confirmatory factor analysis and internal consistency analysis using Cronbach's alpha coefficients. Confirmatory factor analysis was undertaken using AMOS 7.0 software and the maximum likelihood method (Arbuckle 2006). A single model was constructed a priori for the data sets and the solution evaluated using a variety of well known fit indices including the Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Incremental Fit Index (IFI), Relative Fit Index (RFI) and the Root Mean Square Error of Approximation (RMSEA) (Arbuckle 2006). The TLI, CFI, NFI, IFI and RFI indices vary from 0 to 1. Fit indices greater than 0.90 are indicative of acceptable model fit. In addition, an RMSEA score of lower than 0.05 is indicative of a representative model. Finally, the normed chi-square index ($\chi 2/df$) representing parsimonious fit should be below the marginal maximum of 3.00. Statistical analyses were conducted using SPSS for Windows 16.0, Amos 7.0, and LISREL 8.30 software.

It should be noticed that the scales in sport competence subscale, Flamingo standing test, shuttle running test, and rolling test are in a different direction than in other instruments. Therefore, for the clarity of the presented results, those scales were transformed into the same direction than others.

More specifically, the statistical analyses of each study were:

Study 1. The associations among study variables were analyzed by using stepwise regression analysis. Effect size was determined based on the formula, $f\ 2 = R2/(1 - R2)$. The f 2 value is interpreted based on guidelines of .02, .13, and .26 as small, moderate, and large, respectively.

Study 2. The adequacy of the hypothesized model of motivational sequence was tested via structural equation modeling (SEM). The maximum likelihood method was applied. The overall fit of the analyzed model to the data was investigated using the chi-square test ($\chi 2$). A non-significant result shows that the proposed model has an acceptable fit to the data. Additionally, the Standardized Root Mean Square Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA), the Non Normed Fit Index (NNFI), the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI) were examined. The NNFI, CFI, GFI, and AGFI indices vary from

0 to 1. Fit indices greater than 0.90 are indicative of acceptable model fit. In addition, an RMSEA and SRMR of less than 0.05 are indicative of a representative model. Additionally, the proportion of variance predicted by independent variables for the dependent variables were investigated using squared multiple correlations (r^2).

Study 3. All the variables were standardized using z-scores (Hair, Black, Babin, Anderson & Tatham 2006). The data were randomly split into two similar subgroups of 50% each. A hierarchical cluster analysis following Ward’s method was used to profile the first subgroup. The Euclidean distance was used as a similarity measure. To estimate the number of clusters, the dendogram was inspected. A cross-validation of this cluster solution with another subgroup was conducted using the k-means method (Aldenderfer & Blashfield 1984). Following the cluster analysis, a series of one-way analyses of variance and Scheffé post hoc tests were conducted to confirm whether the students in the profiles differed significantly on the cluster variables. Finally, differences in self-reported PA were analyzed for students in each cluster group using one-way analysis of variance and Scheffé post hoc test. In all comparisons of this study, both Cohen’s d effect size and the 95% confidence intervals were calculated to assess the meaningfulness of any differences.

Study 4. Repeated measures MANOVAs were carried out to analyze the interaction between condition (experimental/control) and time (four measurement points) in any individual FMS tests, PA score, and motivational variables. In cases where the interaction between condition and time was found, follow-up post hoc tests were performed to examine which group means differed from each other. Before each MANOVA, Mauchly’s test was firstly used to check the assumption of sphericity. Additionally, in the study 4, all movement skill scales were standardized by using z-scores. Three sum scores (balance, locomotion, and manipulation) were also computed in order to investigate whether the intervention affected any of the FMS categories as a whole. This was done by summing up tests measuring specific types of movement skills. Additionally, a movement skill sum score was calculated by summing up all individual movement skill test scorers.

5 RESULTS

5.1 Validity and reliability of the scales

In order to examine how well the seven-factor structure of the Sport Motivation Scale (SMS), one-factor structure of the Sport Competence subscale (SCS), two-factor structure of the Motivational Climate in School Physical Education Scale (MCSPES), and the one-factor structure of the Sport Enjoyment scale (SE) fitted the data, a confirmatory factor analysis with maximum likelihood method was conducted. Common factors were allowed to be correlated. No correlated residuals were permitted. The goodness-of-fit indices of all scales are shown in Table 3.

TABLE 3 Confirmatory factor analyses for the Sport Motivation Scale, Motivational Climate in School Physical Education Scale, Sport Competence Scale, and Sport Enjoyment scale.

	Sport Motivation Scale	Motivational Climate in School Physical Education Scale	Sport Competence subscale	Sport Enjoyment subscale
CMIN	1135.28	52.98	30.63	0.74
df	329	26	5	2
CMIN/df	3.45	2.11	6.13	0.37
TLI	0.86	0.96	0.91	1.00
CFI	0.88	0.98	0.97	1.00
IFI	0.88	0.98	0.97	1.00
RFI	0.81	0.93	0.90	1.00
NFI	0.84	0.96	0.97	1.00
RMSEA	0.08	0.55	0.12	0.00

The results indicated that the Sport Enjoyment subscale fitted the data well. Additionally, the Sport Competence subscale and the MCSPES fitted the data rather well. Only RMSEA indices for the Sport Competence subscale and the MCSPES were below acceptable limits. Subsequently, the CMIN/df ratio of the Sport Competence subscale was below suggested level. The goodness-of-fit indices of the SMS were somewhat below recommended levels. However, all indices of the SMS were consistently close to acceptable limits. The goodness-of-fit indices of all scales demonstrated more consistent patterns than reported in previous Finnish studies (Jaakkola 2002; Soini 2006).

Cronbach's alpha coefficients for the sub-dimensions of the SMS, MCSPES, the Sport Competence subscale, and the Sport Enjoyment subscale were above .70, indicating adequate internal consistency of the scales. The correlation coefficient for the two items measuring PA was .81 suggesting that these two items reliably analyze the same phenomenon.

5.2 Descriptive statistics and gender differences in the study variables

The descriptive statistics showed that the students perceived more task-involving than ego-involving climate in PE. Additionally, they were experienced rather high enjoyment during PE classes. Students self-reports also indicated that they were physically active slightly more than four times a week. T-tests demonstrated that the girls scored higher in the Flamingo standing test and the rope jumping test comparing with the boys. Boys, instead, scored higher in the rolling test, the leaping test, the accuracy throwing test, and the Figure-8 dribbling test than the girls. Additionally, the boys perceived their PE classes more ego-involving and perceived higher competence toward PA compared with the girls'. In these aforementioned gender differences Cohen's d was high in the rope jumping test difference, moderate in the Figure-8 dribbling test difference, and low in all other tests differences. The descriptive statistics are presented in Table 4.

TABLE 4 Descriptive statistics and t-tests with Cohen's d for all study variables.

Variable	Girls			Boys			t-test		
	n	M	SD	n	M	SD	t-value	p-value	Cohen's d
Flamingo standing (Number of times balance was not maintained in a 30 second period)	180	10.87	6.03	172	12.25	5.41	-2.25	0.003	0.24
Rolling (Time in seconds: 10 [both sides] meters rolling)	187	16.01	3.41	177	14.44	3.70	4.21	0.000	0.44
Shuttle-running (Time in seconds: 10 x 5 m [forward and backward] shuttle runs)	184	24.55	2.09	176	24.20	4.05	1.02	0.307	0.11
Rope jumping (Amount of jumps in 30 [left and right foot] seconds)	185	42.78	13.61	170	25.52	12.42	12.45	0.000	1.33
Leaping (Distance of 5 continuous leaps in centimeters)	188	849.26	108.05	175	889.36	108.00	-3.53	0.000	0.37
Accuracy throwing (Points in the target: 10 balls thrown [left and right hand])	182	7.45	3.95	163	8.72	4.06	-2.96	0.003	0.32
Figure-8 dribbling (Number of times the figure-8 pattern was completed in one minute)	188	13.92	2.77	175	15.47	3.07	-5.05	0.000	0.53
Relative Autonomy Index (1 to 5)	156	2.26	3.15	143	2.37	2.80	-0.31	0.756	0.04
Task-involving climate (1 to 5)	193	3.77	0.79	179	3.73	0.86	0.48	0.629	0.05
Ego-involving climate (1 to 5)	187	2.80	0.90	169	3.12	0.81	-3.42	0.001	0.36
PA competence (1 to 5)	200	2.77	0.81	187	2.62	0.85	2.07	0.039	0.21
Sport Enjoyment (1 to 5)	194	3.70	1.11	173	3.82	1.00	-1.07	0.284	0.11
PA (0 to 7) (Days/wk of activity ≥60 mins)	198	4.22	1.62	186	4.28	1.73	-0.36	0.720	0.04

5.3 Correlations among the study variables in the first measurement

Pearson's correlation coefficients for all measures in the first measurement are shown in the Table 5. Results indicated that for the girls almost all motor skill tests scores had significant and positive inter-correlations. Most of these correlations were moderate while some of them were low. In the girls group, accuracy throwing test was the only test not having significant correlations with other motor skill tests scores. It has significant and positive correlations only with shuttle-running, leaping, and Figure-8 dribbling test scores. In the girls group, neither of motor skill test scores correlated with self-reported PA. Additionally, in the girls group, relative autonomy index, task-involving motivational climate, PA competence, and enjoyment had moderate to high positive inter-correlations. Ego-involving motivational climate instead did not have a significant correlation with any of those motivational variables. Girls' correlational analyses also demonstrated that relative autonomy index, PA competence, and enjoyment had significant but low positive association with self-reported PA. Finally, the girls' correlations showed that relative autonomy index, task-involving motivational climate, PA competence, and enjoyment had low to moderate positive correlations with almost all other motor skills test scores except accuracy throwing test score. Ego-involving climate did not have a significant association with any of motor skill tests scores.

In the boys group inter-correlations among motor skill tests scores were lower than in the girls' group. For the boys, the rope jumping test was the only test to correlate significantly and positively with all other motor skill tests. Otherwise, the inter-correlations among motor skill test scores were inconsistent. Additionally, in the boys' group, relative autonomy index, task-involving motivational climate, PA competence, and enjoyment had significant and positive inter-correlations. PA in the boys' group correlated also positively and significantly with rope jumping and Figure-8 dribbling tests scores, task-involving motivational climate, relatively autonomy index, PA competence, and enjoyment. Finally, in the boys' group, motivational variables had more inconsistent correlations with motor skill tests scores than in the girls' group.

TABLE 5 Correlations among study variables in the first measurement. Girls above and boys below the main diagonal.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1.Flamingo standing	-	0.25**	0.42***	0.45***	0.31***	0.20	0.26***	0.38***	0.31***	0.01	0.28***	0.34***	0.11
2. Rolling	0.01	-	0.38***	0.32***	0.31***	0.05	0.20**	0.20*	0.19*	0.03	0.29***	0.32***	0.11
3. Shuttle-running	0.25***	0.02	-	0.46***	0.57***	0.21***	0.44***	0.34***	0.28***	0.06	0.36***	0.38***	0.05
4. Rope jumping	0.35***	0.17*	0.19**	-	0.37***	0.07	0.26***	0.17*	0.05	0.10	0.29***	0.17*	0.05
5. Leaping	0.17*	0.14	0.13	0.31***	-	0.21**	0.44***	0.25**	0.26***	0.15	0.24***	0.31***	0.01
6. Accuracy throwing	0.16**	0.05	0.06	0.14**	0.28***	-	0.32***	0.03	0.12	0.03	0.02	0.07	0.10
7. Figure-8 dribbling	0.17**	0.10	0.22**	0.29***	0.38***	0.24**	-	0.10	0.22**	0.15	0.18*	0.24***	0.07
8. Relative Autonomy Index	0.16**	0.14	0.27***	0.24**	0.09	0.11	0.08	-	0.60***	-0.11	0.45***	0.74***	0.24*
9. Task climate	0.08	0.01	0.39***	0.08	0.08	0.10	0.09	0.66***	-	0.13	0.23***	0.66***	0.13
10. Ego climate	0.19**	-0.04	-0.21**	0.09	-0.03	-0.02	0.10	0.22**	0.41***	-	0.13	0.05	0.08
11. PA competence	0.12	0.01	0.27***	0.21**	0.27***	0.09	0.29***	0.58***	0.48***	0.19**	-	0.45***	0.19**
12. Sport enjoyment	0.07	0.03	0.13	0.22**	0.21**	0.11	0.21**	0.67***	0.70***	0.23**	0.52***	-	0.16*
13. PA	0.07	0.11	0.01	0.23**	0.11	0.01	0.19**	0.41***	0.21**	0.08	0.36***	0.33***	-

$p<0.001$***, $p<0.01$**, $p<0.05$*

5.4 Relationships between enjoyment, physical activity competence, fundamental movement skills, and physical activity engagement

A multiple stepwise regression analysis was conducted in order to examine whether gender, FMS, enjoyment, and perceived PA competence predicted self-reported PA engagement. In each analysis, gender, FMS, enjoyment, and perceived PA competence were independent variables, and PA engagement represented the dependent variable. The model was statistically significant, $F(1,317) = 18.64$, $p < .000$, and accounted for 5% of the variance in PA engagement (adjusted $r^2 = .05$). The only variable that entered into the regression model that was found to be significant was perceived PA competence (β = - 24). The adjusted r^2 value of .05 translates into an f^2 value of .05, which constitutes a small effect size.

5.5 Relationships among motivational climates, perceived physical activity competence, motivation toward physical education, and fundamental movement skills

The adequacy of the hypothesized model of motivational sequence was tested via structural equation modeling (SEM). First, descriptive statistics were analyzed and results indicated that the scales were normally distributed. Therefore, the maximum likelihood method was applied.

The results of the proposed model (Figure 1) demonstrated poor fit to the data. The next phase was to remove all insignificant path coefficients from the model. After this procedure SEM analysis revealed that the final model had a good fit to the data ($\chi 2$ = [12] = 18.82, $p > .05$; NNFI = 0.96; CFI = 0.98; GFI = 0.98; AGFI = 95; SRMR = 0.050; RMSEA = 0.047).

The model revealed an indirect path from task-involving motivational climate to balance skill mediated by perceived PA competence and self-determined motivation. The model also demonstrated an indirect path from task-involving climate mediated by perceived PA competence onto manipulation and locomotion, respectively. There was also an indirect path from task-involving climate mediated by self-determined motivation to balance. Finally, it was observed a direct path from ego-involving climate to manipulation. Squared multiple correlations revealed that self-determined motivation was explained rather strongly (45 percent) by task-involving motivational climate and perceived PA competence. All other squared multiple correlations were low. The final model is presented in Figure 2.

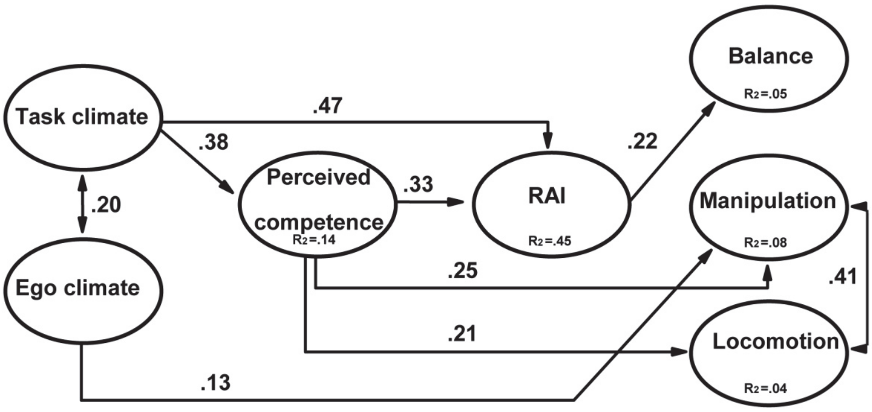

FIGURE 2. The final path model for study variables.

5.6 Identification of cluster groups developed on the basis of children's observed fundamental movement skills, perceived physical activity competence, and self-determined motivation toward physical education

A hierarchical cluster analysis of the first 50% subsample identified multiple clusters. The dendogram of this analysis indicated a clear 3-cluster solution of the data. The following k-means analysis using the second 50% subsample confirmed a 3-cluster structure. Because analyses for both subsamples yielded similar cluster solutions, the subsamples were combined for the following analyses. The k-means cluster analysis for this sample identified three clusters in the whole population (Figure 3). The first cluster was labeled the "Low motivation/low skills profile" (n = 103; 36%) and included students with low FMS, perceived competence, and self-determined motivation toward PE. The second profile was labeled "High skills/low motivation profile" (n = 85; 29%) and included students with high FMS and low perceived competence and self-determined motivation toward PE. The third profile was labeled as the "High skills/ high motivation profile" (n = 101; 35%) and included students with relatively high FMS and high perceived competence and motivation toward PE. The clusters' sizes, as well as the means, standard deviations, and z-scores of their centroids, and analysis of variance's F ratios are shown in Table 6.

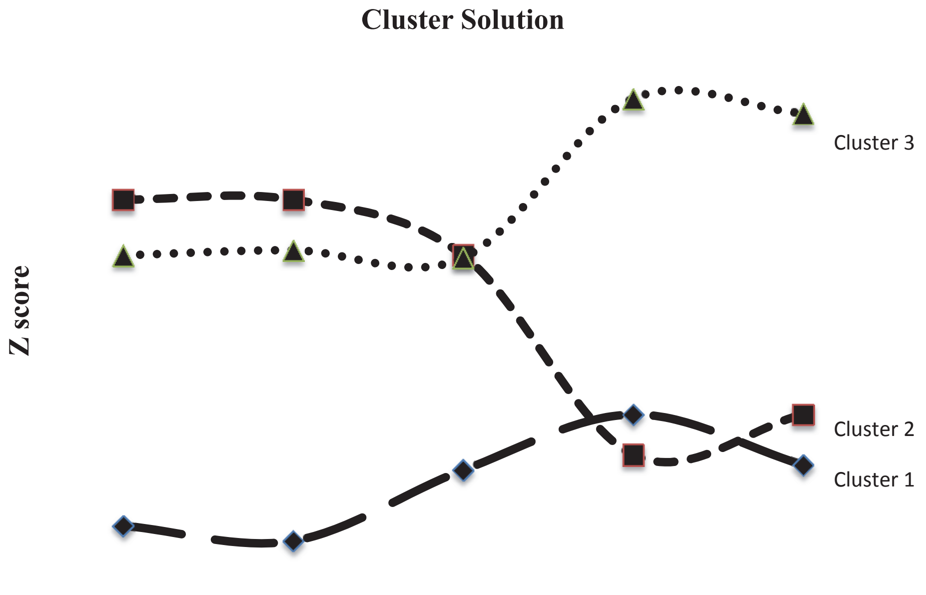

FIGURE 3 Cluster patterns for variable z-scores.

Analysis of variance indicated the three clusters were significantly distinct from each other on all cluster variables. Scheffé post hoc comparisons revealed that Cluster 3 scores for motivation toward PE were significantly higher than both Cluster 1 ($p < .001$, $d = 1.88$, 95%CI = −4.29, 2.97) and Cluster 2 ($p < .001$, $d = 2.38$, 95%CI = −0.24, 1.14). Post hoc tests also revealed that Cluster 3 had significantly higher values for perceived competence than Cluster 1 ($p < .001$, $d = 2.02$, 95%CI = 0.95, 1.36) and Cluster 2 ($p < .001$, $d = 0.27$, 95%CI = −0.05, 0.38). Additionally, the students in Cluster 3 had significantly higher scores on the manipulative skill test than both Clusters 1 ($p < .001$, $d = 1.27$, 95%CI = −4.02, 2.33) and 2 ($p < .001$, $d = 0.26$, 95%CI = −4.72–2.95). The analysis of the locomotor skill variable revealed similar results showing that Cluster 3 had significantly higher scores for the Leaping test than Cluster 1 ($p < .001$, $d = 1.36$, 95%CI = −148.44, −89.96) and Cluster 2 ($p < .001$, $d = 0.24$, 95%CI = −170.35, −109.16). Finally, the Scheffé post hoc tests demonstrated that Cluster 3 had significantly higher balance skill scores than Cluster 1 ($p < .001$, $d = 0.91$, 95%CI = 2.51, 5.52) and Cluster 2 ($p < .001$, $d = 0.02$, 95% CI = 2.51, 5.66).

TABLE 6 Means, standard deviations, and z-scores for three cluster solution and cluster group differences.

Variable	Cluster 1 (n = 103) Low skills/ low motivation			Cluster 2 (n = 85) High skills/ low motivation			Cluster 3 (n = 101) High skills/ high motivation			ANOVA
	M	SD	z	M	SD	z	M	SD	z	$F_{2,286}$
Motivation toward PE	1.33	2.23	-0.31	0.88	1.83	-0.47	4.97	1.60	0.94	133.91
Perceived PA competence	3.13	0.64	0.51	2.96	0.63	0.31	1.97	0.50	-0.88	110.68
Locomotor skill (cm)	792	86.15	-0.81	931	77.95	0.54	911	88.99	0.34	77.48
Manipulative skills (sides)	12.61	2.12	-0.75	16.45	2.37	0.54	15.78	2.81	0.32	68.20
Balance skill (errors)	13.38	4.77	0.53	9.29	4.28	-0.32	9.37	3.99	-0.31	28.46

5.7 Cluster differences in physical activity

The analysis of variance identified significant differences among the three clusters in their self-reported PA levels (F2, 278 = 7.85, p < .001, η2 = 0.05). Scheffé post hoc test indicated that the students in Cluster 3, “High skills/high motivation“ (M = 4.9, SD = 1.6) engaged in significantly more PA than the students of Cluster 1 “Low skills/low motivation” (M = 4.0, SD = 1.8; p < .01, d = 0.48, 95%CI = −1.39, 0.25) and Cluster 2 “High skills/low motivation” (M = 4.1, SD = 1.6; p < .01, d = 0.59, 95%CI = −0.62, 0.58).

5.8 The development of fundamental movement skills, self-reported physical activity, and psychological variables as an outcome of specific intervention

In order to analyze the interaction between condition (experimental/control) and time (four measurement points) in any individual FMS test, PA score, and the psychological variables measured in this study, a repeated measures MANOVAs were carried out. In cases where the interaction between condition and time was found, follow-up post hoc tests were performed to examine which group means differed from each other (Tables 7 and 8).

FMS. The MANOVA for the Flamingo standing test revealed significant interaction between condition and time (Huynh-Feldt’s F[2.852]=6.45, p=.000). Follow-up MANOVAs (post hoc) revealed that the experimental and the control group differed between the first and the third measure (Huynh-Feldt’s F8[1.00]=10.25, p=.001), between the first and the fourth measure (Huynh-

Feldt's F[1.00])=4.03, p=.046), between the second and the third measure (Huynh-Feldt's F[1.00]=14.14, p=.000), and between the second and the fourth measure (Huynh-Feldt's F[1.00]=5.48, p=.020). Scores of the experimental group decreased in static balance from the first to the third measure, from the second to the third measure, and from the first to the fourth measure (Table 2). This decrease demonstrates significant improvement in static balance due to the intervention while the control group demonstrated no statistically significant development in static balance. After the intervention there were no differences in the development of the static balance between the experimental and control groups.

The MANOVA for the rolling test revealed significant interaction between condition and time (Huynh-Feldt's F[2.71]=11.03, p=.000). Follow-up MANOVAs revealed that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F[1.00]=25.37, p=.000), between the second and the third measure (Huynh-Feldt's F[1.00]=17.00, p=.000), and between the third and the fourth measure (Huynh-Feldt's F[1.00]=17.04, p=.000). Dynamic balance in the experimental group decreased during the four measurement phases, whereas the control group's dynamic balance decreased only from the third to the fourth measure. These trends in the rolling test scores show that the intervention improved students' dynamic balance, whereas the control group had no statistically significant change in dynamic balance at the same time. After the intervention both groups improved in dynamic balance but the control group demonstrated greater improvement.

The MANOVA for the balance skill sum score revealed significant interaction between condition and time (Huynh-Feldt's F[2.84]=14.77, p=.000). Follow-up MANOVAs demonstrated that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F[1.00]=29.90, p=.000), between the first and the fourth measure (Huynh-Feldt's F[1.00]=6.08, p=.014), between the second and the third measure (Huynh-Feldt's F[1.00]=31.17, p=.000), between the second and the fourth (Huynh-Feldt's F[1.00]=5.30, p=.022), and between the third and the fourth measure (Huynh-Feldt's F[1.00]=13.30, p=.000). The Z-scores demonstrated that the experimental group increased in balance skills during the intervention, whereas the control group decreased in balance skills. After the intervention the experimental group decreased and the control group slightly increased in balance skills.

The MANOVA for the movement skills sum score revealed significant interaction between condition and time (Huynh-Feldt's F[2.93]=7.99, p=.000). Follow-up MANOVAs showed that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F[1.00]=18.28, p=.000), between the second and the third measure (Huynh-Feldt's F[1.00]=12.70, p=.000), and between the third and the fourth measure(Huynh-Feldt's F[1.00]=12., p=.000). The Z-scores revealed that the experimental group demonstrated higher movement skill sum score development during the intervention compared with the control group. However, after the intervention the movement skill sum score decreased more in the experimental group than in the control group.

It should be noticed that there were differences in the dribbling skill test scores between the experimental and the control group at the baseline measurement. Therefore, a repeated measures MANCOVA was conducted to investigate if there were differences in Figure-8 dribbling test score between the experimental and the control group after adjustment of the baseline measurement of the dribbling skill. In the MANCOVA, the baseline measurement was used as covariate, the type of a group (experimental/control) as independent, and the second, the third, and the fourth measurements as independent variables. The repeated measures MANCOVA for the Figure-8 dribbling test was not significant (Huynh-Feldt's F[1.75]=0.31, p=0.735, eta square=0.001), suggesting that after adjusting for differences in the baseline measurement of the dribbling skill, there were no differences between the experimental and the control group in any of the other measurements.

The MANOVAs for leaping, rope jumping, shuttle running, Figure-8 dribbling, accuracy throwing test scores as well as for locomotor and manipulative skills sum-scores demonstrated non-significant interaction between condition and time meaning that the intervention did not have an effect on such a variables in this study.

Physical activity. The MANOVA for the students' PA revealed significant interaction between condition and time (Huynh-Feldt's F[2.78]=2.77, p=0.044). Follow-up MANOVAs demonstrated that the experimental and the control group differed between the first and the fourth measure (Huynh-Feldt's F[1.00]=5.53, p=0.019), and between the second and the fourth measure (Huynh-Feldt's F[1.00]=5.92, p=0.016). The descriptive statistics revealed that the level of PA decreased in both groups from the first to the fourth measure. However, the decrease in the control group was greater, mostly due to the biggest drop between the third and the fourth measure.

Psychological variables. The MANOVAs for perceived PA competence, self-determined motivation, enjoyment, task-involving motivational climate, and ego-involving motivational climate demonstrated non-significant interaction between condition and time meaning that the intervention did not have an effect on students' psychological variables measured in this study.

TABLE 7 Descriptive statistics and repeated measures MANOVA results for FMS and PA.

Variable	Experimental group				Control group				RM-MANOVA (Condition x Time)		
	m1(sd)	m2(sd)	m3(sd)	m4(sd)	m1(sd)	m2(sd)	m3(sd)	m4(sd)	F(df)	p-value	Eta square
Flamingo standing (errors)	10.94 (5.15)	10.60 (5.02)	9.04 (4.16)	9.17 (4.44)	11.35 (4.79)	10.97 (4.90)	10.88 (4.89)	10.37 (4.55)	6.45 (2.85)	0.000	0.02
Rolling (sec.)	14.82 (2.99)	13.55 (2.63)	12.92 (2.36)	12.01 (2.27)	15.07 (3.09)	14.24 (2.91)	14.69 (2.87)	12.85 (2.63)	11.03 (2.71)	0.000	0.03
Leaping (cm)	875 (100)	881 (114)	884 (111)	921 (119)	865 (111)	855 (117)	859 (117)	895 (122)	2.49 (2.63)	0.068	0.01
Rope jumping (number of jumps)	35.03 (17.56)	37.34 (17.34)	38.73 (17.56)	42.27 (17.76)	33.25 (14.50)	37.08 (16.58)	37.47 (16.50)	41.00 (16.34)	0.70 (2.86)	0.547	0.00
Shuttle-running (sec.)	24.07 (2.12)	23.98 (2.21)	23.84 (2.23)	23.66 (2.33)	24.22 (2.13)	24.10 (2.52)	23.91 (2.51)	23.49 (2.35)	0.62 (2.95)	0. 601	0.00
Figure-8 dribbling (number of sides)	14.30 (2.85)	15.26 (2.93)	15.34 (2.96)	15.96 (2.89)	15.08 (3.04)	15.64 (2.96)	15.71 (3.09)	16.50 (3.07)	1.20 (2.85)	0.309	0.00
Accuracy throwing (points)	8.04 (3.64)	8.22 (4.09)	9.51 (4.52)	8.92 (4.18)	8.10 (4.21)	8.22 (3.91)	8.57 (4.21)	8.95 (3.65)	2.14 (2.96)	0.095	0.01
Balance skills sumscore (Z-scores)	0.02 (0.76)	0.06 (0.73)	0.28 (0.65)	0.12 (0.73)	-0.07 (0.75)	-0.07 (0.76)	-0.20 (0.79)	-0.14 (0.79)	14.77 (2.84)	0.000	0.04
Locomotor skills sumscore (Z-scores)	0.06 (0.75)	0.03 (0.81)	0.08 (0.82)	0.02 (0.77)	-0.02 (0.71)	-0.04 (0.76)	-0.02 (0.77)	-0.04 (0.75)	0.31 (2.87)	0.813	0.00
Manipulative skills sumscore (Z-scores)	-0.07 (0.76)	-0.03 (0.83)	0.03 (0.80)	-0.07 (0.82)	0.09 (0.87)	0.02 (0.79)	-0.01 (0.80)	0.04 (0.78)	2.39 (2.85)	0.071	0.01
All movement skills sumscore (Z-scores)	0.01 (0.60)	0.02 (0.63)	0.13 (0.62)	0.00 (0.62)	0.00 (0.62)	0.04 (0.62)	0.09 (0.65)	0.04 (0.64)	7.99 (2.91)	0.000	0.02
PA (days per week)	4.28 (1.64)	4.07 (1.59)	4.43 (1.56)	4.17 (1.68)	4.31 (1.65)	4.07 (1.79)	4.29 (1.62)	3.83 (1.59)	2.77 (1.00)	0.044	0.01

TABLE 8 Descriptive statistics and repeated measures MANOVA results for psychological variables of the study.

Variable	Experimental group				Control group				RM-MANOVA (Condition x Time)		
	m1(sd)	m2(sd)	m3(sd)	m4(sd)	m1(sd)	m2(sd)	m3(sd)	m4(ds)	F(df)	p-value	Eta square
Perceived PA competence	2.68 (0.76)	2.82 (0.83)	2.75 (0.86)	3.24 (0.75)	2.70 (0.87)	2.72 (0.88)	2.79 (0.89)	3.34 (0.74)	1.12 (1.80)	0.323	0.00
Self-determined motivation	2.53 (2.54)	2.11 (2.63)	1.50 (2.40)	1.67 (2.57)	2.16 (3.04)	1.77 (2.67)	1.00 (1.95)	1.52 (2.34)	0.81 (2.75)	0.480	0.00
Enjoyment	3.77 (1.02)	3.66 (1.02)	3.40 (0.95)	3.49 (0.99)	3.73 (1.05)	3.66 (0.94)	3.34 (0.78)	3.55 (0.87)	0.78 (2.93)	0. 502	0.00
Task climate	3.83 (0.70)	3.78 (0.77)	3.50 (0.72)	3.52 (0.82)	3.67 (0.88)	3.68 (0.81)	3.32 (0.69)	3.40 (0.71)	0.43 (2.87)	0.720	0.00
Ego climate	3.00 (0.81)	2.87 (0.81)	3.08 (0.73)	2.99 (0.82)	2.94 (0.87)	2.88 (0.87)	3.06 (0.72)	3.01 (0.71)	0.44 (2.96)	0.721	0.00

6 DISCUSSION

The main purpose of the study was to plan, implement, and evaluate FMS intervention for Finnish Grade 7 students' in school PE. More specifically, the aim of the study was to examine if the intervention effected on students' FMS, self-reported PA, and motivational variables. Additionally, the aim of the study was to investigate cross-sectional associations among students' FMS, self-reported PA, and motivational variables in the baseline measurement of the study at Grade 7.

6.1 Gender differences in students' fundamental movement skills, self-reported physical activity, and motivation

The first research aim was to investigate the gender differences in measured variables. In line with earlier findings (e.g., Thomas & French 1985; Toole & Kretzschmar 1993; Wieczorek & Adrian 2006) the current results revealed that the girls made fewer errors in the static balance skill task. The data also showed the boys rather than the girls had better dynamic balance skills compared with the girls. In motor behavior literature, there has been suggested that the girls have better balance skills than the boys (Toole & Kretzschmar 1993). However this study showed that this is not always the case because the results of static and dynamic balance skill test scores between the girls and the boys were different. This suggests that in the research, there is need to be more specific when speculating possible gender differences in balance skills.

Additionally, the girls received better results in rope jumping test compared with the boys. The boys, instead, scored higher in leaping test which finding is similar than in Nupponen and Telama's (1998) study for Finnish Grade 8 students. In this data, there were no differences in the shuttle-running test. It has been suggested that the boys' greater strength leads to better results on locomotor skill tests (Raudsepp & Pääsuke 1995). However, this suggestion was evident only in the leaping test scores of this study. Although it was not able to investigate students' activities outside school PE, it can be assumed that the girls' activities typically involve more rope jumping compared with the boys. It is also an interesting finding that there were no gender difference in the shuttle-running test scores because the shuttle-running test is normally rather dependent on the level of explosive strength. However, in this study, the shuttle running test was modified so that it was implemented both directions; forwards and backwards. This modification probably changed the test to emphasize more skill element of moving rather than explosive strength, which probably was at higher level in the boys' group.

The study also demonstrated that the boys scored higher in the Figure-8 dribbling test and the accuracy throwing test, further supporting existing evidence that has showed that boys outperform girls in manipulative skills, (Castelli & Valley 2007; Junaid & Fellowes 2006; Okely et al. 2001). In Finland, boys' and girls' sport and exercise activities typically differ from each other. The Finnish national survey on children's sport hobbies indicated that boys were more active in ball games and the most popular sporting hobbies among boys were football, ice-hockey, and floorball. In contrast, the main girls' hobbies were aerobics, gymnastics, horse-riding, dancing, and figure skating (Nuori Suomi 2006).

This study did not find significant differences between the girls and the boys in their level of PA engagement, whereas Samdal et al. (2007) found clear gender differences, with boys scoring higher in self-reported involvement in regular vigorous PA. A possible reason for these contradictory results might be that Samdal et al. (2007) measured vigorous PA across three age groups including 11-, 13-, and 15-year-old boys and girls while in the current study the focus was on only 13-year-olds. Previous evidence has shown that it is the older adolescent groups that demonstrate the greatest gender differences in engagement in PA (McQuillan & Campbell 2006). Furthermore, a large survey for 5505 3-18-years-old Finnish children and adolescents, investigating PA engagement, revealed that no gender differences emerged when all types of physical activities were analyzed (Nuori Suomi 2006), which suggests an atypical pattern of PA engagement may be demonstrated by Finnish children and youth.

The boys in the current study demonstrated higher levels of perceived PA competence, which is in accordance with previous international research (Biddle et al. 1993; Wang, Chia, Quek & Liu 2006), but not in Finnish research for Grade 9 students (Jaakkola 2002). This means that the Grade 7 boys feel themselves more confident in PE than the girls. Practically, this suggests that especially for the Grade 7 girls' it is important to implement teaching to support their perceptions of competence. The importance of perceived competence in the motivational processes toward self-reported PA in adolescence is evident because many studies have demonstrated the link between perceived competence and PA (Gao 2008; Halvari et al. 2009; Ommundsen & Eikanger-Kvalo 2007; Sallis et al. 2000).

Furthermore, this study did not find significant differences between the girls and the boys in enjoyment. Soini (2006) found, however, that in his sample of 15-year-old Finnish PE students, the boys rated PE as a more enjoyable experience than the girls. The difference in the age might be one reason why these two studies differ in the girls' and the boys' level of enjoyment. This study did not find also gender differences in self-determined motivation. Previous research in Finnish secondary school PE has shown contradictory results about the gender differences in self-determined motivation toward PE. However, it should be noticed that the students of this study were younger than in earlier studies. Finally, this study found gender differences in ego-involving motivational climate but not in task-involving motivational climate. Both results are according to previous Finnish research (e.g., Kokkonen 2003; Soini 2006) and shows that the boys' PE is more competitive than the girls' PE.

6.2 The relationships between enjoyment, perceived physical activity competence, fundamental movement skills, and physical activity (study 1)

The second aim of this study was to analyze the cross-sectional relationships between enjoyment, perceived PA competence, FMS, and PA engagement. Perceived PA competence was the only significant predictor of PA engagement at the first measurement of this study. This finding is in accordance with earlier studies demonstrating a positive association between perceived competence and PA (e.g., Bagoien & Halvari 2005; Carroll & Loumidis 2001) and suggestions that perceived competence is an antecedent of PA in the groups of children and adolescents (Sallis et al. 2000). The resultant association between perceived competence and students' PA engagement has several pedagogical implications. Strategies that PE teachers use can support student's competence in PE and, thus, may benefit their participation in PA, at least within school PE. In sport psychology, researchers have proposed the development of a task-involving motivational climate as an approach for promoting students perception of competence (Epstein 1989; Nicholls 1989; Roberts 2001). Intervention studies in which the purpose has been to increase task-involving motivational climate have also contributed to increases in participants' perceived competence in PA settings (Grieve, Whelan, Kottke & Meyers 1994; Theeboom et al. 1995; Wallhead & Ntoumanis 2004). Those interventions have applied TARGET model of Epstein (1989) to increase task-involving motivational climate in an activity. Although this study did not investigate the association between task-involving motivational climate, perceived competence, and PA, based on the results of earlier studies it can be recommended that teachers adopt the principles of task-involving motivational climate to support students' perceived competence and, as a consequence, their PA levels.

In contrast to previous research (e.g., Kremer et al. 1997; Wallhead & Buckworth 2004), enjoyment in PE was not a significant predictor of PA engagement. Wallhead and Buckworth (2004) found that enjoyment in school PE was related to motivation to adopt a physically active lifestyle outside school hours. A possible reason for the weak association between enjoyment in PE and PA engagement observed in the current data, is that enjoyment was evaluated in the specific context of PE, whereas the questions pertaining to engagement were related to more general exercise and PA behaviors. This suggests that Finnish adolescents may make the distinction between involvement in PE as an enjoyable learning and social activity, and PE as an opportunity to further engage in moderate to vigorous PA.

The finding of the regression analysis that FMS scores did not significantly predict engagement in PA is in contrast to previous research (e.g., Fisher, Reilly, Kelly, Montgomery, Williamson, Paton & Grant 2005; Okely et al. 2001; Wrotniak et al. 2006). In this study PA was only analyzed by self-report, and the information collected was limited to details regarding the number of days of engagement in moderate to vigorous PA per week. Fisher et al. (2005) and Wrotniak et al. (2006), for example, used accelerometers in analyzing PA in their studies. An additional issue may be that the FMS data was derived using only 13 years-olds. At this age the inter-student variation in physical development is substantial, and different individuals may be physically active but generate lower scores in relation to their peers in regards to locomotor and manipulative measures due the maturational status of attributes, such as strength or anaerobic capacity (Ozmun & Gallahue 2005).

6.3 The relationship among motivational climates, perceived competence, motivation toward physical education, and fundamental movement skills (study 2)

The third aim of the study was to investigate a sequentially framed set of relationships between motivational climate, perceived PA competence, self-determined motivation toward PE, and the FMS. More specifically, structural equation modeling was applied to investigate the theoretically proposed sequential process of motivation (Vallerand & Losier 1999). This study represents the first attempt to examine the motivational sequence model using FMS as outcome in secondary school PE.

A positive and indirect path was expected from a task-involving motivational climate through perceived PA competence and self-determined motivation to balance skill. This pattern was found and is consistent with the theoretical tenets of the achievement goal theory and the self-determination theory holding that a mastery supportive motivational climate influences perceived competence, which in turn affects motivation toward PE and subsequently leads to increased balance skill (Ames 1992; Deci & Ryan 1985, 2000). This finding supports existing suggestions of a pattern of ‘social factors > psychological mediators > motivation > consequences’ within the PE domain (Ntoumanis 2005; Ommundsen & Eikanger-Kvalo 2007; Standage et al. 2003b, 2005, 2006). Moreover, the result extends findings from previous studies that have taken advantage of the sequential mediation model while focusing on different outcomes (e.g., Cox & Williams 2008; Cury et al. 1996; Ommundsen & Eikanger-Kvalo 2007; Standage et al. 2006). Apparently, PE teachers are in a position to stimulate students' balance skill by emphasizing student effort, progress and learning. Such a climate seems to facilitate the stimulation of students' need for competence, in turn stimulating more self-determined forms of motivation, and finally balance skill.

The additional path observed consisting of a high task-involving climate – enhanced self-determined motivation – improved balance skill reflects that the enhancement of students' balance skill is not contingent on students' competence perceptions provided that their motivation toward the PE tasks seems relatively intrinsically regulated. Indeed, intrinsically regulated motivation is seen as eliciting effort and perseverance (Deci & Ryan 2000), both important factors for students in order to learn movement skills.

The full sequential model was only partly supported when using manipulative and locomotor skills as outcomes. In both cases students' perceived PA competence was found to play a mediation role. The link between competence and movement skills is consistent with previous research reporting that individuals who are confident in relation to their motor skills typically achieve higher scores on measures of actual motor competence and motor skills (e.g., Castelli et al. 2007; Ebbeck & Becker 1994). Apparently, while the enhancement of balance skill seems contingent on autonomous forms of motivation, satisfying students' need to feel competent seems the key toward the enhancement of manipulative and locomotor skills. It might well be that the learning of manipulative and locomotor skills are the types of tasks that require that students' perceive themselves to have the confidence and the physical capacity needed to develop those specific motor skills. Indeed, in terms of coordination complexity, these two motor skills should be regarded as more challenging than rather simple static balance task. However it is important to acknowledge that the amount of variance accounted for in movement skills by the sequentially framed set of determinants was rather modest.

It was also hypothesized that high ego-involving climate would lead to reduced FMS paths, mediated by lower perceived PA competence and elevated levels of extrinsically regulated motivation. No one of these paths was supported. Instead, a positive direct path, albeit modest in size, was found between an ego-involving motivational climate and locomotor skills. Apparently, a class climate perceived to be focused on social comparison, competition and being the best did not represent any hindrance for these students when it comes to fundamental movement skill performances. For manipulative skills, ego-involving climate facilitated students' performances. It could be that the two opportunities to practice permitted before the test on this skill elicited social comparison among the students' for this particular motor skill test, thus mildly favoring those perceiving the climate as ego-involving.

The amount of variance accounted for in balance skill was higher for RAI (4 percent) (proximal determinant) than for perceived competence (2.3 percent) (more distal determinant) and for task-involving climate (2.3 percent) (most distal determinant). This pattern of findings supports Vallerand and Losier's (1999) suggestions that proximal factors in the motivational process should be stronger predictors of behavioral outcomes than distal factors.

It is also noteworthy that task-involving climate and perceived competence together explained 45 percent of the variance of self-determined motivation toward PE. This finding is important from the pedagogical perspective and suggests that one of the most powerful means to affect students' motivation in PE is to enhance their perceived competence by creating a task-involving motivational climate. The pattern of associations is in line with previous studies in the PE context and demonstrates that conditions in which the teacher emphasizes effort, trying hard, learning and progress contributes toward students' behavioral practices to be self-determined in PE (Ntoumanis 2001; Ommundsen & Eikanger-Kvalo 2007).

6.4 Cluster groups: Fundamental movement skills, perceived physical activity competence, self-determined motivation, and cluster differences in physical activity (study 3)

The fourth task of the study also was to identify groups within a sample of adolescents based on their FMS, perceived PA competence, and self-determined motivation toward PE. Additionally, the fifth aim of this study was to analyze variations among these groups in relation to their self-reported PA. A review of studies using cluster analysis in the context of health and PE shows attributes associated with PA and motivation (Biddle & Wang 2003; Murcia, Gimeno & Coll 2007; Wang, Chatzisarantis, Spray & Biddle 2002) have received attention but no researchers have evaluated PA differences between children profiled on the basis of their motor skills.

Cluster analysis gave three profiles: Cluster 1 profile, students with low skills and low motivation; Cluster 2 profile, students with high skills and low motivation; and Cluster 3 profile, students with high skills and high motivation. The Cluster 3 group had significantly higher self-reported engagement in PA than the other two profiles. These results provide support for previous claims regarding the importance of the relations of FMS with continuing engagement in PA (Okely et al. 2001; Stodden et al. 2008). The low-skill group was the least active and as a consequence maybe at higher long-term health risk due to their physical inactivity (Okely et al. 2001). FMS provide young people with basic skills to engage successfully in physical activities and must remain as a foundation element within the spectrum of prerequisites for the on-going maintenance of health for all individuals. Unexpectedly, the Cluster 2 group, who demonstrated high FMS, also reported low PA. This suggests that high FMS alone may be insufficient to maintain participation among PA in adolescents. Low motivation toward PE may contribute to disinterest in continuing engagement in school-based PA. It is important pedagogically that schools maintain clear focus on the PE and school PA environments to provide experiences which positively motivate children toward regular engagement in moderate to vigorous PA (McKenzie 2007). Additionally, the lack of involvement in activity reported by this group may confound their perceptions of perceived PA competence. This group's limited use of opportunities to engage in physical activities reduces the chance for them to observe and make judgments on their own skill, so, they might choose to rate their competencies as low (Stodden et al. 2008; Wrotniak et al. 2006).

It should be noticed that in this dissertation the results of the study 3 were different comparing with the study 1, which suggested that FMS were not a significant predictor of PA engagement. However, the study 3 found that the FMS are related to students' PA engagement. The difference in the results between study 1 and study 3 are probably caused by different statistical methods. In the study 1, all students formed the research group, whereas study 3 searched for subgroups of students based on their FMS and motivation, and utilized these subgroups when analyzing the association between cluster characteristics and PA engagement. The results of the study 3 demonstrated that in PE, there can be found subgroups of students with different skill level and motivation, and these subgroups vary in their level of PA engagement. This finding suggests that the studies incorporating FMS, PA, and motivation in school PE, should consider utilizing statistical methods which take into account individual variation in these variables.

6.5 The development of fundamental movement skills, self-reported physical activity, and motivational variables during the intervention (study 4)

The final aim of this study was to investigate whether students' FMS, the level of their self-reported PA, and motivational variables measured in this study developed during the intervention aiming to improve students' FMS.

The results of the study revealed that the intervention group improved both in static and dynamic balance during the intervention. An improvement was also evident in the balance skill sum score, in which static and dynamic balance scores were standardized by using Z-scores, and summed together. However, after the intervention, dynamic balance and balance skill sum score developed more positively within the control group. Although the change occurred after the intervention, the experimental group remained at higher level in dynamic balance and balance sum score in the retention test. This result probably implies that static and/or dynamic balance need constant practice in order to sustain the gains of FMS training or that it takes more practice time in order to stabilize those balance performance scores in higher levels. Moreover, although no longitudinal studies of fundamental skills in teenagers have been reported, it needs to have in mind that balance (both static and dynamic) can be affected by the rate of growth. It is widely known that teenagers are gaining height at this age and usually these changes happen mostly during the summer season, which was in between the third and fourth wave of measurement. It can be then hypothesize that students' balance skills at this age are not stable even after a FMS training period due to changes in growth (e.g., increase in height).

Concerning self-reported PA, the decrease in the control group was significantly greater, mostly because of the biggest drop between the third and the fourth measurement. Although the effect size was small, the FMS intervention seemed to prevent the typical decline in PA within secondary school aged students (Telama & Yang 2000). That decline was also evident in the control group of this study. These findings support previous research findings showing that FMS and PA are related with each other (Barnett et al. 2008a, 2008b; McKenzie et al. 2002; Raudsepp & Päll 2006; Sääkslahti et al. 1999).

An interesting finding in this study was that balance skills rather than locomotor and manipulative skills developed during the intervention. This implies that locomotion or manipulation skills may need more time in order to progress significantly. Locomotor performances, such as running, leaping, and skipping, require certain levels of explosiveness and strength to be executed properly. Manipulative skills can be seen as more complex than balance skills because they raise issues on perceptional demands (Nessler 1973), and thus require more practice to be improved.

Regarding the dribbling test scores, it should be noticed that there were differences between the experimental and the control group in the baseline measure. That fact may have affected the results. However, the multivariate covariance analysis revealed that after the adjustment of the original differences, there were no differences on the dribbling skill between the experimental and the control group. This could be explained by the fact that dribbling skill is very common in several subjects of the PE curriculum and in several out-of-school sport activities for example in handball and in basketball. This implies that students both in the experimental and control group practice dribbling skills rather regularly and probably with almost the same amount of repetitions throughout the year.

The time invested in improving students' FMS was rather limited, including approximately 33 x 25 minutes practice during the academic year. Being able to affect students' balance skills and the level of their self-reported PA by a curriculum alteration in a naturalistic school PE setting gives the teachers and curriculum developers a strong positive message. Although only balance skills improved due to the intervention, the results of this study encourage PE teachers to develop PE class activities in which students may improve their FMS in order to promote their PA. Thus, developing FMS should be one of the major aims of school PE. Today this is even more important because children and adolescents are physically more inactive than ever before (Samdal et al. 2007).

The study results also demonstrated that the motivational variables analyzed in this study did not change during the intervention. These results demonstrate that although the study implemented rather structural and goal oriented PE curriculum, the students in the experimental group still perceived PE as motivating as in the control group. These findings suggest that practicing FMS in PE does not decrease students' PE motivation.

6.6 Limitations of the study

The use of self-reports in analyzing PA is the main limitation in this study. However, self-reports were the only viable instruments available for the study purpose where PA was analyzed four times with a rather large sample. The use of more objective measures would have been logistically and financially impossible. Another limitation in the study is that not all of the tests aimed to measure students' FMS have been proven as reliable in previous studies. Although this limitation exist, in this study individual test items correlated rather highly with the sum score of the respective FMS category, reflecting adequate reliability of individual tests in this study. It is also a limitation that all FMS tests were product-oriented rather than process-oriented measures. The use of product-oriented measures might be considered as limitation in the studies for young adolescents (Okely et al. 2001). However, process-oriented tests break down skills, such as the running and leaping, into specific observable components (e.g., Ulrich 2000) and are more complex and difficult to administer. The final limitation of this study is that the effect sizes of the analyses of the intervention were rather small. Therefore, the results should be interpreted cautiously.

6.7 Future studies

Future studies need to examine children's and adolescents' movement skill development in a longitudinal design. This would provide more complete understanding of the meaning of FMS and their relationship with students' PA levels and children's growth rates. In future it would be also beneficial to further study the effect of motivational and motor skill factors on PA engagement patterns using a longitudinal design and involving samples from the three key stages of adolescence (i.e., early, middle, late). This would give us important information on the development of the antecedents of PA participation in school students. Additionally, PE based intervention studies (e.g., motivational climate) structured to evaluate the effect of improving students' perceived competence as a strategy for the promotion of adolescent engagement in PA are needed. There is also a need to develop tests in PE to better capture students' FMS. One possibility would be using process-oriented (quality of the movement) rather than product-oriented (quantity or outcome of the movement) tests. Additionally, in future it would also be important to include climate dimensions pertaining to autonomy support and social relatedness in studies applying motivational sequence model when examining determinants of motor skills. This might provide produce important information as to whether other qualities of the social context add to the prediction of fundamental motor skills in PE.

TIIVISTELMÄ

Perusliikuntataidot, fyysinen aktiivisuus ja motivaatiotekijät koululiikuntaa kohtaan: perusliikuntataitointerventio.

Tutkimuksen tarkoituksena oli analysoida muutoksia koululaisten motorisissa perustaidoissa, itse raportoidussa fyysisessä aktiivisuudessa ja koululiikuntaa kohtaan koetussa motivaatiossa yhden lukuvuoden mittaisen, liikuntatunneilla toteutetun intervention seurauksena. Tutkimus oli luonteeltaan kvasikokeellinen interventiotutkimus, jossa koe- ja kontrolliryhmiä arvioitiin neljällä mittauskerralla (alku-, väli-, loppu- ja jälkimittaukset). Lisäksi tutkimuksen tarkoituksena oli tarkastella koululaisten motoristen perustaitojen, itseraportoidun fyysisen aktiivisuuden ja motivaatiomuuttujien välisiä yhteyksiä alkutilanteessa 7. vuosiluokalla. Tutkimusryhmään kuului 446 suomalaista 7. luokan oppilasta. Koeryhmässä oli 199 oppilasta (110 tyttöä ja 89 poikaa) yhden koulun yhdeksältä eri luokalta ja neljältä eri liikunnanopettajalta. Kontrolliryhmässä oli 247 oppilasta (120 tyttöä ja 127 poikaa) kahden koulun 13 eri luokalta ja kuudelta liikunnanopettajalta. Koehenkilöt suorittivat seitsemän motorista perustaitotestiä ja he vastasivat kyselyihin, jotka olivat itsearvioitu fyysinen aktiivisuus, sisäisen motivaation mittari (Sport Motivation Scale), liikuntapätevyys -alaskaala koetun fyysisen pätevyyden mittarista, motivaatioilmastomittari (Motivational Climate in School Physical Education Questionnaire) ja viihtyvyysmittari (Sport Enjoyment Scale). Intervention jälkeen koe- ja kontrolliryhmien välillä oli eroja staattisessa ja dynaamisessa tasapainossa ja perusliikuntataitosummamuuttujassa. Koeryhmä osoitti kontrolliryhmää positiivisempaa kehitystä näissä muuttujissa. Lisäksi koeryhmä kehittyi intervention aikana itseraportoidussa fyysisessä aktiivisuudessa, kun kontrolliryhmän fyysinen aktiivisuus aleni. Tytöt saavuttivat poikia parempia tuloksia staattisessa tasapainossa ja naruhyppelytestissä, ja pojat saivat tyttöjä parempia tuloksia dynaamisessa tasapainossa, loikkaamisessa, tarkkuusheitossa ja 8-kuljetustestissä sekä koetussa liikuntapätevyydessä ja minä-suuntautuneessa motivaatioilmastossa. Koettu liikuntapätevyys oli ainoa merkitsevä fyysisen aktiivisuuden ennustaja. Perusliikuntataidot ja itsemääräämismotivaatio eivät olleet merkitseviä aktiivisuuden ennustajia. Tulokset tukivat myös nelivaiheista motivaatiomallia ja osoittivat että tehtäväsuuntautunut motivaatioilmasto oli vahva koetun liikuntapätevyyden ja itsemääräytyneen liikuntamotivaation ennustaja. Suomalaisista 7. vuosiluokan liikuntatuntien koululaisista löydettiin kolme klusteriryhmää: 1) koululaiset, joilla on heikot taidot ja matala motivaatio, 2) koululaiset, joilla on hyvät taidot ja matala motivaatio ja 3) koululaiset, joilla on hyvät taidot ja korkea motivaatio. Klusterilla 3 oli merkitsevästi korkeampi itseraportoitu fyysinen aktiivisuus kuin kahdella muulla klusterilla. Tämä tutkimus osoitti, että yläkoulun liikunnan opetuksessa olisi tarvetta painottaa koululaisten motoristen perustaitojen opetusta. Kohentuneet taidot saattaisivat olla yksi fyysisen aktiivisuuden laskua ehkäisevä tekijä nuoruusiässä.

Avainsanat: liikunnan opetus, fyysinen aktiivisuus, perusliikuntataidot, motivaatio

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APPENDICES

Appendix A.

Instrumentation in Finnish

The Finnish Version of the Physical Activity Scale

Seuraavassa kysymyksessä liikunnalla tarkoitetaan kaikkea sellaista toimintaa, joka nostaa sydämen lyöntitiheyttä ja saa sinut hetkeksi hengästymään esimerkiksi urheillessa, ystävien kanssa pelatessa, koulumatkalla tai koulun liikuntatunneilla. Liikuntaa on esimerkiksi juokseminen, ripeä kävely, rullaluistelu, pyöräily, tanssiminen, rullalautailu, uinti, laskettelu, hiihto, jalkapallo, koripallo ja pesäpallo.

Mieti tyypillistä viikkoasi. Merkitse kuinka monena päivänä olet liikkunut **vähintään 60** minuuttia päivässä?

□□□□□□□□
0 1 2 3 4 5 6 7
päivänä

Mieti edellistä 7 päivää. Merkitse kuinka monena päivänä olet liikkunut **vähintään 60** minuuttia päivässä?

□□□□□□□□
0 1 2 3 4 5 6 7
päivänä

The Finnish version of the Sport Motivation Scale

Ympyröi seuraavista väittämistä yksi vaihtoehto, joka parhaiten
vastaa sinun käsitystäsi:
Syy miksi osallistun koululiikuntaan**…**
1=Täysin eri mieltä… 5= Täysin samaa mieltä

1. Mielihyvän takia, jota saan jännittävistä kokemuksista
2. Mielihyvän takia, jota tunnen kun opin uusia asioita
3. Minulla oli aikaisemmin hyviä syitä liikkua, mutta nyt mietin onko tässä enää ”järkeä”
4. Mielihyvästä, jota tunnen kun löydän uusia harjoittelutapoja
5. Minulla on käsitys, etten pysty menestymään liikunnassa
6. Koska se saa minulle tutut ihmiset arvostamaan minua
7. Koska mielestäni se on yksi parhaista tavoista tavata ihmisiä
8. Koska olen tyytyväinen, kun opin jonkin vaikean harjoittelutekniikan
9. Koska on todella tarpeellista harrastaa liikuntaa, jos haluaa pysyä kunnossa
10. Etuoikeudesta olla urheilija
11. Koska se on yksi parhaista valitsemistani tavoista kehittää elämäni muita osa-alueita
12. Mielihyvästä jota saan kun parannan heikkoja kohtiani
13. Jännityksestä jota tunnen kun osallistun toimintaan
14. Koska minun täytyy harrastaa liikuntaa, että voin olla tyytyväinen itseeni
15. Tyytyväisyydestä jota koen kun parannan kykyjäni
16. Koska minulle läheiset ihmiset ajattelevat, että on tärkeää pysyä kunnossa
17. Koska se on hyvä tapa oppia paljon asioita, jotka voivat olla hyödyllisiä elämän muillakin alueilla
18. Voimakkaiden tunteiden takia, joita tunnen kun harrastan jotain mistä pidän
19. Se ei ole minulle enää selvää. En tunne että paikkani on liikuntatunnilla
20. Mielihyvästä, jota tunnen vaikean tehtävän suorittamisen jälkeen
21. Koska tuntuisi pahalta jos minulla ei olisi enää aikaa tehdä sitä
22. Näyttääkseni muille kuinka hyvä olen liikunnassa
23. Mielihyvästä, jota tunnen kun opin tekniikan jota en ole aikaisemmin yrittänyt
24. Koska se on yksi parhaista tavoista pitää suhteita yllä ystävieni kanssa
25. Koska pidän tunteesta olla täysin syventynyt toimintaan
26. Koska minun täytyy harrastaa liikuntaa säännöllisesti
27. Mielihyvän tunteesta jota uusien suoritusmenetelmien löytäminen aikaansaa
28. Mietin usein itsekseni: En pysty saavuttamaan itselleni asettamiani tavoitteita

The Finnish version of the Physical Self-Perception Profile

Millainen liikkuja olen?

Vastaa seuraavaan itseäsi koskevaan kysymykseen mahdollisimman tarkasti
Ympyröi seuraava yksi vaihtoehto, joka parhaiten vastaa sinun käsitystäsi:

(esim. olen vaalea	1	2	3	4	5	olen tumma)
1. Olen hyvä liikunnassa	1	2	3	4	5	Olen huono liikunnassa
2. Olen mielestäni yksi parhaimmista liikunnassa	1	2	3	4	5	Kuulun taidoiltani heikoimpiin liikunnassa
3. Olen itsevarma urheilu-tilanteessa	1	2	3	4	5	En luota itseeni urheilutilanteissa
4. Olen kyvykkäimpien joukossa valittaessa oppilaita urheilutehtäviin	1	2	3	4	5	En kuulu niihin oppilaisiin, joita valitaan (kilpailut, pelit ym.) urheilutehtäviin
5. Olen ensimmäisten joukossa, kun tarjoutuu mahdollisuus päästä suorittamaan urheilutehtäviä	1	2	3	4	5	Vetäydyn taka-alalle, kun tarjoutuu mahdollisuus päästä suorittamaan urheilutehtäviä

The Finnish version of the Sport Enjoyment scale

Mielipiteeni liikuntatunneista

1 = Täysin eri mieltä… 5 = Täysin samaa mieltä

Pidän liikuntatunneista
Liikuntatunneilla on hauskaa
Liikuntatunnit tuovat minulle iloa
Nautin liikuntatunneista

The Finnish version of the Motivational Climate in School Physical Education Scale (MCSPES)

Seuraavassa sinua pyydetään arvioimaan itseäsi ja omia käsityksiäsi koulun liikuntatunneista.

Ympyröi numero, joka parhaiten vastaa käsitystäsi.

1=Täysin eri mieltä… 5=Täysin samaa mieltä

1. Oppilaille on tärkeä yrittää parhaansa liikuntatunneilla
2. Pääasia on, että kehitymme vuosi vuodelta omissa taidoissamme
3. Uuden oppiminen kannustaa minua oppimaan yhä enemmän
4. Liikuntaryhmämme on yhtenäinen
5. Oppilaille on tärkeää näyttää muille olevansa parempia liikuntatunneilla kuin toiset
6. Oppilailla on merkittävästi päätösvaltaa liikuntatunneilla
7. Liikuntaryhmämme on yhtenäinen toimiessaan liikuntatunneilla
8. Liikuntatunneilla oppilaat vertaavat suorituksiaan pääsääntöisesti toisten suorituksiin
9. Oppilaat todella toimivat yhtenä ryhmänä
10. Oppilaille on tärkeää yrittää parantaa omia taitojaan
11. Oppilailla on mahdollisuus vaikuttaa liikuntatuntien toteutukseen
12. Liikuntatunneilla oppilaat ”puhaltavat yhteen hiileen”
13. On tärkeää jatkaa yrittämistä, vaikka olisi tehnyt virheitä
14. Oppilaille on tärkeää onnistua muita oppilaita paremmin
15. Oppilailla on merkittävästi valinnan vapauksia liikuntatunneilla
16. Liikuntatunneilla oppilaat kilpailevat suorituksissa toistensa kanssa
17. Oppilailla on mahdollisuus valita harjoitteita oman mielenkiinnon mukaan
18. Oppilaat voivat vaikuttaa liikuntatuntien kulkuun

Appendix B.

Instrumentation in English

Physical Activity Scale

In the next two questions physical activity means all activities which raise your heart rate or momentarily get you out of breath, for example, in doing exercise, playing with your friends, going to school, or in school physical education. Sport also includes, for example, jogging, intensive walking, roller skating, cycling, dancing, skating, skiing, soccer, basketball, and baseball.

When you think about your typical week, on how many days are you physically active for a total of *at least 60 minutes* per day?

□□□□□□□□
0 1 2 3 4 5 6 7
days

Over the past 7 days, on how many days were you physically active for a total of *at least 60 minutes* per day?

□□□□□□□□
0 1 2 3 4 5 6 7
days

Sport Motivation Scale

Using the scale below, please circle the number that best describes your values concerning various school subjects.

Why am I currently participating in physical education?

1=Strongly disagree… 5= Strongly agree

1. For the pleasure I feel in living exciting experiences
2. For the pleasure it gives me to know more about the sport skills that I practice
3. I used to have good reasons for participating in PE, but now I am asking myself if I should continue doing it
4. For the pleasure of discovering new training techniques
5. I don't know anymore; I have the impression that I'm incapable of succeeding in PE
6. Because it allows me to be well regarded by people that I know
7. Because, in my opinion, it is one of the best ways to get acquainted with others
8. Because I feel a lot of personal satisfaction while mastering certain difficult training technique
9. Because it is absolutely necessary to do sports if one wants to be in shape
10. For the prestige of being an athlete
11. Because it is one of the best ways I have chosen to develop other aspects of myself
12. For the pleasure I feel when I improve some of my weak points
13. For the excitement I feel when I'm really involved in the activity
14. Because I must do sports to feel good about myself
15. For the satisfaction I experience when I am perfecting my abilities
16. Because people around me think it is important to be in shape
17. Because it is a good way to learn lots of things which could be useful to me in other areas of my life
18. For the intense emotions that I feel when I am doing sports that I like
19. It is not clear to me anymore; I don't really think my place is in PE
20. For the pleasure that I feel when executing certain difficult movements
21. Because I would feel bad if I was not taking time to do it
22. To show others how good I am at sport
23. For the pleasure that I feel when learning skills that I have never tried before
24. Because it is one of the best ways to maintain good relationships with my school friends
25. I like the feeling of being totally immersed in the activity
26. Because I must do sports regularly
27. For the pleasure of discovering new performance strategies
28. I often ask myself; I can't seem to achieve the goals that I set for myself

Physical Self-Perception Profile

What am I like:

1. I'm good at sport	1	2	3	4	5	I'm not good at sport
2. I'm among the best when it comes to athletic ability	1	2	3	4	5	I'm not among the best when it comes to athletics
3. I feel confident when - it comes to taking part in sport activities	1	2	3	4	5	I feel not confident when it comes to taking part in sport activities
4. I'm among the best when it comes to joining in sport activities	1	2	3	4	5	I'm not among the best when it comes to joining in sport activities
5. I'm among the first to join in sport activities	1	2	3	4	5	I draw back when it comes to join in sport activities

Sport Enjoyment scale

Please read each of the statements carefully and respond to them in terms of how you view your PE lessons. Circle the number that best represents how you feel.

1 = Strongly disagree … 5 = Strongly agree

I like PE lessons
I have fun during PE lessons
PE lessons make me happy
I enjoy PE lessons

Motivational Climate in School Physical Education Scale (MCSPES)

Please read each of the statements carefully and respond to them in terms of how you view your PE lessons. Circle the number that best represents how you feel.

1 = strongly disagree … 5 = strongly agree

1 It is important for the pupils to try their best during PE lessons
What's most important is that we progress every year in our own skills
2 Learning new things makes me want to learn more
3 Our PE class has a good sense of unity
4 It is important for the pupils to show that they are better in PE than others
5 Pupils have a significant role in decision making in PE lessons
6 Our PE class is united when practicing during PE lessons
7 During PE lessons pupils compare their performance mainly to that of others
8 Pupils really "work together" as a team
9 It is important for the pupils to try to improve their own skills
10 Pupils are given the opportunity to affect the way PE lessons are run
11 During PE lessons the pupils "pull together"
12 It is important to keep trying even though you make mistakes
13 It is important for the pupils to succeed better than the others
14 Pupils have a remarkable freedom of choice during PE lessons
15 During PE lessons the pupils compete with each other in their performances
16 Pupils are given the opportunity to select activities according to their own interest
17 Pupils can affect the course of PE lessons

Appendix C.

The content of the intervention

Week	Skill category	Main fundamental movement skill
34	motor tests	
35	locomotor skills	running, jumping, leaping
36	locomotor skills	running, jumping, leaping, galloping
37	locomotor skills	running, jumping, leaping
38	manipulative skills	kicking, punting, catching
39	manipulative skills	throwing, catching
40	locomotor skills	walking, running
41	locomotor skills	walking, running
42	autumn holiday	
43	locomotor skills	walking running
44	locomotor skills	climbing, landing
45	manipulative skills	bouncing, ball rolling, throwing, dodging, turning
46	manipulative skills	bouncing, ball rolling, throwing, dodging, turning
47	balance skills	landing, balancing, stretching, rolling
48	balance skills	rolling, piking, stretching
49	balance skills	turning, rolling
50	balance skills	landing, dodging, balancing
51	christmas holiday	
52	christmas holiday	
1	motor tests	
2	manipulation skills	dribbling, throwing, catching
3	manipulation skills	hitting, throwing, catching
4	manipulation skills	hitting, throwing, catching
5	balance skills	swinging, landing
6	balance skills	landing, balancing
7	locomotor skills	gliding
8	skiing holiday	
9	locomotor skills	gliding
10	balance skills	swinging, landing
11	balance skills	inverted supports, balancing
12	manipulation skills	throwing, catching
13	manipulation skills	hitting, volleying
14	balance skills	dodging, balancing
15	balance skills	rolling, turning
16	balance skills	rolling, turning
17	locomotor skills	climbing, dodging
18	locomotor skills	Jumping, turning
19	manipulation skills	throwing, catching
20	manipulation skills	dribbling, ball rolling
21	motor tests	

Appendix D.

Examples of the intervention contents

Week 37
Locomotor skills (running, jumping, leaping)

Warm-up Ultimate-game
Exercises (every jump 10 times, then recovery):
- normal jumping Jacks
- jumping Jacks / legs in 1-2 rhythm / arms 1-2-3 rhythm, change at auditive signal to 1-2 rhythtm and back
- jumping Jacks with skiing technique = legs and arms move in front-back direction
- jumping Jacks legs sideways – arms front-back
- jumping Jacks legs front-back – arms sideways
- skating jumps 3 x 10
- calf jumps 3 x 10
- low starts (concentration in staying low and leaning forward) 4 x 20 m
- acceleration-rolling- sprints (acceleration 10 m – relaxed running 10 m – acceleration 10m – relaxed running 10 m) 4 x
- jumps backwards 3 x 10
- leaps backwards 3 x 10

Week 47
Balancing skills (landing/balancing/stretching/rolling)

On gymnastics mat:
- forward rolls
- backward rolls
- forward roll-step to balance scale, both sides
- horizontal rolls left / right
- On the floor:
- trying the correct landing position (=flexing ankles, knees, hip, arms in side)
- jump + landing – free testing
- jump + silent landing (=guided discovery to use of ankles)
- Jump from step-board – landing on gymnastic mat, aim to learn safe falling technique:
- jump down – parachute roll
- starting sideways, jump down + roll sideways
- starting backwards, jump down + roll backwards
- Jump from step-board / all landings to ”perfect balance”:
- basic jump
- basic jump with half twist / right and left

- basic jump backwards
- basic jump sideways
- basic jump with full twist / right and left
- all above mentioned jumps eyes closed

Week 45
Manipulative skills (bouncing / ball rolling / throwing / dodging / turning)

Warm up:
- dodgeball with ball rollingpolttopallo vierittämällä
    - similar balls in the beginning
    - more balls, different balls
    - unsymmetric balls
    - rolling only with non-dominating hand

Dribbling:
- dribbling with hand changing
- dribbling in low position kahdella samanlaisella pallolla kuljetus
- dribbling with two different balls (basketball and tennisball)

Examples of the intervention contents in Finnish

Viikko 37
Viikon teema LIIKKUMISTAIDOT (juokseminen, tasaponnistus, vuoro ponnistus)

Alkuverryttelynä ultimate

Harjoitteet (jokaista hyppyä aina n. 10 kpl, jonka jälkeen pieni palautus) :
- tavalliset haara-perushypyt
- haara-perushypyt / jalat 1-2 –rytmissä, kädet 1-2-3 –rytmissä, äänimerkistä vaihto 1-2 rytmiin ja takaisin
- haara-perushypyt hiihtotekniikalla = jalat ja kädet liikkuvat eteen-taakse –suunnassa
- haara-perushypyt jalat sivusuunnassa – kädet eteen taakse
- haara-perushypyt jalat eteen-taakse – kädet sivusuunnassa
- luisteluhypyt 3 x 10
- pohjehypyt 3 x 10
- matalana lähdöt (keskittyminen alhaalla pysymiseen ja eteenpäin kallistuneeseen asentoon) 4 x 20 m
- kiihdytys-rentous –juoksut (alkukiihdytys 10 m – rento rullaus 10 m – kiihdytys 10m – rentous 10m) 4 x
- tasaloikat takaperin 3 x 10
- vuoroloikat takaperin 3 x 10

Viikko 47
Viikon teema TASAPAINOTAIDOT
(alastulo/tasapainoilu/ojentaminen/kieriminen

Pitkällä rullamatolla:
- kuperkeikat eteenpäin
- kuperkeikat taaksepäin
- eteenpäin kuperkeikasta askel vaakaan, vuorotellen oikealla ja vasemmalla jalalla
- kierimiset vasemmalle
- kierimiset oikealle
- Lattialla:
- oikean alastuloasennon hakeminen (=jousto nilkoista, polvista ja lantiosta, kädet sivulla)
- tasaponnistuksesta alastulo – vapaata kokeilua
- tasaponnistuksesta äänetön alastulo (=ohjattu oivaltaminen nilkan käyttöön)

Steppilaudalta tasahyppy – alastulo rullamatolle, tavoitteena oppia turvallinen kaatuminen joka suuntaan:

- -hyppy alas + laskuvarjohyppääjän kuperkeikka
- -lähtöasento sivuttain, hyppy alas + kierähdys sivulle
- -lähtöasento selin, hyppy alas + taaksepäin kuperkeikka

- Steppilaudalta jännehypyt matolle / kaikki alastulot kontrolloidusti tasapainoiseen alastuloasentoon, ”paikkaan”:
- -tavallinen jännehyppy
- -jännehyppy ½ käännöksellä, vuorotellen kääntyminen oikealle ja vasemmalle
- -jännehyppy lähtö takaperin
- -jännehyppy lähtö sivuttain
- -jännehyppy kokokäännöksellä / vasemmalle ja oikealle

- -samat kuin edellä silmät suljettuina

Viikko 45
Viikon teema VÄLINEEN KÄSITTELYTAIDOT
(pomputtelu/vierittäminen/heittäminen/väistäminen/kääntyminen)

Alkuverryttely:

- polttopallo vierittämällä
    - aluksi muutamalla samanlaisella pallolla
    - palloja lisää, erilaiset pallot
    - epäkesko- ja epäsäännöllismuotoiset pallot (=oranssit möhkälepallot, siniset epäkeskopallot)
    - sääntöjen ”tiukentaminen” -> vain huonommalla kädellä vieritys

Pallon kuljetus:

- pomputtamalla pallon kuljetus salin toiseen päähän – toisella kädellä kuljetus takaisin
- pallon kuljetus pomputtamalla – viivojen väli matalaa kuljetusta
- kahdella samanlaisella pallolla kuljetus
- kahdella erilaisella pallolla kuljetus (esim. kori- ja tennispallo), välillä pallojen vaihto kädestä toiseen

Appendix E.

Parental consent in Finnish

Motoristen taitojen kehittämishanke koululiikunnassa –tutkimus

Arvoisa kotiväki

Teen väitöskirjaa aiheesta "Motoristen taitojen kehittämishanke koululiikunnassa" Jyväskylän Yliopiston Liikuntatieteiden laitokselle. Tutkimusta johtaa lehtori Timo Jaakkola. Tutkimuksen kohteena ovat Kilpisen ja Kuokkalan koulujen 7. luokkien oppilaat lukuvuonna 2007 – 2008..

Tutkimuksessa selvitetään voiko liikunnallisten perustaitojen oppimista tehostaa opetussuunnitelmalla, jossa lähtökohtana ovat motoriset perustaidot liikuntalajien sijaan. Kilpisen koulun 7. luokkalaisten liikuntatunneilla taitojen opettaminen toteutetaan edellä mainitusta lähtökohdasta käsin, Kuokkalan koulussa opetus tapahtuu perinteiseen tapaan liikuntalajilähtöisesti. Tutkimukseen kuuluu motoristen taitojen testaaminen ja taustatieto- ja motivaatiokyselyjen täyttäminen kolme kertaa vuodessa. Motorisilla perustaidoilla tarkoitetaan liikkumis- (esim. juokseminen), tasapaino- (esim. kieriminen) ja välineenkäsittelytaitoja (esim. heittäminen). Tutkimuksessa käytettävä testipatteri toteutetaan koulun normaalilla liikuntatunnilla koulun salissa osana normaalia liikunnan opetusta. Testikerta kestää yhden kaksoistunnin. Motoristen taitojen testit ovat luonteeltaan hyvin yksinkertaisia, eikä niihin tarvitse valmistautua mitenkään. Testaamisesta ei aiheudu oppilaille minkäänlaisia seuraamuksia. Esimerkkejä taitotesteistä ovat mm. tarkkuusheitto, yhden jalan seisonta ja hyppynarutesti. Tutkimukseen liittyvä taustakysely toteutetaan jollakin koulun oppitunnilla tutkijan läsnä ollessa. Taustakyselyllä kartoitetaan oppilaiden liikuntaharrastuneisuuden määrää ja laatua, sekä liikuntatunteihin liittyviä motivaatiotekijöitä. Lomakkeessa kysytään myös oppilaan pituus ja paino. Lisäksi osa liikuntatunneista kuvataan videolle. Videokasetteja säilytetään ainoastaan tutkimuksen keston ajan, kuitenkin enintään 10 vuotta. Sen jälkeen kasetit tuhotaan.

Kaikki toimenpiteet toteutetaan normaalien oppituntien aikana osana normaalia koulutyötä. Tutkimukseen osallistuminen ei vaadi oppilailta tai kodeilta ylimääräistä vaivannäköä.

Tutkimusaineistoa käsitellään ehdottoman luottamuksellisesti. Sitä käytetään ainoastaan tutkimustarkoituksiin. Aineisto säilytetään tietosuojattuna tutkijan henkilökohtaisella tietokoneella. Yksittäistä oppilasta koskevaa tietoa ei luovuteta muiden käyttöön. Tutkimushenkilöstöä sitoo vaitiolovelvollisuus. Oppilaita pyydetään kyselylomakkeissa ilmoittamaan nimensä, tämä sen vuoksi että eri testikertojen ja kyselyjen tuloksia voidaan vertailla keskenään. Oppilaiden henkilöllisyys tai koulu eivät paljastu ulkopuolisille tutkimuksen missään vaiheessa. Tutkimusraporteista ja muista julkisesti esitettävistä aineistokuvauksista häivytetään kaikki tunnistamista edesauttavat elementit.

Ystävällisin terveisin

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Suostumuslomake
palautetaan liikunnanopettajalle 17.8.2007 mennessä

Oppilas____ (nimi ja luokka)

saa (   ) ei saa (   ) osallistua Motoristen taitojen kehittämishanke koululiikunnassa -tutkimukseen.

Oppilaan huoltajan allekirjoitus

ORIGINAL PAPERS

I

THE ROLE OF GENDER, ENJOYMENT, PERCEIVED PHYSICAL ACTIVITY COMPETENCE, AND FUNDAMENTAL MOVEMENT SKILLS AS CORRELATES OF THE PHYSICAL ACTIVITY ENGAGEMENT OF FINNISH PHYSICAL E DUCATION STUDENTS.

by

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The Role of Gender, Enjoyment, Perceived Competence, and Fundamental Movement Skills as Correlates of the Physical Activity Engagement of Finnish Physical Education Students

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Abstract

The aim of the study was to investigate the relationships between enjoyment, perceived competence, fundamental movement skills, and physical activity engagement of Grade 7 students participating in Finnish physical education. A secondary aim of the study was to examine gender differences in all assessed variables. The participants of the study were 404 Grade 7 students aged 13 years. The sample comprised 210 girls and 194 boys, who were involved in 23 classes taught by 10 physical education teachers at three secondary schools. Physical activity engagement, enjoyment, and perceived physical activity competence were assessed by self-report questionnaires. Locomotor skill were evaluated by the shuttle running test, balance skill by the flamingo standing test, and manipulative skills by the figure-8 dribbling test. Results of a stepwise regression analysis revealed that only perceived physical activity competence was a statistically significant predictor of physical activity engagement. The t-tests revealed that the girls scored better in the balance test, whereas the boys scored better in the shuttle running test. Additionally, the boys perceived higher levels of physical activity competence than the girls.

Key words: physical activity, enjoyment, perceived competence, fundamental movement skills

Background

The links between physical activity and health are clearly shown in many studies (Bouchard, Blair, and Haskell 2007; Malina, Bouchard, and Bar-Or 2004). Although we recognize the fact of the association between physical activity and health, the majority of individuals in many developed populations are not sufficiently active. Many researchers including Andersen et al. (2006), Biddle, Sallis, and Cavill (1998) and Strong *et al.* (2005) have detailed recommendations that children should participate in moderate physical activity at least 60 minutes per day. In Finland, young people are also demonstrating higher levels of exercise passivity with Samdal *et al.* (2007) reporting that for a large sample of adolescents only 43 per cent of girls and 56 per cent of boys engaged in vigorous physical activity at least four times a week. Studies have indicated that childhood and adolescence are important periods for adopting physically active lifestyle later in adulthood (Malina 2001; Telama *et al.* 1997). Research has also shown that physical activity levels decline markedly after the age of 12 in both frequency of physical activity engagement and actual participation time in sport (Telama and Yang 2000). We can then argue that the transition period from elementary school to secondary school is an important time for the development of later activity patterns. Review of the research regarding physical activity and the variables that affect participation highlights that very few studies have investigated factors such as motor skill proficiency and exercise motivation involving secondary school samples (e.g., Okely, Booth, and Patterson 2001). Most studies of childhood physical activity engagement have been conducted using pre and elementary school aged students (e.g., Fisher *et al.* 2005; Sääkslahti *et al.* 1999; Wrotniak *et al.* 2006). There is a need, therefore, to study physical activity and the associated motivational and motor skill antecedents at the secondary school level.

The concept of enjoyment has been defined as a multidimensional construct consisting of factors associated with excitement, affect, competence, attitude, and cognition (Crocker, Bouffard, and Gessaroli 1995; Wankel 1997). According to Scanlan and Simons (1992) enjoyment is an important factor in participation in sport that may lead to greater involvement in the activity. Research has also shown that enjoyment is an antecedent of physical activity. Rowland and Freedson (1994) stated that providing enjoyable experiences is a potential strategy for increasing physical activity levels in youth. Wallhead and Buckworth (2004) found that enjoyment in school physical education was related to the motivational factors associated with the adoption of a physically active lifestyle outside school hours. Additionally, enjoyment has been linked with physical activity engagement in physical education (Kremer, Trew, and Ogle 1997; Wallhead and Buckworth 2004).

Perceived physical competence reflects the perception a person has of their abilities resulting from cumulative interactions with the environment (Harter 1978). According to Fox (1997) perceived competence can be seen as "the statement of personal ability that generalises across a domain such as sport, scholarship, or work" (Fox 1997, p. xii.). According to Harter's (1978) competence motivation theory, highly competent individuals will persist longer in certain activities compared with individuals of low perceived competence. Harter (1978) assumed that in achievement situations individuals seek activities that provide feelings of competence and avoid those with a probability of failure. Sonstroem (1978) suggested that perception of physical competence leads to more positive attitudes toward physical activity. These attitudes affect voluntary involvement in activity. Studies have also indicated that perceived physical competence have been positively associated with engagement in physical activity (Bagoien and Halvari 2005; Carroll and Loumidis 2001) and motor skill abilities (Ebbeck and Becker 1994; Sonstroem, Harlow and Salisbury, 1993). Additionally, Sallis, Prochaska, and Taylor (2000) in their review of correlates of physical activity of children and adolescents concluded that perceived competence was a critical element related to engagement in physical activity.

Fundamental movement skills include balance, manipulative and locomotor skills. Balance refers to both the body remaining in place but moving around its horizontal or vertical axis (Gallahue and Donnelly 2003) and the process for maintaining postural stability (Wescott, Lowes, and Richardson 1997). More specifically, Wescott *et al.* defined static balance as the "ability to maintain a posture, such as balancing in a standing or sitting position", and dynamic balance as the "ability to maintain postural control during other movements, such as when reaching for an object or walking across a lawn" (p. 630). According to Gallahue and Donnelly (2003), axial movements such as bending, stretching, twisting, turning, swinging, body inversion, body rolling and landing/stopping are all considered to be balance skills. Manipulative movement skills include either gross motor or fine motor movements. Gross motor manipulation involves movements that give force to objects or receive force from objects.

Throwing, catching, kicking, trapping, striking, volleying, bouncing, ball rolling and punting are considered to be fundamental gross motor manipulative skills. The term fine motor manipulation refers to object-handling activities that emphasize motor control, precision and accuracy of movement. Locomotor skills refer to the body being transported in a horizontal or vertical direction from one point to another. Activities, such as walking, running, jumping, hopping, skipping, galloping, sliding, leaping and climbing are considered to represent locomotor movement skills (Gallahue and Donnelly 2003).

Gender differences have been reported for each of the three areas of fundamental movement skills. Boys have been found to perform better in manipulative movement skills (Castelli and Valley 2007; Junaid and Fellowes 2006; Okely *et al*. 2001). Okely *et al*. (2001) studied a sample of 2,026 boys and girls, aged 13 and 15 years, who completed fundamental movement tasks involving throwing and catching skills, and reported boys having significantly higher scores for both tasks at each age level. Gender differences have been found to be less consistent when evaluating children's balance skills. Fjortoft (2000) and Sääkslahti (2005) found that 3- to 6-year-old girls are better than boys of the same ages in balance skills. This finding was also supported in the Toole and Kretzschmar's (1993) meta-analysis. Junaid and Fellowes (2006), however, found no gender differences in balance skills for children aged seven and eight. Wieczorek and Adrian (2006) detailed the Eurofit balance test scores for 615 Polish 11- to 15-year-olds and highlighted variations across age groups which suggested as children mature physically, gender differences in relation to balance are smaller. Existing evidence indicates that 12- and 14-year-old boys are better in locomotor skills, such as leaping and running, possibly due to the higher strength level of the boys (Nupponen and Telama 1998). Overall, the findings concerning gender differences in movement skills are interesting because they may be related to the reported higher levels of physical activity of boys (e.g., Aarnio *et al*. 2002; Castelli and Valley 2007; Riddoch *et al*. 2004). These types of trends, however, may be an outcome of the strong association between higher levels of in engagement in physical activity and participation in sport clubs. Eiosdottir et al. (2008) reported that for a sample of Icelandic adolescents, boys were substantially higher than girls in both reported vigorous physical activity and sport club participation. Physical education sociologists have noted that that sport club membership is often a result of the male oriented dominance of many sporting cultures

(Flintoff 2008), which may lead to reduced opportunities for girls to be involved in sport and physical activity and as a consequence operate as a limiting factor in the development of their fundamental movement skills. Finally, gender differences have been found in perceived competence and enjoyment that indicate boys perceive themselves as more competent and report higher levels of enjoyment in physical activity (Biddle *et al*. 1993; Carroll and Loumidis 2001; Soini 2006).

As yet only a limited number of studies have investigated the effect of motor skill capabilities on physical activity engagement within samples involving children and adolescents. Okely *et al.* (2001) found that fundamental movement skill levels significantly predicted time in organized physical activity within a sample of 13-15 years-old Australian students. Fisher *et al.* (2005) reported moderate associations between the movement skill capabilities and physical activity participation of 4-year-old Scottish children. Additionally, Wrotniak *et al.* (2006) determined that motor proficiency was positively associated with physical activity and inversely associated with sedentary activity in a sample of students aged 8 to 10 years.

Although only limited information exists on the relationship between motor skills and physical activity engagement, we may assume that the mastery of fundamental motor skills is a critical element of effective participation in physical activity. Satisfactory levels of motor skill competence demonstrated in childhood and adolescence may be predictive of later physical activity engagement (Sallis *et al*. 2000). Overall, youth with more developed motor proficiencies may find it easier to be physically active and may be more likely to engage in a wider variety of sport and exercise activities compared with their peers who demonstrate lower levels of motor skill competence (Haywood and Getchell 2005). Alternatively, Vallerand and Losier (1999) consider that motivation leads to consequences associated with cognitive, affective, and behavioural outcomes, and on this basis, the motivation to be physically active could also be considered a causal factor in the development of fundamental movement skills. Furthermore, young people who demonstrate higher levels of perceived physical activity competence and enjoyment in physical education may also maintain efficacious engagement in physical activity.

The aim of the study was to investigate the relationships between enjoyment, perceived physical activity competence, fundamental movement skills, and physical activity engagement of Grade 7 students participating in Finnish physical education. It was hypothesized that enjoyment, perceived physical activity competence, and fundamental movement skills are related to participation levels in physical activity. A secondary aim of the study was to examine gender differences in all assessed variables.

Methods

Participants

The participants of the study were 404 Finnish Grade 7 students aged 13 years. The sample comprised 210 girls and 194 boys, who were involved in 23 classes that were taught by 10 physical education teachers at three secondary schools.

Measures

Physical activity engagement data were collected by means of a self-report questionnaire. The stem for the questions were: "In the next two questions physical activity means all activities which raises your heart rate or momentarily gets you out of breath for example in doing exercise, playing with your friends, going to school, or in school physical education. Physical activity also includes for example jogging, intensive walking, roller skating, cycling, dancing, skating, skiing, soccer, basketball and baseball." The items were: "Think about your typical week. How many days did you exercise for at least 60 min during which you get out of breath" and "Think about your last 7 days. How many days did you exercise for at least 60 min during which you get out of breath?". Both items were presented using an eight-point response scale (0 to 7 days in a week). A sumscale of physical activity engagement was formulated by adding the response scores for the two items. The two items were developed to analyze students' self-reported engagement in both moderate to vigorous and vigorous physical activity. The two physical activity engagement items have been reported to indicate adequate levels of reliability in adolescent samples (Prochaska, Sallis, and Long 2001; Vuori *et al*. 2004).

Perceived competence in the physical activity setting was analyzed by using a modified Finnish version of the sport competence sub-scale of Physical Self-Perception Profile (PSPP; Fox 1990; Fox and Corbin 1989). Each item was rated on a five-point Osgood scale (e.g., "(1) I am: good at physical activity to (5) poor at physical activity". The Finnish version of PSPP subscale is titled the Physical Activity Competence Scale (PACS). This study had the individual item stem of "What am I like?". The five key themes covered in the items were physical ability, athletic ability, confidence, skill level, and participation. Scale score was calculated by summing item scores for the sport competence subscale. Research has shown that the Finnish version of the PACS has demonstrated satisfactory levels of validity and reliability (Jaakkola 2002).

In the present study we used the Finnish version of the sport enjoyment subscale of the Sport Commitment Model (Scanlan *et al.* 1993). This version of the subscale includes four items to evaluate the themes of enjoyment, pleasure, fun, and happiness, modified to reflect a physical education context (i.e., "In my physical education class…") and rated on a five point Likert scale (1 = strongly agree to 5 = strongly disagree). The Finnish version of the sport enjoyment subscale has been found to be a valid and reliable tool in Finnish sport psychology research (Soini 2006).

All measures were translated from English to Finnish by a panel of experts in sport psychology and later back into English by a translator whose first language is English and was skilled in Finnish. The back-translated English version was compared with the original version for consistency. The panel of experts discussed items that were shown to have number of possible meanings in Finnish in order to redraft them to minimize any confusion regarding meaning.

Balance skills were measured by using the Flamingo standing test, which is one test item of the motor test section of the Eurofit test battery, which is widely used in physical education in European countries (Eurofit 1988). The Flamingo test measures static balance. In the test procedure, the participants stand for 30 s on one leg balanced on a 50 cm long, 4 cm high, and 3 cm wide wooden beam. The free leg is bent backwards and the back of the foot gripped with the hand on the same side. There was no practicing time before the test. Each time the participant lost balance by releasing the free leg or when the participant touched the floor with any parts of the body, the stopwatch was stopped. After each loss of balance, the same procedure was started again. The number of attempts required within the 30 s time period was the participant's final score. The test was executed twice (2 x 30 s), first with the right leg and then with the left leg, and the scores summed. The researcher announced time limits, recorded the attempts, and provided support for participants as required before each trial. The Flamingo test has been demonstrated to be reliable tool to analyze children's balance skills (Nupponen 1997; Tsigilis, Douda, and Tokmakidis 2002).

Manipulative skills were assessed using the figure-8 dribbling test in which the task is to dribble a volleyball around a figure-8 track, first using the feet (30 s) and secondly using the hands (30 s). Participants were permitted two practice rounds. The participant starts behind the starting line and following the "go" signal starts to dribble the ball with their feet along the figure-8 track. The track includes arrows indicating the dribbling direction. Both the participant and the ball must go around three marker cones, that are 2.5 meters apart and set in a straight line. After 30 s the researchers give a "change" instruction and the manipulation style is switched to hand-dribbling. In the hand-dribbling task the ball does not have to pass the cones, only the participant. Changing of the dribbling hand was allowed. The total dribbling time is 1 min. If the ball leaves the test area (i.e. ringed zone constructed of wooden gymnastic benches) the stopwatch was not stopped. The final result is the total number of crossed lines in one minute. The dribbling test is one part of the widely used Finnish Fitness Test Package (Nupponen *et al.* 1999). Nupponen (1997) found the dribbling test to be reliable tool in measuring manipulative skills within Finnish school students.

The shuttle running test was used to measure students' locomotor skills. The shuttle running test is widely used in Finnish physical education because it is part of a physical fitness test package, which teachers implement twice a year throughout secondary schools (Nupponen and Telama 1998). In the shuttle running test the task is to run as fast as possible 10 times over a 5 m distance, alternating between the forward and backward direction. Both legs should pass the 5 m marker line at each turn. The result is the running time to cover the 10 shuttles. This test is a modification of a widely used shuttle running test, where the participants run forward all the time. We modified the original shuttle run test by including both forward and backward directions. Research has demonstrated that shuttle running test is a reliable tool to analyze children's locomotor skills (Fjortoft 2000; Houwen *et al.* 2006).

Procedure

The data was collected during regularly timetabled PE classes. The students responded to the instruments under the supervision of their PE teacher. All motor skill tests were conducted in the school gym. The researchers coordinated the testing sessions and recruited assistance from the PE teaching staff as required. Each test period started with a warm-up phase. The test protocol lasted approximately 90 min. Participation in all areas of the data collection was voluntary. Students were informed that all data was confidential and would only be used by the researchers for the purposes of this study. The University of Jyväskylä ethics committee approved the study. Written consent from parents was also required for students to participate in the study.

Data analysis

The validity and reliability of the questionnaire s were analyzed by confirmatory factor analysis and internal consistency analysis using Cronbach's alpha. Confirmatory factor analysis was undertaken using AMOS 7.0 software and the maximum likelihood method (Arbuckle 2006). A single model was constructed a priori for the data set for each of the Physical Activity Competence Scale and Enjoyment in Sport Questionnaire and the solution evaluated using a variety of well known fit indices including the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA). The TLI and the CFI indices can vary from 0 to 1. The closer to one, the better the model fit is considered to be. In addition, the root mean square error of approximation (RMSEA) of <0.05, is indicative of representative model. Finally, the ratio of CMIN/df is suggested to present a good fit if it is below 5. Common factors were allowed to be correlated. No correlated residuals were permitted. The data were summarized using descriptive statistics, and the relationships between variables determined using Pearson's correlation coefficients and stepwise regression analyses. Effect size was determined based on the formula, $f^2 = R^2/(1 - R^2)$. The f^2 value is interpreted based on guidelines of .02, .13, and .26 as small, moderate, and large, respectively. Additionally, gender differences were analyzed using independent samples *t*-tests and Cohen's *d*. The *d* value is interpreted based on guidelines of .20. .50. and .80 as small, moderate, and large, respectively (Cohen 1988).

Results

Validity and reliability of the scales

Resultant fit indices derived from the CFA of the primary models of the Physical Activity Competence Scale and the Enjoyment in Sports Questionnaire indicated adequate fit of the data for both scales (Table 1). The goodness-of-fit indices demonstrated more consistent patterns than reported in previous Finnish studies (Jaakkola 2002; Soini 2006). Cronbach's alpha coefficient for the Physical Activity Competence scale and the Enjoyment in Sports Scale were .88 and .94, respectively, indicating high reliability of each scale. The correlation coefficient for the two items measuring physical activity was .81.

Table 1 *Results from Confirmatory Factor Analyses for the Physical Activity Competence Scale and Enjoyment in Sports Questionnaire (n = 398)*

	Physical Activity Scale	Enjoyment in Sport Questionnaire
CMIN	34.73	.74
df	5	2
CMIN/df	6.95	.37
TLI	.91	1.00
CFI	.97	1.00
RMSEA	.12	1.00

Descriptive statistics

The descriptive data is shown in Table 2. Mean scores for both males and females indicated that on average the participants exercised at least 60 minutes per day approximately four times per week. The results showed that the mean scores for students' enjoyment in physical education were rather high. The t-tests revealed that the girls scored better in the balance test $t(391) = -2.07, p = 0.039, d = 0.21$), whereas the boys scored better in the figure-8 dribbling test $t(350) = -5.02, p = 0.000, d = 0.54$). Additionally, the

Table 2 *The Descriptive Statistics for Locomotor, Manipulative, Balance Skills as well as Physical Activity, Enjoyment and Perceived Competence*

	Boys			Girls		
	mean	standard deviation	n	mean	standard deviation	n
Figure-8 test[a]	15.47	3.08	177	13.91	2.76	175
Running test[c] (s)	24.65	4.02	178	24.20	2.13	172
Balance test[c] (errors)	12.08	5.41	179	10.85	5.79	176
Activity[b]	4.29	1.75	188	4.19	1.70	205
Enjoyment	3.83	.97	188	3.68	1.12	209
Perceived competence[c]	2.62	.84	191	2.79	.82	209

Notes [a] score from crossed lines
[b] items scored 0 to 7
[c] results are scored in the negative direction

boys perceived higher levels of sport competence $t(398)=2.07$, $p=0.039$, $d=0.21$). No significant gender differences emerged from analysis of the shuttle running test scores, the level of physical activity engagement or enjoyment.

Correlation analysis

Pearson's correlation coefficients for all measures are shown in Table 3. Results indicated that for the boys significant moderate correlations were found between perceived physical activity competence and figure-8 dribbling test, physical activity and enjoyment. Results demonstrated that for the girls significant moderate correlations exist between shuttle running and balance test, figure-8 dribbling test, perceived physical activity competence and enjoyment; and between enjoyment and balance test and perceived physical activity competence. All other correlations demonstrated only weak relationships between variables.

Table 3 *Correlations among Students' Fundamental Movement Skills, Physical Activity, Enjoyment, and Perceived Competence*

	1	2	3	4	5	6
1. Figure-8 test		-.42***	-.21**	.02	.21**	-.12
2. Running test	-.22**		.44***	-.04	-.37***	.32***
3. Balance test	-.16*	.25***		-.09	-.31***	.27***
4. Physical activity	.17*	-.02	-.09		.11	-.20**
5. Enjoyment	.17*	-.12	-.07	.28***		-.44***
6. Perceived competence	-.30***	.28***	.16*	-.34***	-.47***	

Note 1 Correlations for boys below the main diagonal and for girls above the main diagonal.

Note 2 *$p < 0.05$, ** $p < 0.01$, ***$p < 0.001$.

Regression analyses

We conducted a multiple stepwise regression analysis in order to examine whether gender, fundamental movement skills, enjoyment, and perceived physical activity competence predicted physical activity engagement. In each analysis, gender, fundamental movement skills, enjoyment, and perceived physical activity competence were independent variables, and physical activity engagement represented the dependent variable. The model was statistically significant, $F(1,317) = 18.64$, $p < .000$, and accounted for 5% of the variance in physical activity engagement (adjusted $R^2 = .05$). The only variable that entered into the regression model that was found to be significant was perceived physical activity competence (β = - 24). The adjusted R^2 value of .05 translates into an f^2 value of .05, which constitutes a small effect size.

Discussion

The aim of the study was to investigate the role of enjoyment, perceived physical activity competence, and fundamental movement skills as correlates of physical activity engagement in Finnish physical education students. Although we have preliminary evidence that motivation and motor skills are important antecedents of physical activity in early childhood, we do not as yet have studies where these variables have been evaluated simultaneously within secondary school children.

Perceived physical activity competence was the only significant predictor of physical activity engagement within this sample of Finnish Grade 7 students. This finding is in accordance with earlier studies demonstrating a positive association between perceived competence and physical activity (e.g., Bagoien and Halvari 2005; Carroll and Loumidis 2001) and suggestions that perceived competence is an antecedent of physical activity in children and adolescents (Sallis *et al*. 2000). The resultant association between perceived competence in sport and students' physical activity engagement has several pedagogical implications. Strategies that physical education teachers use can support student's competence in sport-oriented activities and, thus, may benefit their participation in physical activity, at least within school physical education. In sport psychology, researchers have proposed the development of a task-involving motivational climate as an approach for promoting students perception of competence (Epstein 1989; Nicholls 1989; Roberts 2001). Intervention studies in which the purpose has been to increase task-involving motivational climate have also contributed to increases in participants' perceived competence in physical activity settings (Grieve *et al*. 1994; Theeboom, DeKnopp, and Weiss 1995; Wallhead and Ntoumanis 2004). Those interventions have applied TARGET model of Epstein (1989) to increase task-involving motivational climate in an activity. Although we did not investigate the association between task-involving motivational climate, perceived competence, and physical activity, based on the results of earlier studies we recommend that teachers adopt the principles of task-involving motivational climate to support students' perceived competence and, as a consequence, their physical activity levels.

In contrast to previous research (e.g., Kremer, Trew, and Ogle 1997; Wallhead and Buckworth 2004), enjoyment in physical education was not a significant predictor of physical activity engagement. Wallhead and Buckworth (2004) found that enjoyment in school physical education was related to motivation to adopt a physically active lifestyle outside school hours. A possible reason for the weak association between enjoyment in physical education and physical activity engagement observed in the current data, is that enjoyment was evaluated in the specific context of physical education, whereas the questions pertaining to engagement were related to more general exercise and physical activity behaviors. This suggests that Finnish adolescents may make the distinction between involvement in physical education as an enjoyable learning and social activity, and physical education as an opportunity to further engage in moderate to vigorous physical activity.

The finding that fundamental movement skill scores did not significantly predict engagement in physical activity is in contrast to previous research (e.g., Fisher *et al*. 2005; Okely *et al*. 2001; Wrotniak *et al*. 2006). In this study physical activity was only analyzed by self-report, and the information collected was limited to details regarding the number of days of engagement in moderate to vigorous physical activity per week. Fisher *et al*. (2005) and Wrotniak *et al*. (2006), for example, used accelerometers in analyzing physical activity in their studies. An additional issue may be that the fundamental movement skills data was derived using only 13 years-olds. At this age the inter-student variation in physical development is substantial, and different individuals may be physically active but generate lower scores in relation to their peers in regards to locomotor and manipulative measures we used due the maturational status of attributes such as strength or anaerobic capacity (Ozmun and Gallahue 2005). Assessment of fundamental movement skills for the purpose of comparison with other variables may be more effectively undertaken involving samples at the pre, mid, and post adolescent phases.

The second research task was to examine gender differences in all measured variables. In line with earlier findings (e.g., Thomas and French 1985; Toole and Kretzschmar 1993; Wieczorek and Adrian 2006) the current results revealed that the girls made fewer errors in the balance skill task. The study also demonstrated that the boys had better results in the figure-8 dribbling test, further supporting existing evidence that showed that boys outperform girls in manipulative skills, (Castelli and Valley, 2007; Junaid and Fellowes, 2006; Okely et al, 2001). No gender differences emerged in the running test scores, which is contrary to other investigations that have found differences between genders in locomotor skills (Nupponen and Telama, 1998; Wrotniak et al., 2006). In the current study, however, we modified the original shuttle run test by including both forward and backward directions to better highlight the locomotor skill elements as characteristics of strength. In the Nupponen and Telama (1998) study the shuttle running test used traditional method that only involved running in the forward direction. The differences in the current results and Nupponen and Telama's study mean that gender differences in the running skills of seventh grade Finnish students may be dependent on the type of task used to evaluate this fundamental movement skill. In Finland, boys and girls sport and exercise activities typically differ from each other. The Finnish national survey on children's sport hobbies indicated that boys were more active in ball games and the most popular sporting hobbies among boys were football, ice-hockey, and floorball. In contrast, the main girls' hobbies were aerobics, gymnastics, horse-riding, dancing, and figure skating (Nuori Suomi 2006). The boys in the current study demonstrated higher levels of perceived competence in physical education, which is in accordance with previous research (Biddle *et al.* 1993; Wang *et al.* 2006). Furthermore, we did not find significant differences between the girls and the boys in enjoyment. Soini (2006) found, however, that in his sample of 15-year-old Finnish physical education students, the boys rated physical education as a more enjoyable experience than the girls. The difference in the age might be one reason why these two studies differ in the girls' and the boys' level of enjoyment. Lastly, we did not find significant differences between the girls and the boys in their level of physical activity engagement, whereas Samdal *et al*. (2007) found clear gender differences, with boys scoring higher in self-reported involvement in regular vigorous physical activity. A possible reason for these contradictory results might be that Samdal *et al*. (2007) measured vigorous physical activity across three age groups including 11, 13, and 15 year-old boys and girls while in the current study the focus was on only 13 year-olds. Previous evidence has shown that it is the older adolescent groups that demonstrate the greatest gender differences in engagement in physical activity (McQuillan and Campbell 2006). Furthermore, a large survey for 5505 3-18 years-old Finnish children and adolescents, investigating physical activity engagement, revealed that no gender differences emerged when all types of physical activities were analyzed (Nuori Suomi 2006), which suggests an atypical pattern of physical activity engagement may be demonstrated by Finnish children and youth.

Cross-sectional design is one of the limitations of this study. The use of only cross-sectional data makes it difficult to identify the antecedents of engagement in physical activity within younger adolescent samples. Another limitation of this study is the use of the self-report format in measuring physical activity engagement. In some studies self-report measures of physical activity have been shown to have limited reliability and validity particularly in relation to samples including children (Shephard 2003). Self-report questionnaires, however, were the most practical instruments for use in this study because the use of more objective measures typically adds extra cost and time to the data collection phase. Finally, our use of a product-oriented rather than process-oriented assessment of fundamental movement skills may be considered as a further limitation (Okely *et al.* 2001). Process-oriented tests break down skills, such as the running and leaping, into specific observable components (e.g., Ulrich 2000) but are more complex and difficult to administer. Although we fully acknowledge these limitations, this study was the first attempt to analyze motivational factors and fundamental movement skills as antecedents of physical activity engagement of younger adolescents.

In future it would be beneficial to further study the effect of motivational and motor skill factors on physical activity engagement patterns using a longitudinal design and involving samples from the three key stages of adolescence (i.e., early, middle, late). This would give us important information on the development of the antecedents of physical activity participation in school students. Additionally, physical education based intervention studies (e.g., motivational climate) structured to evaluate the effect of improving students' perceived competence as a strategy for the promotion of adolescent engagement in physical activity.

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II

THE ASSOCIATIONS BETWEEN SEVENTH GRADE FINNISH STUDENTS' MOTIVATIONAL CLIMATE, PERCEIVED COMPETENCE, SELF-DETERMINED MOTIVATION, AND FUNDAMENTAL MOVEMENT SKILLS.

by

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EPER

The associations between seventh grade Finnish students' motivational climate, perceived competence, self-determined motivation and fundamental movement skills

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Abstract

The aim of the study was to investigate the relationships between motivational climate, perceived competence, self-determined motivation towards physical education (PE) and the fundamental movement skills of Finnish secondary school students. A sample of 370 seventh-grade PE students (girls n = 189; boys n = 181; mean age = 13.08; SD = 0.25) completed measures pertaining to motivational climates, perceived competence, regulation of motivation and fundamental movement skills. Path analysis revealed results generally consistent with the theoretical tenets of the self-determination and the achievement goal theories by demonstrating that a task-involving motivational climate influenced perceived competence, which in turn affected motivation towards PE. Furthermore, results revealed that this motivational sequence was associated with increased balance skill. A sequence consisting of task-involving climate, intrinsically regulated motivation and balance skills was also observed. Additionally, the results indicated that task-involving motivational climate influenced perceived competence, in turn influencing manipulative and locomotor skills. Finally, an ego-involving climate was found to be a marginally positive predictor of manipulative skills.

Key-words: fundamental movement skills • motivational climate • perceived competence • physical education • self-determined motivation

Introduction

It is widely believed that exercise motivation is one crucial element in the adoption of a physically active lifestyle (Malina et al., 2004). The quality of children's experiences while exercising in schools, sport clubs, or when involved in self-initiated physical activity in their leisure time might be crucial for their future activity patterns (McKenzie, 2007). There is evidence that childhood patterns of physical activity track into adulthood (Telama et al., 2005). Additionally, research has shown that fundamental movement skills and physical activity are related in both childhood and adulthood (McKenzie et al., 2004; Raudsepp and Päll, 2006; Sääkslahti et al., 1999). Fundamental movement skill competency increases the likelihood of children participating in different physical activities throughout their lives (Haywood and Getchell, 2005; Stodden et al., 2008). Indeed, studies have shown that childhood motor skill proficiency influences adolescent physical activity and fitness, mediated by perceived sports competence (Barnett et al., 2008a).

Motivational research has examined a broad range of cognitive, affective and behavioural outcomes resulting from personal and environmental motivational conditions and processes. To our knowledge, however, no studies have investigated the role of motivational factors in the performance of fundamental movement skills at the secondary school age level. Examining the relationship between motivational factors and fundamental movement skill levels in the context of secondary school physical education (PE) would seem important because students in this age group are potentially sensitive to motivational loss emanating from a lowering in perceived physical and motor competence (Barnett et al., 2008b; Stodden et al., 2008). Hence, the purpose of the present study is to examine the association between social and cognitive motivational factors and secondary school PE students' demonstration of fundamental movement skills.

Fundamental movement skills

Fundamental movement skills include balance, manipulative and locomotor skills. Balance refers to both the body remaining in place but moving around its horizontal or vertical axis (Gallahue and Donnelly, 2003) and the process for maintaining postural stability (Westcott et al., 1997). Specifically, Westcott et al. defined static balance as the 'ability to maintain a posture, such as balancing in a standing or sitting position', and dynamic balance as the 'ability to maintain postural control during other movements, such as when reaching for an object or walking across a lawn' (1997: 630). According to Gallahue and Donnelly (2003), axial movements, such as bending, stretching, twisting, turning, swinging, body inversion, body rolling and landing/stopping are all considered to be balance skills. Manipulative movement skills include either gross motor or fine motor movements. Gross motor manipulation involves movements that give force to objects or receive force from objects. Throwing, catching, kicking, trapping, striking, volleying, bouncing, ball rolling and punting are considered to be fundamental gross motor manipulative skills. The term fine motor manipulation refers to object-handling activities that emphasize motor control, precision and accuracy of movement. Locomotor skills refer to the body being transported in a horizontal or vertical direction from one point to another. Activities, such as walking, running, jumping, hopping, skipping, galloping, sliding, leaping and climbing are representative examples of locomotor movement skills (Gallahue and Donnelly, 2003).

Fundamental movement skills constitute crucial elements in the performance of specific sport skills (Gallahue and Donnelly, 2003), and the development of a functional level of fundamental movement skills can be considered as an important motivating force for the prolonged engagement of children in physical activity (Stodden et al., 2008). Fundamental motor skills, therefore, can facilitate participation and success in many sport and exercise activities undertaken during both school and leisure time (Barnett et. al., 2008b). Hence, it seems important to identify the motivational prerequisites for the learning of fundamental motor skills in PE. In the present study we focus on motivational climates in PE, perceived physical competence and the regulation of motivation as prerequisites.

Motivational climate and fundamental movement skills

Motivational climate refers to a situational psychological perception of the activity that directs the goals of action (Ames, 1992). A motivational climate influences the achievement-related cognitions, affective responses and behaviours in an activity, such as PE (e.g. Standage et al., 2003a). According to the achievement goal theory (Nicholls, 1989) two motivational climates are proposed to exist, specifically a task-involving climate and an ego-involving climate. In a task-involving climate, students are rewarded for effort, and they concentrate on cooperation, learning and task-mastery (Ames, 1992). In an ego-involving climate teachers typically emphasize performance outcomes, competition and social comparison between students.

Empirical studies in PE have revealed that a task-involving climate is positively associated with perceived competence and intrinsically regulated motivation (e.g. Cox and Williams, 2008; Standage et al., 2003b). An ego-involving climate has been shown to be unrelated to intrinsic motivation and perceived competence (e.g. Cury et al., 1996; Standage et al., 2003b), instead predicting amotivation (Ommundsen and Eikanger- Kvalo, 2007). Although an ego-involving motivational climate has not typically been found to be negatively related to perceived competence and intrinsically regulated motivation (Standage et al., 2003b), it has been proposed that they are thwarted in environments which include social and normative comparison and the provision of rewards contingent on performance (Deci and Ryan, 2000). Associations between motivational climates and motor skills have also been demonstrated. Theeboom et al. (1995) implemented a three-week intervention for 119 children aged 8–12 years who participated in an organized sports programme. Results revealed that those in the task-involving group exhibited better motor skills than those in the ego-involving group. Martin et al. (2009) conducted a six-week intervention for 64 kindergarten children and observed that the high task-involving group improved significantly in locomotor- and object control skills compared with the low task-involving group. Despite these findings, research on the role of social and personal motivational prerequisites for fundamental motor skill learning in the PE context have not yet been reported.

Perceived competence and fundamental movement skills

The concept of perceived physical competence has been used to describe the perception a person has of their abilities resulting from cumulative interactions with the environment (Harter, 1978). Fox (1997) defines perceived competence as 'the statement of personal ability that generalises across a domain, such as sport, scholarship, or work' (Fox, 1997: p. xii.). Within a multidimensional and hierarchically organized model of self-perception (Shavelson and Bolus, 1982), an important tenet is that general self-esteem results from self-perceptions of different specific domain competencies. These include competencies in the physical, academic, social and emotional domains. If considered personally important, high perceived competencies in a particular life domain can affect young peoples' global self-esteem. Furthermore, an individual with high perceived physical competence in a particular domain may perceive being competent as personally valuable, thus, enhancing their self-esteem (Fox, 1997).

According to Harter's (1978) competence motivation theory, highly competent individuals will persist longer in certain activities compared with individuals of low perceived competence. Additionally, individuals in achievement situations seek activities that provide feelings of competence and avoid those with a probability of failure. Sonstroem (1978) suggested that positive perception of physical competence leads to more positive attitudes toward physical activity. Indeed, studies have shown that perceived physical competence is associated with self-determined motivation (e.g. Ntoumanis, 2005; Standage et al., 2003b), and higher levels of physical activity (Bagoien and Halvari, 2005), motor competence (e.g. Castelli et al., 2007; Raudsepp and Liblik, 2002), and motor skill performance (Ebbeck and Becker, 1994; Sonstroem et al., 1993).

The regulation of motivation and fundamental movement skills

According to the self-determination theory, the regulation of motivation reflects a continuum comprising different levels of self-determination ranging from amotivation to true intrinsic motivation (Deci and Ryan, 2000). Four different types of extrinsic motivation exist within the continuum, these being external regulation, introjected regulation, identified regulation, and integrated regulation (Deci and Ryan, 2000; Ryan and Connell, 1989).

Intrinsic motivation involves pursuing an activity out of interest and enjoyment without external contingencies (Deci and Ryan, 2000). External regulation is occurring if an activity is done because of external factors like rewards, constraints, or fear of punishment. Motivational forces within introjected regulation are partially internalized but self-esteem oriented pressure still regulates behaviours. These include avoidance of guilt and shame, or concerns about self- and other approval (Ryan and Connell, 1989). Identified regulation occurs when an individual has recognized and accepted the underlying behaviour values or goals (Deci and Ryan, 2000). The behaviour then typically takes the form of 'I want' (Ryan and Connell, 1989). The most self-determined form of extrinsic motivation is integrated regulation. It is the most complete form of internalization of extrinsic motivation. Integrated regulation involves the identification of the importance of behaviours, but also integrates those identifications with other aspects of the self. In integrated regulation a person has fully accepted behaviour by bringing it into harmony or coherence with other aspects of their goals and values (Deci and Ryan, 2000). Amotivation is defined as a state in which a person lacks the intention to behave, and thus lacks motivation (Deci and Ryan, 2000). Amotivated individuals experience feelings of incompetence, expectancies of uncontrollability, and perform activities without purpose.

According to the self-determination theory, self-determined forms of regulation promote adaptive cognitive, affective and behavioural functioning by facilitating enhanced learning, improved performance, higher interest and greater effort. Less self-determined forms of regulation, in contrast, are negatively related to these outcomes (Grolnick and Ryan, 1987; Williams et al., 1996). In PE, studies have revealed links between perceived competence and self-determination, and a task-involving climate and self-determined motivation link that is mediated by enhanced competence perceptions (e.g. Ommundsen and Eikanger-Kvalo, 2007; Standage et al., 2006). Research has also shown that individuals who are intrinsically motivated are more persistent in their physical activity (Fortier and Grenier, 1999; Pelletier et al., 2001; Sarrazin et al., 2001). Despite a lot of research based on self-determination theory being conducted in school PE (e.g. Ntoumanis, 2005; Ommundsen and Eikanger-Kvalo, 2007; Standage et al., 2006), the role of intrinsically regulated motivation in the development of motor skills has yet to be investigated.

The four-stage motivational sequence model of the teacher– student relationship

A viable way to combine tenets from the achievement goal theory and the self-determination perspective in the study of fundamental movement skills is to make use of the four-stage causal sequence model of motivation put forward by Vallerand and co-workers (Mageau and Vallerand, 2003; Vallerand and Losier, 1999). This model holds that contextual factors, such as motivational climates, influence the regulation of motivation, mediated by needs satisfaction, one being the need for competence. In turn, the regulation of motivation is hypothesized to impact on cognitive, affective and behavioural consequences. In this research, we have adopted an approach akin to the motivational sequence identified in the four-stage sequential model of motivation (social factors – psychological mediators – types of motivation – consequences) proposed by Vallerand and colleagues. While Mageau and Vallerand (2003) also proposed a role for the need for autonomy and relatedness as mediators, we chose to include only perceived competence, given that fuelling the need for physical competence would seem most important when examining motor skills as outcome. The hypothesized model of the association among study variables is presented in Figure 1.

In the sequential model, social factors, such as motivational class climate represent the most distal factor, followed by the mediator, with the regulation of motivation as the most proximal determinant of the hypothesized cognitive, affective and behavioural consequences in the sequence. In PE the proposed motivational sequence has been investigated focusing on a variety of cognitive, affective and behavioural consequences, such as boredom, effort, intentions for future participation, concentration, positive and negative affects, enjoyment, leisure time physical activity and sport participation, and preference for challenging tasks (Ntoumanis, 2005; Ommundsen and Eikanger-Kvalo, 2007; Standage et al., 2003b, 2005, 2006). These consequences have shown to be positive in task-involving climate and negative in ego-involving climate.

The purpose of the study

While the results of previous studies have supported the theoretical predictions embedded in the sequential motivational model in the context of PE, the sequential motivational model has not been examined with fundamental movement skills as a behavioural outcome. Hence, the main purpose of the present study was to combine tenets of the achievement goal theory and the self-determination perspective using the four-stage causal sequence model of motivation put forward by Vallerand and co-workers (Mageau and Vallerand, 2003; Vallerand and Losier, 1999) to examine

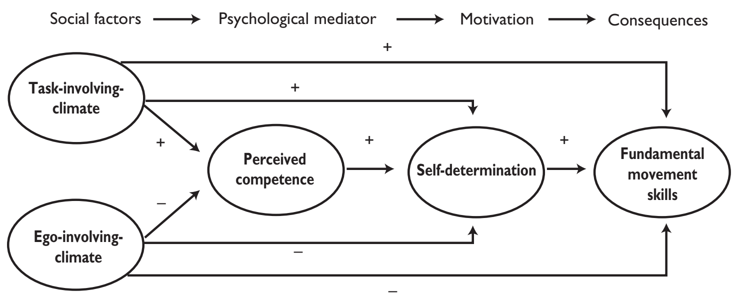

Figure 1 The hypothesized sequential pattern of associations among study variables

motivational antecedents of fundamental movement skills in school PE. We hypothesized that a perception of task-involving climate, perceived competence and self-determined motivation would positively and sequentially predict balance, manipulative and locomotor skills. We expected an opposing pattern of relationships for an ego-involving climate. Additionally, as suggested by Vallerand and Losier (1999) we expected that proximal antecedents (self-determined motivation in PE) would account for more variance in fundamental movement skills than would more distal antecedents (e.g. motivational climates and perceived competence). Because it has been suggested that the similar sequence of motivational process exists across both genders, gender-specific analyses were not conducted (Vallerand, 1997).

Method

Participants

The participants were recruited from three secondary schools in the city of Jyväskylä in central Finland. The final sample comprised 370 Grade 7 students (girls *n* = 189; boys *n* =181; mean age = 13.08; SD = 0.25). The students were drawn from 23 class groups, taught by 10 PE teachers. The Grade 7 cohort constituted a convenience sample specifically in regards to minimizing the disruption to the normal school PE programme and in providing a greater opportunity to monitor the group longitudinally over their secondary school experience as an additional study within a larger fundamental movement skills project.

Measures

Sport Motivation Scale

The contextual self-determined motivation towards PE was measured by the Finnish version of the Sport Motivation Scale (SMS; Pelletier et al., 1995). The SMS consists of seven subscales, comprising three types of intrinsic motivation which are IM to accomplish things ('Because I feel a lot of personal satisfaction while mastering certain difficult training techniques'), IM to know ('For the pleasure it gives me to know about the sport skills that I practise') and IM toexperience stimulation ('For the pleasure I feel in living exciting experiences'), three forms of extrinsic motivation including identified regulation ('Because, in my opinion, it is one of the best ways to get acquainted with other students'), introjected regulation ('Because it is absolutely necessary to do sports if one wants to be in shape') and external regulation ('Because it allows me to be well regarded by people I know'), and amotivation ('I often asked myself; I cannot seem to achieve the goals that I have set for myself'). Each dimension consists of four items. Each item was rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The SMS used in this study had the individual item stem of 'Why I'm currently participating in physical education'. Subscale scores were calculated for amotivation, external regulation, introjected regulation, identified regulation and intrinsic motivation. When calculating the subscale for intrinsic motivation we combined all 12 items, measuring three different types of intrinsic motivation. This is the normal procedure before calculating the Relative Autonomy Index (RAI) as suggested by Vallerand (1997). The next step was to formulate the RAI which can be done by weighting the scores of the subscales so as to derive a single score. The various motivation types are theoretically posited to lie on a continuum of self-determination from intrinsic motivation to amotivation. Weights are given based on the position of the particular motivation type on the continuum (Vallerand, 1997). This was done by weighting intrinsic motivation (+2) and identified regulation (+1) positively. Then introjected regulation and external regulation were summed up and weighted –1. Amotivation was weighted –2. The value of the RAI can be either positive or negative. An increasingly positive index score is reflective of an increasingly self-determined form of motivation for the given activity. This index has been shown to indicate the amount of self-determination in an activity. The Finnish version of the SMS has demonstrated high levels of reliability and validity. In the study by Jaakkola et al. (2008), the Cronbach's alpha coefficients of the SMS subscales were above .70, indicating satisfactory internal consistency. Additionally, the indices of confirmatory factor analyses demonstrated satisfactory construct validity. Subsequently, correlation analysis of the Finnish version of the SMS has supported existing motivational continuum and, thus, the formulation of RAI index. Subscales that are adjacent to each other along the continuum correlated more positively than those further from each other (Jaakkola and Liukkonen, 2006).

Sport Competence Scale

Perceived sport competence in physical activity was analysed using the Finnish version of the sport competence subscale of the Physical Self-Perception Profile (PSPP; Fox, 1990; Fox and Corbin, 1989). Each item was rated on a five-point Osgood scale from 'I'm among the best when it comes to athletic ability' (1) to 'I'm not among the best when it comes to athletic ability' (5) (scale scores reversed in analyses). The Sport Competence Scale used in this study had the individual item stem of 'What am I like?' Scale score was calculated by summing item scores. Research has shown that the Sport Competence Scale has demonstrated satisfactory reliability and validity (Fox and Corbin, 1989; Wang et al., 2008).

Intrinsic Motivation Climate in Physical Education Questionnaire

Motivational climate was measured by using the Intrinsic Motivation Climate in Physical Education Questionnaire (IMCPEQ), which consists of four subscales comprising autonomy support, social relatedness, task- and ego-involving climate factors (Soini et al., 2004). For this study purpose only task-involving and ego-involving subscales of the IMCPQ were used. The task-involving climate factor consists of five items (e.g. 'It is important for the students to try their best during PE lessons') and the ego-involving factor includes four items (e.g. 'During PE lessons students compare their performance mainly to that of others'). Each item was rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The IMCPEQ had the individual item stem of 'In my physical education class . . .' Research has demonstrated satisfactory reliability and validity for the IMCPEQ (Soini et al., 2004).

All measures were translated into Finnish by a panel of experts in sport psychology and later back into English by a first-language-English-speaking translator. The back-translated English version was compared with the original version for consistency. Items that were shown to have a number of possible meanings in Finnish were discussed by the panel of experts in order to redraft them to be as accurate as possible in meaning.

Balance skill

Balance skill was measured using the flamingo standing test. The test measures static balance and is one task from the motor test section of the Eurofit test battery (EUROFIT, 1988). In the test procedure, the participant had to stand for 30 seconds on one leg balanced on a 50cm long, 4cm high, and 3cm wide wooden beam. The free leg was bent backwards and the back of the foot was gripped with the hand on the same side. There was no practising time before the test. Each time the participant lost their balance by releasing the free leg or touched the floor with any part of the body, the stopwatch was stopped. After each such fall, the same procedure was started again. The number of attempts required within the 30 second time period was the participant's final score. The test was executed twice (2 × 30 s), first with the right leg and then with the left leg, and the scores were summed. The researcher announced time limits and recorded the attempts. Nupponen (1997) reported test–retest correlations of .53 for the boys and .59 for the girls for the flamingo standing test. Tsigilis et al. (2002) examined the reliability of flamingo standing test with university students. In their study the test–retest correlation for the flamingo standing test was .73. Earlier studies show that the flamingo standing test has demonstrated moderate reliabilities.

Locomotor skill

The leaping test was used to measure one component of students' locomotor skills. The leaping test is widely used in Finnish PE because it is included in the physical fitness test battery, which teachers normally implement during all semesters in secondary schools. In the leaping test, the task was to leap five times consecutively starting from the initial leaping position with both legs parallel. After the first jump the leaping sequence was a leap with the preferred leg followed by a leap with the opposite leg until the sequence of five leaps was completed. The test was performed on a 6cm thick gymnastics mat. The final landing was also completed with both legs parallel. The result was measured as the length of the leap in centimetres from the heel of the leg furthest back upon the landing phase. The participants were allowed to practise three times before the test, which was implemented once. The researcher measured all performances. Nupponen and Telama (1998) analysed the reliability of the leaping test using a sample of 548 Grade 8 Finnish PE students and reported a test–retest correlation of .95 for boys and .93 for girls.

Manipulative skills

Manipulative skills were assessed using the figure-8 dribbling test in which the task was to dribble a volleyball around a figure-8 track, first using the feet (30 s), and secondly using the hands (30 s). Participants were permitted two practice rounds. The participant started behind the starting line and following the 'go' signal started to dribble the ball with their feet along the figure-8 track. The track included arrows indicating the dribbling direction. Both the participant and the ball had to go around the marker cones. After 30 seconds the researchers gave a 'change' instruction and the manipulation style was switched to hand-dribbling. In the hand-dribbling task the ball did not have to pass the cones, only the participant. Changing of the dribbling hand was allowed. The total dribbling time was one minute. If the ball left the test area (i.e. ringed zone constructed of wooden gymnastic benches) the stopwatch was not stopped. The final result was the total number of crossed lines in one minute. The dribbling test is a part of the widely used Finnish Fitness Test Package (Nupponen et al., 1999). Nupponen (1997) investigated the reliability of the test and reported test–retest correlations of .70 for the boys and .60 for the girls for a large sample of Finnish school students. These correlations demonstrate moderate reliability of the figure-8 dribbling test.

Procedure

The data were collected during one 90-minute PE class in the school gym by the researchers under the supervision of the students' PE teacher. The students voluntarily participated in both the motor tests and the self-report questionnaires. Each test period started with a standardized ten-minute warm-up phase. Standard parental consent procedures were followed in consultation with the principals of each school. Ethics approval was obtained from the University of Jyväskylä ethics committee.

Data analysis

The validity and reliability of the Sport Motivation Scale, the Sport Competence Scale and the IMCPEQ were analysed using confirmatory factor analysis and Cronbach's alpha coefficients. The participants' scores for both the motor tests and the self-report questionnaires were summarized using descriptive statistics. Pearson's correlation coefficients and structural equation modelling were used to examine the relationships between variables. Statistical analyses were conducted using SPSS for Windows 16.0 and LISREL 8.30 software. It should be noticed that the scales in perceived competence and balance skill measures are in a different direction than in other instruments. Therefore, for the clarity in results in correlation and SEM analyses we transformed those two scales so they would be comparable with other measures.

Results

Validity and reliability of the scales

In order to examine how well the seven-factor structure of the SMS, one-factor structure of the Sport Competence Scale and two-factor structure of the IMCPEQ fitted the data, we conducted confirmatory factor analyses. To determine the appropriateness of the model, the Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Incremental Fit Index (IFI), Relative Fit Index (RFI) and the Root Mean Square Error of Approximation (RMSEA) scores were calculated (Arbuckle, 2006). The TLI, CFI, NFI, IFI and RFI indices appearing in the Table 1 vary from 0 to 1. Fit indices greater than 0.90 are indicative of acceptable model fit. In addition, an RMSEA score of lower than 0.05 is indicative of a representative model. Finally, the normed chi-square index (χ^2/d.f.) representing parsimonious fit should be below the marginal maximum of 3.00. Common factors were allowed to be correlated. No correlated residuals were permitted. The goodness-of-fit indices are shown in Table 1. The results indicated that the IMCPEQ and the Sport Competence Scale fitted the data well. Only RMSEA indices for the both scales were below acceptable limits. The goodness-of-fit indices of the SMS were somewhat below recommended levels. However, all indices of the SMS were consistently close to acceptable limits.

Cronbach's alpha coefficients for the subdimensions of the SMS, IMCPEQ, and the Sport Competence Scale were above .70, indicating high internal consistency of the scales.

Table 1 Confirmatory factor analyses for the SMS, the IMCPEQ, and the Sport Competence Scale

	SMS	IMCPEQ	Sport Competence Scale
Chi-square test (CMIN)	1135.28	52.98	30.63
degrees of freedom (df)	329	26	5
CMIN/df	3.45	2.11	6.13
Tucker-Lewis Index (TLI)	0.86	0.96	0.91
Comparative Fit Index (CFI)	0.88	0.98	0.97
Incremental Fit Index (IFI)	0.88	0.98	0.97
Relative Fit Index (RFI)	0.81	0.93	0.90
Normed Fit Index (NFI)	0.84	0.96	0.97
Root Mean Square Error of Approximation (RMSEA)	0.081	0.55	0.12

Table 2 Descriptive statistics of key variables

	M	SD	Min	Max
Relative Autonomy Index	2.46	2.70	5.29	8.96
Task-involving climate	3.81	0.79	1.00	5.00
Ego-involving climate	2.95	0.88	1.00	5.00
Perceived competence	2.68	0.80	1.00	4.80
Balance skill (errors)	10.84	4.81	2	25
Locomotor skill (meters)	8.75	1.04	5.75	11.42
Manipulative skills (sides)	14.84	2.98	8	23

Descriptive statistics and correlation analysis

The descriptive statistics showed that students perceived their PE climate as more task-involving than ego-involving and reported higher levels of self-determined than non-self-determined forms of motivation.

Significant positive correlations were found between task-involving motivational climate and all other variables than locomotion. Instead, ego-involving climate correlated significantly and positively only with perceived competence and manipulation. Perceived competence correlated significantly and positively with all other study variables. However, it should be recognized that the association between perceived competence and task-involving motivational climate was higher than between perceived competence and ego-involving motivational climate. The self-determined motivation correlated significantly and positively with all other variables except for ego-involving motivational climate and manipulation. Pearson's correlation coefficients for all measures are shown in Table 3.

Structural equation modelling

The adequacy of the hypothesized model of motivational sequence was tested via structural equation modelling (SEM). First, descriptive statistics were analysed and results indicated that the scales were normally distributed. Therefore, the maximum likelihood method was applied. The overall fit of the analysed model to the data was

Table 3 Correlations among all study variables

	1	2	3	4	5	6	7
1. Task climate	–						
2. Ego climate	0.23***	–					
3. Perceived competence	0.34***	0.15**	–				
4. RAI	0.58***	0.00	0.49***	–			
5. Balance skill	0.15**	0.09	0.15**	0.20***	–		
6. Locomotor skill	0.11	0.11	0.22***	0.15**	0.16**	–	
7. Manipulative skills	0.13*	0.19**	0.22***	0.07	0.10	0.45***	–

$p < 0.05$*, $p < 0.01$**, $p < 0.001$***

investigated using the chi-square test (χ^2). A non-significant result shows that the proposed model has an acceptable fit to the data. Additionally, the Standardized Root Mean Square Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA), the Non Normed Fit Index (NNFI), the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI) were examined. The NNFI, CFI, GFI, and AGFI indices vary from 0 to 1. Fit indices greater than 0.90 are indicative of acceptable model fit. In addition, an RMSEA and SRMR of less than 0.05 are indicative of a representative model. Additionally, the proportion of variance predicted by independent variables for the dependent variables were investigated using squared multiple correlations (r²).

The results of the proposed model demonstrated poor fit to the data. The next phase was to remove all insignificant path coefficients from the model. After this procedure SEM analysis revealed that the final model had a good fit to the data (χ^2 = [12] = 18.82, $p > .05$; NNFI = 0.96; CFI = 0.98; GFI = 0.98; AGFI = 95; SRMR = 0.050; RMSEA = 0.047). The model revealed an indirect path from task-involving motivational climate to balance skill mediated by perceived competence and self-determined motivation. The model also demonstrated an indirect path from task-involving climate mediated by perceived competence onto manipulation and locomotion, respectively. There was also a indirect path from task-involving climate mediated by self-determined motivation to balance. Finally, we observed a direct path from ego-involving climate to manipulation. Squared multiple correlations revealed that self-determined motivation was explained rather strongly (45 percent) by task-involving motivational climate and perceived competence. All other squared multiple correlations were low. The final model is presented in Figure 2.

Discussion

The aim of the study was to investigate a sequentially framed set of relationships between motivational climate, perceived competence, self-determined motivation

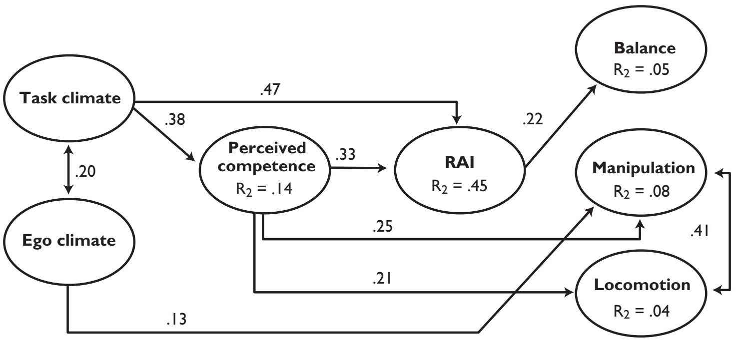

Figure 2 The final path model for study variables

towards PE, and the fundamental movement skills of Finnish secondary school students. More specifically, structural equation modelling was applied to investigate the theoretically proposed sequential process of motivation (Vallerand and Losier, 1999). To our knowledge, this study represents the first attempt to examine the motivational sequence model using fundamental movement skills as outcome in secondary school PE.

A positive and indirect path was expected from a task-involving motivational climate through perceived competence and self-determined motivation to balance skill. This pattern was found and is consistent with the theoretical tenets of the achievement goal theory and the self-determination theory holding that a mastery supportive motivational climate influences perceived competence, which in turn affects motivation towards PE and subsequently leads to increased balance skill (Ames, 1992; Deci and Ryan, 1985, 2000). This finding supports existing suggestions of a pattern of 'social factors > psychological mediators > motivation > consequences' within the PE domain (Ntoumanis, 2005; Ommundsen and Eikanger-Kvalo, 2007; Standage et al., 2003b, 2005, 2006). Moreover, the result extends findings from previous studies that have taken advantage of the sequential mediation model while focusing on different outcomes (e.g. Cox and Williams, 2008; Cury et al., 1996; Ommundsen and Eikanger-Kvalo, 2007; Standage et al., 2006). Apparently, PE teachers are in a position to stimulate students' balance skill by emphasizing student effort, progress and learning. Such a climate seems to facilitate the stimulation of students' need for competence, in turn stimulating more self-determined forms of motivation, and finally balance skill. The additional path observed consisting of a high task-involving climate – enhanced self-determined motivation – improved balance skill reflects that the enhancement of students' balance skill is not contingent on students' competence perceptions provided that their motivation towards the PE tasks seems relatively intrinsically regulated. Indeed, intrinsically regulated motivation is seen as eliciting effort and perseverance (Deci and Ryan, 2000), both important factors for students in order to learn movement skills.

The full sequential model was only partly supported when using manipulative and locomotor skills as outcomes. In both cases students' perceived competence was found to play a mediation role. The link between competence and movement skills is consistent with previous research reporting that individuals who are confident in relation to their motor skills typically achieve higher scores on measures of actual motor competence and motor skills (e.g. Castelli et al., 2007; Ebbeck and Becker, 1994). Apparently, while the enhancement of balance skills seems contingent on autonomous forms of motivation, satisfying students' need to feel competent seems the key towards the enhancement of manipulative and locomotor skills. It might well be that the learning of manipulative and locomotor skills are the types of tasks that require that students' perceive themselves to have the confidence and the physical capacity needed to develop those specific motor skills. Indeed, in terms of coordination complexity, these two motor skills should be regarded as more challenging than the ability to keep one's static balance for a certain time period.

It is important to acknowledge that the amount of variance accounted for in movement skills by the sequentially framed set of determinants was rather modest. Hence, future studies would need to look for alternative environmental and personal characteristics as determinants for students' fundamental movement skill performances. With respect to this, researchers have recently argued for the need to develop skill-analysis competency in PE teachers based on evidence that pre-service PE teacher do not obtain better scores on skill analysis competency than undergraduate students (Lounsberry and Coker, 2008).

We also hypothesized that high ego-involving climate would lead to reduced fundamental movement skills paths, mediated by lower perceived competence and elevated levels of extrinsically regulated motivation. No one of these paths was supported. Instead, a positive direct path, albeit modest in size, was found between an ego-involving motivational climate and locomotor skills. Apparently, a class climate perceived to be focused on social comparison, competition and being the best did not represent any hindrance for these students when it comes to fundamental movement skill performances. For manipulative skills, ego-involving climate facilitated students' performances. It could be that the three opportunities to practise permitted before the test on this skill elicited social comparison among the students' for this particular motor skill test, thus mildly favouring those perceiving the climate as ego-involving. Nevertheless, teachers should concentrate on creating a task-involving climate and work towards limiting an emphasis on an ego-involving climate. Indeed, Ommundsen and Eikanger-Kvalo (2007) and Standage et al. (2003b) also recognized in their studies that an ego-involving climate counteracted PE students' intrinsic motivation and even facilitated amotivation (Ommundsen and Eikanger-Kvalo, 2007).

The amount of variance accounted for in balance skill was higher for RAI (4 percent) (proximal determinant) than for perceived competence (2.3 percent) (more distal determinant) and for task-involving climate (2.3 percent) (most distal determinant). This pattern of findings supports Vallerand and Losier's (1999) suggestions that proximal factors in the motivational process should be stronger predictors of behavioural outcomes than distal factors.

It is also noteworthy that task-involving climate and perceived competence together explained 45 percent of the variance of self-determined motivation towards PE. This finding is important from the pedagogical perspective and suggests that one of the most powerful means to affect students' motivation in PE is to enhance their perceived competence by creating a task-involving motivational climate. The pattern of associations is in line with previous studies in the PE context and demonstrates that conditions in which the teacher emphasizes effort, trying hard, learning and progress contributes towards students' behavioural practices to be self-determined in PE (Ntoumanis, 2001; Ommundsen and Eikanger-Kvalo, 2007).

Limitations and future studies

The SMS in this study obtained less than optimal factorial validity, and earlier studies revealed the figure-8 dribbling and flamingo tests to have suboptimal reliability scores. Hence, the possible shortcomings pertaining to the psychometrics of these measures need to be taken into account when interpreting the results. Despite variability in test–retest reliability shown for the tests in previous studies, there was little difference in the amount of variance accounted for by the variable set for the three different motor skill tests. In fact, the test revealing the lowest reliability estimates in previous studies accounted for the highest amount of variance in the current investigation (e.g. manipulative skills, 8 percent of the variance). Another limitation of the study is that it was not possible to control for the students' starting level of movement skills. It might be that students' with greater experience, for example in manipulative skills, performed better in figure-8 dribbling in this study than those with less experience.

Future research could benefit from examining how students' motivation to participate in sport and exercise combines with fundamental movement skill levels and specific sport skill levels to affect physical activity patterns over time. There is also a need to develop tests in PE to better capture the whole pattern of students' fundamental movement skills. One possibility would be using process-oriented (quality of the movement) rather than product-oriented (quantity or outcome of the movement) tests. In this study we used only product-oriented tests to analyse students' motor skills. Additionally, in future it would also be important to include motivational climate dimensions pertaining to autonomy support and social relatedness in studies applying the motivational sequence model when examining determinants of movement skills. This might provide important information as to whether other qualities of the social context add to the prediction of fundamental motor skills in PE.

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III

FUNDAMENTAL MOVEMENT SKILLS AND MOTIVATIONAL FACTORS INFLUENCING ENGAGEMENT IN PHYSICAL ACTIVITY.

by

Kalaja, S., Jaakkola, T., Liukkonen, J. & Watt, A. (2010). *Perceptual and Motor Skills* 111(1), 115-128.

IV

DEVELOPMENT OF JUNIOR HIGH SCHOOL STUDENTS' FUNDAMENTAL MOVEMENT SKILLS AND PHYSICAL ACTIVITY IN A NATURALISTIC PHYSICAL EDUCATION SETTING.

by

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Development of junior high school students' fundamental movement skills and physical activity in a naturalistic physical education setting

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Background: There is evidence showing that fundamental movement skills and physical activity are related with each other. The ability to perform a variety of fundamental movement skills increases the likelihood of children participating in different physical activities throughout their lives. However, no fundamental movement skill interventions implemented with junior high school students have yet been reported.
Purpose: To investigate the changes in students' locomotor, manipulative, and balance skills and their level of self-reported physical activity during the specific intervention program aiming to increase students' fundamental movement skills in Finnish junior high school physical education.
Participants and setting: 446 Finnish Grade 7 students (~13 years old) from Central Finland.
Research design: A quasi-experimental intervention study with pre-, middle-, post-, and retention tests was used. The experimental group consisted of 199 students taught by 4 teachers and the control group included 247 students taught by 6 teachers. The intervention consisted of 33 sessions, 25 minutes of each, and included training of fundamental movement skills within naturalistic physical education classes during one academic year.
Data collection: There were four waves of measurement for fundamental movement skill tests and self-reports of physical activity.
Data analysis: Repeated measures MANOVAs were conducted to analyze interactions between condition (experimental/control) and time (four measurement points). In cases with an interaction between condition and time, follow-up post hoc tests were performed to examine which group means differed from each other.
Findings: Results indicated significant condition × time interaction in static balance, dynamic balance, balance skills sum score, movement skills sum score, and self-reported physical activity. The experimental group demonstrated more positive development of these variables compared to the control group.
Conclusions: This study revealed that it is possible to develop junior high school students' fundamental skills through physical education. These changes seem to be more obvious when focusing on students' balance skills. Although further longitudinal investigation is needed, the fundamental movement skill intervention seemed also to prevent the typical decline in physical activity within junior high school students.

Keywords: movement skills; physical activity; intervention; school physical education

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Introduction

There is evidence showing that four- to seven-year-old children's fundamental movement skills and physical activity are weakly interrelated (McKenzie et al. 2002; Raudsepp and Päll 2006; Sääkslahti et al. 1999). More specifically, studies have shown that childhood motor skill proficiency influences adolescent physical activity and fitness (Barnett et al. 2008a, 2008b). Therefore, the ability to perform a variety of fundamental movement skills (FMS) increases the likelihood of children's participation in different physical activities throughout their lives (Haywood and Getchell 2009; Stodden et al. 2008). Subsequently, sufficient fundamental movement skills are considered as one of the most important antecedents of physical activity and can facilitate participation and success in many sport and exercise activities undertaken during school and leisure time (Barnett et al. 2008a, 2008b).

FMS consist of locomotor, manipulative, and balance skills. Locomotor skills refer to a body moving from one point to another in a vertical or horizontal dimension. Activities, such as walking, running, jumping, hopping, skipping, galloping, sliding, leaping, and climbing are representative examples of locomotor movement skills (Gallahue and Cleland-Donnelly 2007). Manipulative skills include either gross motor or fine motor movements. Gross motor manipulative skills involve movements that give force to objects or receive force from objects. Throwing, catching, kicking, trapping, striking, volleying, bouncing, rolling, and punting are examples of fundamental gross motor manipulative skills. Fine motor manipulative skills refer to small object-handling activities that emphasize motor control, precision, and accuracy of movement. Balance refers to both the body remaining in place but moving around its horizontal or vertical axis (Gallahue and Cleland-Donnelly 2007) and the process for maintaining postural stability (Westcott, Lowes, and Richardson 1997). More specifically, Westcott, Lowes, and Richardson defined static balance as 'the ability to maintain a posture, such as balancing in a standing or sitting position', and dynamic balance as 'the ability to maintain postural control during other movements, such as reaching for an object or walking across a lawn' (630). According to Gallahue and Cleland-Donnelly (2007), axial movements, such as bending, stretching, twisting, turning, swinging, body inversion, body rolling, and landing/stopping are all considered as balance skills.

In motor learning literature there are two hypotheses describing skill acquisition. One is the transfer, which implies to the influence of previous practice or performance of a skill or skills on the learning of a new skill (Magill 2007). Another one is called the specificity hypothesis which suggests that abilities are specific to the task or goal of the activity and not transferable (Henry 1958). According to O'Keeffe, Harrison, and Smyth (2007), researchers have typically applied either transfer or specificity hypothesis as theoretical framework of studies concerning motor learning and only few studies have utilized both perspectives concurrently. Therefore, these hypotheses are rather contradictory in the motor learning research and have created a debate among scientists. Another finding from O'Keeffe, Harrison, and Smyth (2007) was that there is not much empirical evidence on any of these two hypotheses in practical learning/teaching situations. This suggests that conclusions made by many practitioners when selecting methods of learning and teaching may not have a strong scientific base. O'Keeffe, Harrison, and Smyth (2007) also found that only few researchers have tried to combine transfer and specificity hypotheses (Cratty 1966; Sharp 1992). According to these assumptions novices can use basic motor skills with some degree of success. However, when a learner adopts more skills, technique become more distinctive and practice must be specific.

An example of research supporting both the transfer and the specificity hypotheses is reported by O'Keeffe, Harrison, and Smyth (2007). They implemented an intervention for 46 senior high school students (mean age 15.8 years) and found that students who were taught the fundamental over-arm throw, improved skills in throwing, but also in badminton overhead clear and the javelin throw. These results support the transfer hypothesis. The group who were taught badminton overhead clear improved in badminton clear but not in over-arm or javelin throws. These results imply specificity hypothesis. Altogether, O'Keeffe, Harrison, and Smyth's (2007) study results show that adolescents learn motor skills in both ways; by practicing fundamental movement skills, and by rehearsing specific skills.

Motor development literature have typically utilized the transfer hypothesis suggesting that movement skill level during childhood represents a significant transfer effect when an individual acquires general skills that can be used later in more specific situations related to physical activity engagement (Haywood and Getchell 2009). Therefore, researchers supporting the transfer hypothesis have recommended that physical education curricula should include a lot of activities where students have the potential to develop their fundamental movement skills (McKenzie 2007). In our study we apply the transfer hypothesis because the participants of the study are relatively young without years of experience in practicing a wide variety of motor skills. In other words, they have not yet reached the level of skills when techniques are becoming more distinctive and practice must be specific (Cratty 1966; Sharp 1992).

The present literature suggests that the sensitive learning period for the development of FMS is between two and seven years of age (Gallahue and Cleland-Donnelly 2007). However, as suggested by Martin, Rudisill, and Hastie (2009) it is important to recognize that children do not acquire these skills as a result of the maturation process but rather through a teacher's or coach's instruction and practice. After the sensitive learning period, children naturally move to a specialized movement skill phase which starts around the age of seven years. In this period, they begin to develop an interest in a wide variety of sport and physical activities. However, they need to acquire an appropriate level of fundamental movement skills before they can learn specific sport skills. Failure to take advantage of this sensitive movement skill phase in childhood makes it more difficult to attain higher levels of motor skills later in their life (Gallahue and Cleland-Donnelly 2007).

Research has revealed that many children demonstrate mature patterns of motor skill development by the age of 10 (Ulrich 2000). However, a review of the norms proposed by Ulrich showed that for many of the fundamental movement tasks proposed by the Test of Gross Motor Development (Ulrich 2000), approximately 30 to 40% of children had not reached the mature pattern of motor skills. In Finland large scale studies revealed that 14-year-old students had better fundamental movement skills compared with 11-year-old students (Nupponen 1997; Nupponen, Soini, and Telama 1999; Nupponen and Telama 1998) which implies that in junior high school it is still possible to improve students' fundamental movement skills such as leaping, running, balancing, dribbling, and throwing.

Although childhood and adolescence are crucial time periods for developing FMS, the review of the literature indicates that most motor skill interventions have been implemented within adapted physical education (Pless and Carlsson 2000) and in kindergarten or preschool settings (Martin, Rudisill, and Hastie 2009; Sääkslahti et al. 1999). Although research has been conducted on the relationship of physical activity to fundamental motor skills among adolescents (Hands et al. 2009; Okely, Booth, and Patterson 2001; Raudsepp and Liblik 2002), there is a lack of research with motor skill interventions implemented within that age group. This is a clear shortcoming because it is evident that fundamental movement skills are linked with physical activity also in junior high school aged adolescents (Barnett et al. 2008a). Therefore, it is important to study if and how FMS can be developed in junior high school physical education by designing a special intervention and how possible improvements in FMS are associated with students' physical activity.

The purpose of the study was to investigate whether students' locomotor, manipulative, and balance skills as well as the level of self-reported physical activity increase through specific intervention in Finnish Grade 7 students. We hypothesized that the intervention would have a positive effect on students' locomotor, manipulative, and balance skills as well as their level of self-reported physical activity.

Method

Participants and setting

The participants of the study consisted of 446 Finnish Grade 7 students (∼13 years old). The experimental group consisted of 199 students (110 girls and 89 boys) of one school, from nine classes, taught by four physical education (PE) teachers. The teaching experience of the experimental group teachers varied from 2 to 10 years. One of them was working in his first school, whereas others had been working in two or three different schools. Teachers' teaching experience in the control group varied from 5 to 15 years. The control group consisted of 247 students (120 girls and 127 boys) from two schools (13 classes in total), taught by six teachers. Regarding demographics, these three schools represent a typical Finnish junior high school sample concerning students' population and class size. All students represented the region of Central Finland. In order to collect data, convenience sample procedures were followed based on the distance of the school from the University. The data collection procedure required altogether 150 visits at schools, and therefore the participating schools were chosen from proximal location of the university.

Movement skill intervention design

The purpose of the intervention was to develop students' fundamental movement skills within the intervention year. Teachers participated in the intervention voluntarily. At first, teachers were interviewed in order to clarify their level of interest to participate in the intervention. Before the start, they were also informed about the goals, methods, and procedures of the intervention.

Prior to the intervention, a team of academics organized a set of seminars and workshops for the teachers in the experimental group, which included: a) seminar on fundamental movement skills; b) workshop about planning the intervention content and the use of the spectrum of teaching styles (Mosston and Ashworth 2002). Altogether four sessions were organized starting with a two-day seminar and continuing with two four-hour workshops. Additionally, in the middle of the intervention a three-hour workshop was also organized in order to discuss the experiences on the first phase of the intervention and to check the plans of the second half of the intervention.

In the planning phase, the researcher and teachers of the experimental group together designed curriculum contents that would be realistic and feasible in naturalistic physical education settings. The researcher was responsible for transferring the theoretical background of fundamental movement skills in the intervention. However, the planning of the intervention represented a cooperative process with physical education teachers being actively involved in the planning of PE lessons. Based on the cooperative planning process, the researcher drew up the final lesson plans, which were delivered to the intervention teachers at least one week prior to each class. All PE lesson plans were standardized to guarantee that all four teachers participating in the intervention implemented the same content and had the same learning objectives. Although the lesson plans were standardized, the four teachers did not run the class at the same time.

The intervention included FMS training sessions, which focused on developing one dimension of FMS at each time (locomotion, manipulation, or balance). Each FMS training session lasted 25 minutes. The FMS training sessions were scheduled at the beginning of the PE class and, therefore, were marketed to the students as prolonged warm-up periods. The FMS sessions included activities and exercises, the purposes of which were to develop students' fundamental movement skills individually and/or privately, which is reflective of the style B (Mosston and Ashworth 2002, 94). Activities within the FMS sessions were planned to include plenty of differentiation in order to enable students with different skill levels to participate. Examples of each FMS training session are presented in Appendices 1–3. After each FMS training session, PE teachers in the experimental group followed the guidelines stemming from the Finnish National Core Curriculum. After each intervention session PE teachers still had approximately 60 minutes for practicing sport skills, such as volleyball, orienteering, and skiing, which are determined in the Finnish National Core Curriculum. Therefore, all content defined in the Finnish National Core Curriculum were conducted despite of the intervention.

The intervention lasted 33 weeks, which covers almost the whole academic year. The curriculum was organized and divided into 11 blocks. Each block lasted three weeks and focused on one of the FMS (locomotion, manipulation, and balance). So, to sum up, there were 11 weeks for locomotive skills, 11 for manipulation skills, and 11 for balance skills. In the FMS training sessions, teachers were asked to use the practice style of teaching, representing style B in the continuum of teaching cycles of Mosston and Ashworth (2002). Although the practice style was used, the teachers guided and encouraged students to be active by themselves. The students were given plenty of autonomy when selecting practices matching their skill level. This implies also the use of the inclusive style of teaching (style E; Mosston and Ashworth 2002) where students make choices over task difficulty.

Physical education teachers in the control group followed the guidelines stemming from the Finnish national curriculum. In Finland, students in the junior high school (grades 7–9) have one PE lesson weekly, comprising of two consecutive 45-minute lessons. Thus, the amount of obligatory physical education was the same for all three schools.

Data collection and procedures

The intervention lasted one academic year starting in the middle of August 2007 and lasted until the end of May 2008. The intervention consisted of three phases: i) educational phase (PE teacher seminars and workshops), ii) planning phase (teachers in conjunction with the research team planned the lessons for FMS training sessions) and iii) implementation phase (running the intervention).

There were four waves of measurements almost every four months: a) baseline measurement was carried out before the start of the intervention in August 2007; b) the second measurement was held in January 2008; c) the third measurement was done at the end of the intervention in May 2008; and d) the retention test was carried out in December 2008.

The students responded to the physical activity instrument under the presence of one of the researchers. All FMS tests were conducted in the indoor sport facilities of each school. The researchers coordinated the testing sessions and recruited assistance from the PE teaching staff whenever it was required. Each measurement period started with a warm-up phase. The measurement protocol lasted approximately 90 minutes. Students participated voluntarily, and their parents' informed consent was acquired based on the guidelines of the Ethical Committee of the University of Jyväskylä.

Treatment validity

The treatment validity was confirmed through monitoring of the implementation of the intervention by one of the researchers and by interviewing PE teachers who participated in the intervention. Because the lesson plans were designed by the teachers in conjunction with the research team and were standardized, the monitoring of the implementation of the intervention was possible. One of the researchers observed every fifth lesson of each teacher and compared the class content with the lesson plan. Additionally, all intervention teachers reported weekly to the researcher if the lesson was executed as planned or if the plan was not implemented. Through these procedures, the researchers ensured that the teachers had implemented the intervention lesson plans as they were designed. Teachers did not report remarkable deviances between planned and implemented lessons through the intervention.

Instrumentation

In order to examine intervention effects on students' fundamental skills, the following tests were chosen by the researchers based on the content of PE lesson plans and the learning outcomes of the intervention plan: a) flamingo standing test, b) rolling test, c) leaping test, d) shuttle run test, e) rope jumping test, f) accuracy throwing test and g) figure-8 dribbling test. The students in the intervention group did not have any practice for the specific tests prior to the measurements. Also, in order to measure physical activity a self-report scale was used.

Flamingo standing test

Static balance was measured using the flamingo standing test (EUROFIT 1988). In this test procedure, the participant balances for 30 seconds on one leg on a 50 cm long, 4 cm high, and 3 cm wide wooden beam. The free leg is bent backwards and the back of the foot is gripped with the hand of the same side. No practicing time before the test is allowed. Each time that the participant loses his/her balance by releasing the free leg or touches the floor with any part of the body, stopwatch is stopped. After each fall, the same procedure starts again. The number of attempts required to complete the 30 seconds time period is the participant's final score. The test is executed twice (2×30 seconds), first with the right leg and then with the left leg, and the scores are summed up. The researcher announces time limits and records the attempts. Nupponen (1997) reported test-retest correlations of .53 for the boys and .59 for the girls for the flamingo standing test. Tsigilis, Douda, and Tokmakidis (2002) examined the reliability of flamingo standing test with university students.

In their study, the test-retest correlation for the flamingo standing test was .73. These two previous studies showed that the flamingo standing test has demonstrated moderate reliabilities.

Rolling test

Dynamic balance was analyzed by the rolling test, which was implemented on a 6-meter long gymnastic mat. The starting position is lying on the mat face down and arms extended. The task is to roll a 5-meter distance over the end line and back to the starting line as fast as possible. If the subject moves away from the mat, the researcher asks him to move back on the centerline and continue rolling, while the stopwatch continues the timing procedure. Two warm-up turns are allowed before the actual test. Finnish PE studies have demonstrated rolling test to be a reliable tool for measuring junior high school students' balance skills. Kalaja, Jaakkola, and Liukkonen (2008) recognized that the test-retest correlation of the rolling test was .71, indicating adequate reliability of the test.

Leaping test

The leaping test was used to measure one component of students' locomotor skills. The leaping test is widely used in Finnish PE because it is included in the Finnish Fitness Test Package, which physical education teachers normally implement at least once a year in junior high schools (Nupponen, Soini, and Telama 1999). In the leaping test, the task is to leap five times consecutively starting from the initial leaping position with both legs parallel. After the first jump the leaping sequence is a leap with the preferred leg followed by a leap with the opposite leg until the sequence of five leaps is completed. The test is performed on a 6 cm thick gymnastics mat. The final landing is also completed with both legs parallel. The result is calculated from measuring the total length of the five leaps. The participants are allowed to practice three times before the actual test, which is implemented once. Nupponen and Telama (1998) analyzed the reliability of the leaping test with 548 Grade 8 Finnish students and reported a test-retest correlation of .95 for boys and .93 for girls.

Shuttle run test

A modified shuttle-run test was used to measure one component of students' locomotor skills (Nupponen and Telama 1998). This specific shuttle-run test is also widely used in Finnish PE because it is also part of the Finnish Fitness Test Package. In this modified shuttle-run test the aim is to run as fast as possible 10 times over a five meter distance, alternating between the forwards and backwards direction. The participant always faces the same side, and both legs should pass the five-meter marker line at each turn. The result is the total running time for 10 shuttles. No practicing is allowed before the test. This test is a modification of a widely used shuttle-run test, where the participants run forward all the time. Research has demonstrated that this shuttle-run test is a reliable tool to analyze children's locomotor skills (Fjørtoft 2000; Houwen et al. 2006). Additionally, Kalaja, Jaakkola, and Liukkonen (2008) recognized that the test-retest correlation of the shuttle run test was .78, indicating adequate reliability of the test.

Rope jumping test

In this test, subjects are asked to jump rope on one leg as many times as possible in 30 seconds. Five test trials with each leg before the actual execution is allowed. The length of the rope is adjusted so that the rope touches the floor when elbows are in a 90-degree angle. The subject decides about the starting leg. After 15 seconds, the researcher gives a 'change' signal, and the jumping leg changes. The researcher counts the total number of successful jumps in 30 seconds. Studies in Finnish physical education have demonstrated rope jumping test to be reliable. Kalaja, Jaakkola, and Liukkonen (2008) revealed that the test-retest correlation of the rope jumping test was .84, indicating satisfactory reliability for the test. Additionally, they found that the results of the rope jumping test correlated significantly with leaping and shuttle-run test scores, indicating the validity of the test.

Accuracy throwing test

The accuracy throwing test was used to analyze a component of students' manipulative skills. The task is a part of the APM-Inventory, a Finnish test developed for assessing pre-school children's perceptual and fundamental movement skills (Numminen 1995) as it was modified by Kalaja, Jaakkola, and Liukkonen (2008). The target is a wooden circle hanging vertically on the wall. The center of the target is set at average eye-level height for children of this age (150cm boys/145 cm girls). The diameter of the three-point area is 20 cm, two-point area 40 cm, and the one-point area 60 cm. The throwing distance to the target is five meters. The throwing object is a tennis ball. The participants are allowed two practice attempts with each hand. Only overarm throws are allowed. The score is the total number of points from ten throws (five with right hand and five with left hand). The researcher stands by the throwing target recording students' scores. In cases where the throw is between two different scores, higher score is given. Accuracy throwing test has been found to be a reliable tool to measure young children's manipulative skills (Sääkslahti et al. 1999). However, Kalaja, Jaakkola, and Liukkonen (2008) recognized that the test-retest correlation of the accuracy throwing test was .46, demonstrating only moderate reliability of the test within Grade 7 students in Finnish PE.

Figure-8 dribbling test

Manipulative skills were assessed using the figure-8 dribbling test in which the task is to dribble volleyball around a figure-8 track, first using the feet (30 sec.), and then using the hands (30 sec.). The participants are allowed to execute two practice trials. The test starts with the participants standing behind the starting line, and following the 'go' signal they start to dribble the ball with their feet along the figure-8 track. The track is marked with arrows indicating the dribbling direction. Both the participant and the ball have to go around the marker cones. After 30 seconds the researcher gives a 'change' instruction, and the manipulation style is switched to hand-dribbling. In the hand-dribbling test, the ball is not allowed to pass the cones. Changing of the dribbling hand is allowed. The total dribbling time is one minute. If the ball leaves the test area (i.e. ringed zone constructed of wooden gymnastic benches) the stopwatch is not stopped. The final result is the total number of crossed lines in one minute. The dribbling test is a part of the widely used Finnish Fitness Test Package (Nupponen, Soini, and Telama 1999). Nupponen (1997) reported the test-retest correlation of .70 for the boys and .60 for the girls for a large sample of Finnish school students. These correlations demonstrate moderate reliability of the figure-8 dribbling test.

Physical activity

Physical activity was examined using a two-item self-report scale originally developed by Prochaska, Sallis, and Long (2001). The Finnish version of the scale has been modified by Vuori et al. (2004). The stem for the items was: 'In the next two questions physical activity means all activities which raise your heart rate or momentarily gets you out of breath for example in doing exercise, playing with your friends, going to school, or in school physical education. Physical activity also includes for example jogging, intensive walking, roller skating, cycling, dancing, skating, skiing, soccer, basketball, and baseball.' The items were: 'Think about your typical week. How many days did you exercise for at least 60 min. during which you got out of breath' and 'Think about your last 7 days. How many days did you exercise for at least 60 min. during which you got out of breath?'. Both items are presented using an eight-point response scale (0 to 7 days in a week). A sum-scale of physical activity is computed by calculating a mean score for the two items. This scale has shown acceptable levels of internal consistency with teenagers (Prochaska, Sallis, and Long 2001; Vuori et al. 2004) and it was chosen for reasons of suitability due to the size of the sample.

Data analyses

The EM data imputation method was used in order to replace missing values. The percentage of missing values per variable was less than 5%. Also, univariate and multivariate outliers were excluded according to procedures described by Tabachnick and Fidell (2007, 72–77) in order to prevent extreme values from distorting statistical analyses. Those outliers are considered to be basically exceptional performances of highly skilled adolescents that probably had higher participation in sport activities or were athletes and therefore did not represent the average scores of the population. According to Tabachnick and Fidell (2007, 72–77), it is more appropriate to examine those outliers on their own. Twenty variables out of 32 did not include outliers. The remaining 12 variables included outliers varying from 1 to 13 cases. These outliers were excluded from the statistical analyses.

Kolmogorov-Smirnov tests were conducted to examine the normality of the distributions. Descriptive statistics and Pearson's product moment correlation coefficients were analyzed in order to examine the mean level of measured variables and to investigate associations among variables. Independent samples *t*-tests were conducted to examine possible differences in the fundamental movement skill test scores and the physical activity score between the experimental and the control group in the baseline measurement. Subsequently, repeated measures MANOVAs were carried out to analyze the interaction between condition (experimental/control) and time (four measurement points) in any individual fundamental movement skill test and physical activity score. In cases where the interaction between condition and time was found, follow-up post hoc tests were performed to examine which group means differed from each other. Before each MANOVA, Mauchly's test was firstly used to check the assumption of sphericity.

In the next step of the analyses, all movement skill scales were standardized by using Z-scores. Three sum scores (balance, locomotion, and manipulation) were also computed in order to investigate whether the intervention affected any of the fundamental movement skill categories as a whole. This was done by summing up tests measuring specific types of movement skills. Additionally, a movement skill sum score was calculated by summing up all individual movement skill test scorers

Results

Preliminary analyses

Kolmogorov-Smirnov test scores indicated that all variables demonstrated normal distribution ($p > .05$). Independent samples *t*-tests revealed that there was only one statistically significant difference between the experimental and the control group in the baseline test. Students in the control group demonstrated higher scores in figure-8 dribbling test compared with the students in the experimental group ($t = [361] = 2.49$, $p = .013$). Apart from that, there were no other baseline differences (*t*-test *p*-value $> .05$).

Correlations

Pearson product moment correlations showed that the associations between the variables in the first and the third measurement were quite similar (Table 1). The only notable difference was found between physical activity and FMS performances. The association between physical activity and FMS was stronger in the third measurement compared with the first measurement. Correlation analyses also demonstrated that all individual skill tests were highly associated with the sum score of the respective movement skill category. For example, flamingo standing test and rolling test correlated highly with the balance skill sum score. These high correlations indicate an appropriate reliability of the movement skill tests.

Repeated measures MANOVAs

The MANOVA for the flamingo standing test revealed significant interaction between condition and time (Huynh-Feldt's F[2.852] = 6.45, $p = .000$). Follow-up MANOVAs (post hoc) revealed that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F8[1.00] = 10.25, $p = .001$), between the first and the fourth measure (Huynh-Feldt's F[1.00]) = 4.03, $p = .046$), between the second and the third measure (Huynh-Feldt's F[1.00] = 14.14, $p = .000$), and between the second and the fourth measure (Huynh-Feldt's F[1.00] = 5.48, $p = .020$). Scores of the experimental group decreased in static balance from the first to the third measure, from the second to the third measure, and from the first to the fourth measure (Table 2). This decrease demonstrates significant improvement in static balance due to the intervention while the control group demonstrated no statistically significant development in static balance. After the intervention there were no differences in the development of the static balance between the experimental and control groups.

The MANOVA for the rolling test revealed significant interaction between condition and time (Huynh-Feldt's F[2.71] = 11.03, $p = .000$). Follow-up MANOVAs revealed that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F[1.00] = 25.37, $p = .000$), between the second and the third measure (Huynh-Feldt's F[1.00] = 17.00, $p = .000$), and between the third and the fourth measure (Huynh-Feldt's F[1.00] = 17.04, $p = .000$). Dynamic balance in the experimental group decreased during the four measurement phases, whereas the control group's dynamic balance decreased only from the third to the fourth measure. These trends in the rolling test scores show that the intervention improved students' dynamic balance, whereas the control group had no statistically significant change in dynamic balance at the same time. After the intervention both groups improved in dynamic balance but the control group demonstrated greater improvement.

Table 1. Correlations among students' fundamental movement skills and physical activity.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Flamingo standing	-											
2. Rolling	0.24***	-										
	0.17***											
3. Leaping	0.19***	0.26***	-									
	0.32***	0.26***										
4. Shuttle running	0.33***	0.30***	0.52***	-								
	0.33***	0.31***	0.63***									
5. Rope jumping	0.38***	0.01	0.20***	0.25***	-							
	0.47***	0.05	0.30***	0.24***								
6. Accuracy throwing	0.11*	0.12*	0.26***	0.24***	0.24***	-						
	0.17***	0.24***	0.24***	0.25***	0.02							
7. Dribbling	0.14**	0.24***	0.43***	0.43***	0.07	0.32***	-					
	0.28***	0.29***	0.50***	0.28***	0.14**	0.28***						
8. Balance skills	0.75***	0.76***	0.30***	0.42***	0.26***	0.16**	0.25***	-				
sumscore (Z-score)	0.78***	0.78***	0.37***	0.42***	0.34***	0.26***	0.36***					
9. Locomotor skills	0.39***	0.25***	0.78***	0.80***	0.66***	0.11***	0.42***	0.42***	-			
sumscore (Z-score)	0.46***	0.26***	0.84***	0.82***	0.69***	0.21***	0.52***	0.46***				
10. Manipulative skills	0.15**	0.20***	0.42***	0.39***	0.03	0.82***	0.83***	0.23***	0.38***	-		
sumscore (Z-score)	0.27***	0.33***	0.46***	0.51***	0.07	0.81***	0.81***	0.38***	0.46***			
11. Motor skills sumscore	0.56***	0.50***	0.70***	0.75***	0.47***	0.51***	0.64***	0.70***	0.85***	0.70***	-	
(Z-score)	0.63***	0.55***	0.75***	0.77***	0.52***	0.51***	0.81***	0.75***	0.86***	0.76***		
12. Physical activity	0.03	0.07	0.06	0.12*	0.07	0.06	0.12*	0.08	0.11*	0.10	0.14**	-
	0.10	0.09	0.17**	0.18**	0.09	0.14**	0.25***	0.13*	0.20***	0.24***	0.25***	

Notes: Correlations in the first measurement above and in the third measurement below.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 2. Descriptive statistics and repeated measures MANOVA results.

	Experimental group				Control group				RM-MANOVA (Condition x Time)		
Variable	m1(sd)	m2(sd)	m3(sd)	m4(sd)	m1(sd)	m2(sd)	m3(sd)	m4(sd)	F(df)	*p*-value	Eta^2
1. Flamingo standing (errors)	10.94 (5.15)	10.60 (5.02)	9.04 (4.16)	9.17 (4.44)	11.35 (4.79)	10.97 (4.90)	10.88 (4.89)	10.37 (4.55)	6.45 (2.85)	0.000	0.02
2. Rolling (sec.)	14.82 (2.99)	13.55 (2.63)	12.92 (2.36)	12.01 (2.27)	15.07 (3.09)	14.24 (2.91)	14.69 (2.87)	12.85 (2.63)	11.03 (2.71)	0.000	0.03
3. Leaping (cm)	875 (100)	881 (114)	884 (111)	921 (119)	865 (111)	855 (117)	859 (117)	895 (122)	2.49 (2.63)	0.068	0.01
4. Rope jumping (number of jumps)	35.03 (17.56)	37.34 (17.34)	38.73 (17.56)	42.27 (17.76)	33.25 (14.50)	37.08 (16.58)	37.47 (16.50)	41.00 (16.34)	0.70 (2.86)	0.547	0.00
5. Shuttle running (sec.)	24.07 (2.12)	23.98 (2.21)	23.84 (2.23)	23.66 (2.33)	24.22 (2.13)	24.10 (2.52)	23.91 (2.51)	23.49 (2.35)	0.62 (2.95)	0. 601	0.00
6. Figure-8 dribbling (number of sides)	14.30 (2.85)	15.26 (2.93)	15.34 (2.96)	15.96 (2.89)	15.08 (3.04)	15.64 (2.96)	15.71 (3.09)	16.50 (3.07)	1.20 (2.85)	0.309	0.00
7. Accuracy throwing (points)	8.04 (3.64)	8.22 (4.09)	9.51 (4.52)	8.92 (4.18)	8.10 (4.21)	8.22 (3.91)	8.57 (4.21)	8.95 (3.65)	2.14 (2.96)	0.095	0.01
8. Balance skills sumscore (Z-scores)	0.02 (0.76)	0.06 (0.73)	0.28 (0.65)	0.12 (0.73)	−0.07 (0.75)	−0.07 (0.76)	−0.20 (0.79)	−0.14 (0.79)	14.77 (2.84)	0.000	0.04
9. Locomotor skills sumscore (Z-scores)	0.06 (0.75)	0.03 (0.81)	0.08 (0.82)	0.02 (0.77)	−0.02 (0.71)	−0.04 (0.76)	−0.02 (0.77)	−0.04 (0.75)	0.31 (2.87)	0.813	0.00
10. Manipulative skills sumscore (Z-scores)	−0.07 (0.76)	−0.03 (0.83)	0.03 (0.80)	−0.07 (0.82)	0.09 (0.87)	0.02 (0.79)	−0.01 (0.80)	0.04 (0.78)	2.39 (2.85)	0.071	0.01
11. All movement skills sumscore (Z-scores)	0.01 (0.60)	0.02 (0.63)	0.13 (0.62)	0.00 (0.62)	0.00 (0.62)	0.04 (0.62)	0.09 (0.65)	0.04 (0.64)	7.99 (2.91)	0.000	0.02
12. Physical activity (days per week)	4.28 (1.64)	4.07 (1.59)	4.43 (1.56)	4.17 (1.68)	4.31 (1.65)	4.07 (1.79)	4.29 (1.62)	3.83 (1.59)	2.77 (1.00)	0.044	0.01

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

The MANOVA for the students' physical activity revealed significant interaction between condition and time (Huynh-Feldt's F[2.78] = 2.77, $p = 0.044$). Follow-up MANOVAs demonstrated that the experimental and the control group differed between the first and the fourth measure (Huynh-Feldt's F[1.00] = 5.53, $p = 0.019$), and between the second and the fourth measure (Huynh-Feldt's F[1.00] = 5.92, $p = 0.016$). The descriptive statistics revealed that the level of physical activity decreased in both groups from the first to the fourth measure. However, the decrease in the control group was greater, mostly due to the biggest drop between the third and the fourth measure.

The MANOVA for the balance skill sum score revealed significant interaction between condition and time (Huynh-Feldt's F[2.84] = 14.77, $p = .000$). Follow-up MANOVAs demonstrated that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F[1.00] = 29.90, $p = .000$), between the first and the fourth measure (Huynh-Feldt's F[1.00] = 6.08, $p = .014$), between the second and the third measure (Huynh-Feldt's F[1.00] = 31.17, $p = .000$), between the second and the fourth (Huynh-Feldt's F[1.00] = 5.30, $p = .022$), and between the third and the fourth measure (Huynh-Feldt's F[1.00] = 13.30, $p = .000$). The Z-scores demonstrated that the experimental group increased in balance skills during the intervention, whereas the control group decreased in balance skills. After the intervention the experimental group decreased and the control group slightly increased in balance skills.

The MANOVA for the movement skills sum score revealed significant interaction between condition and time (Huynh-Feldt's F[2.93] = 7.99, $p = .000$). Follow-up MANOVAs showed that the experimental and the control group differed between the first and the third measure (Huynh-Feldt's F[1.00] = 18.28, $p = .000$), between the second and the third measure (Huynh-Feldt's F[1.00] = 12.70, $p = .000$), and between the third and the fourth measure (Huynh-Feldt's F[1.00] = 12., $p = .000$). The Z-scores revealed that the experimental group demonstrated higher movement skill sum score development during the intervention compared with the control group. However, after the intervention the movement skill sum score decreased more in the experimental group than in the control group.

It should be noticed that there were differences in the dribbling skill test scores between the experimental and the control group at the baseline measurement. Therefore, a repeated measures MANCOVA was conducted to investigate if there were differences in figure-8 dribbling test score between the experimental and the control group after adjustment of the baseline measurement of the dribbling skill. In the MANCOVA, the baseline measurement was used as covariate, the type of a group (experimental/control) as independent, and the second, the third, and the fourth measurements as independent variables. The repeated measures MANCOVA for the figure-8 dribbling test was not significant (Huynh-Feldt's F[1.75] = 0.31, $p = 0.735$, $eta^2 = 0.001$), suggesting that after adjusting for differences in the baseline measurement of the dribbling skill, there were no differences between the experimental and the control group in any of the other measurements.

Discussion

The purpose of the study was to investigate whether students' locomotor, manipulative, and balance skills, and the level of their self-reported physical activity developed during the intervention aiming to improve students' fundamental movement skills. This was the first reported movement skill intervention conducted in junior high school physical education.

The results of the study revealed that the intervention group improved both in static and dynamic balance during the intervention. An improvement was also evident in the balance skill sum score, in which static and dynamic balance scores were standardized by using Z-scores, and summed together. However, after the intervention dynamic balance and balance skill sum score developed more positively within the control group. Although the change occurred after the intervention, the experimental group remained at higher level in dynamic balance and balance sum score in the retention test. This result probably implies that static and/or dynamic balance need constant practice in order to sustain the gains of FMS training or that it takes more practice time in order to stabilize those balance performance scores in higher levels. Moreover, although no longitudinal studies of fundamental skills in teenagers have been reported, we need to have in mind that balance (both static and dynamic) can be affected by the rate of growth. It is widely known that teenagers are gaining height at this age and usually these changes happen mostly during the summer season, which was in between the third and fourth wave of measurement. We may thus hypothesize that students' balance skills at this age are not stable even after a FMS training period due to changes in growth (e.g., increase in height).

The results also indicated that the experimental group scored higher in the FMS sum score compared with the control group. However, after the intervention the FMS sum score decreased more in the experimental group than in the control group. Although the gains of the intervention on FMS were small and leveled after the intervention, the finding that the intervention improved students' FMS is remarkable because it has been recognized that the level of childhood movement skills is linked with later physical activity (Barnett et al. 2008a, 2008b). The ability to perform a variety of fundamental movement skills increases the likelihood of children participating in different physical activities throughout their lives (Stodden et al. 2008). Motor development literature has suggested that the sensitive learning period to develop fundamental movement skills is between two and seven years of age (Hynes-Dusel 2002; Ulrich 2000). This study, however, revealed that it is still possible to increase students' FMS by specific intervention even in the junior high school ages.

Concerning self-reported physical activity, the decrease in the control group was significantly greater, mostly because of the biggest drop between the third and the fourth measurement. Although the effect size was small, the fundamental movement skill intervention seemed to prevent the typical decline in physical activity within junior high school aged students (Telama and Yang 2000). That decline was also evident in the control group of this study. These findings together with the detected correlation changes between the first and the third measurement support previous research findings showing that FMS and physical activity are related with each other (Barnett et al. 2008a, 2008b; McKenzie et al. 2002; Raudsepp and Päll 2006; Sääkslahti et al. 1999).

An interesting finding in this study was that balance skills rather than locomotor and manipulative skills developed during the intervention. This implies that locomotion or manipulation skills may need more time in order to progress significantly. Locomotor performances, such as running, leaping, and skipping, require certain levels of explosiveness and strength to be executed properly. Manipulative skills can be seen as more complex than balance skills because they raise issues on perceptional demands (Nessler 1973), and thus require more practice to be improved.

It is noteworthy that in this study manipulative skills were not associated with physical activity. Previous studies have revealed that the object control skills have been related with physical activity of children (Barnett et al. 2008a; Cliff et al. 2009). Nevertheless, it is important to keep in mind that we examined indirect relationships between manipulative skills and out-of-school physical activity. Additionally, another possible explanation for this result might be that in the studies of Barnett et al. (2008a) and Cliff et al. (2009) the participants were preschool-aged children, whereas in this study the participants represented Grade 7 students. Motor behavior studies pertaining preschool children typically utilize process-oriented measures, which analyze the qualitative aspects of movement skills (Ulrich 2000), while in the present study, product-oriented tests were used emphasizing the quantitative result of the performance. Therefore, future studies are needed to analyze the validity and reliability of process versus product-oriented measures especially in manipulative skills within junior high school students.

Regarding the dribbling test scores, it should be noticed that there were differences between the experimental and the control group in the baseline measure. That fact may have affected the results. However, the multivariate covariance analysis revealed that after the adjustment of the original differences, there were no differences on the dribbling skill between the experimental and the control group. This could be explained by the fact that dribbling skill is very common in several subjects of the PE curriculum and in several out-of-school sport activities for example in handball and in basketball. This implies that students both in the experimental and control group practice dribbling skills rather regularly and probably with almost the same amount of repetitions throughout the year.

The time invested in improving students' fundamental movement skills was rather limited, including approximately 33 × 25 minutes practice during the academic year. Being able to affect students' balance skills and the level of their self-reported physical activity by a curriculum alteration in a naturalistic school physical education setting gives the teachers and curriculum developers a strong positive message. Although only balance skills improved due to the intervention, the results of this study encourage physical education teachers to develop PE class activities in which students may improve their fundamental movement skills in order to promote their physical activity. Thus, developing fundamental movement skills should be one of the major aims of school PE. Today this is even more important because children and adolescents are physically more inactive than ever before (Samdal et al. 2007).

The use of self-reports in analyzing physical activity is the main limitation in this study. However, self-reports were the only viable instruments available for the study purpose where physical activity was analyzed four times with a rather large sample. The use of more objective measures would have been logistically and financially impossible. Another limitation in the study is that not all of the tests aimed to measure students' FMS have been proven as reliable in previous studies. Although this limitation exists, in this study individual test items correlated rather highly with the sum score of the respective FMS category, reflecting adequate reliability of individual tests in this study. The third limitation of this study is that the effect sizes of the analyses were rather small. Therefore, the results should be interpreted cautiously.

Future studies need to examine children's and adolescents' movement skill development and physical activity in a longitudinal design. This would provide more complete understanding of the meaning of fundamental movement skills and their relationship with students' physical activity levels and children's growth rates.

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Appendix 1. Example of locomotor skills training session

Task	Important aspects	Variations
Basic jumping jacks	Arms & legs in same rhythm	Changing speed
Jumping jacks	Arms 1-2-3, legs 1-2 rhythm	After signal back to original rhythm
Jumping jacks skiing style	Arms & legs moving front-back	Changing from skiing to original style
Jumping jacks legs sideways	Arms front-back, legs sideways	Changing speed
Jumping jacks arms sideways	Arms sideways, legs front-back	Changing speed
Skating leaps	Proper body segment alignment	Stopping after each leap
Calve jumps	Angle action	Alternating leading leg
Jumps backwards	Proper body segment alignment	Eyes closed
Leaps backwards	Proper body segment alignment	Eyes closed

Appendix 2. Example of manipulation skills training session

Task	Important aspects	Variations
Basketball dribbling two balls	Both hands simultaneously	Different types of balls
Dribbling two balls	Both hands unsimultaneously	Different types of balls
Balancing two balls	One ball on palm other ball above first ball	Different types of balls
Bouncing the ball with other ball	Vertical bouncing	Different types of balls, with one hand/two hands
Throwing balls, catching	Balls collide in the air, catching	Different types of balls and throws
Bouncing the ball with palm	Soft touch, eyes on the ball	Left / right hand
Bouncing the ball with back of the hand	Soft touch, eyes on the ball	Left / right hand
Bouncing the ball alternatively with palm and back of the hand	Soft touch eyes on the ball	Left / right hand
Two hand underarm throw upwards, catching the ball	Quick perception of ball	Meanwhile ball is in the air, landing to knees / sit / lying
Two hand underarm throw upwards, landing to lying – lifting legs – catching the ball behind hamstrings	Quick perception of ball	Different kinds of balls and throws
Two hand underarm throw upwards, turning 360 degrees – catching the ball	Quick perception of ball	Different kinds of balls and throws

Appendix 3. Example of balance skills training session

Task	Important aspects	Variations
Jump in the air	Silent landing	Eyes closed
Jump from the box	Wooden box, 30 cm high, controlled landing on gymnastic mat	Eyes closed
Jump from the box	Wooden box, 30 cm high, controlled landing on gymnastic mat	Telemark landing, alternating leading leg
Jump down backwards	Wooden box, 30 cm high, controlled landing on gymnastic mat	Eyes closed
Jump down sidewards	Wooden box, 30 cm high, controlled landing on gymnastic mat	Left / right side
Jump down with 90 degrees turn	Wooden box, 30 cm high, controlled landing on gymnastic mat	Turn left / right
Jump down backwards with 90 degrees turn	Wooden box, 30 cm high, controlled landing on gymnastic mat	Turn left / right
Jump down with full turn (360 degrees)	Wooden box, 30 cm high, controlled landing on gymnastic mat	Turn left / right
Jump down backwards with full turn (360 degrees)	Wooden box, 30 cm high, controlled landing on gymnastic mat	Turn left / right

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