MOVE! PERFORMANCE TECHNIQUE ERRORS OBSERVED BY STUDENTS IN TEACHER EDUCATION

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ABSTRACT

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Move! physical functional capacity measurements are implemented in every Finnish school for fifth (since August, 2016) and eighth (since August, 2018) grade students. The purpose of the Move! system is to particularly assist a student and his/her parents to understand the relationship between physical functional capacity, health, well-being and studying. To motivate the children to take care of their own physical functional capacity, to avoid musculoskeletal disorders and to ensure the correct information of the children's physical functional capacity, the teachers must be extensively aware of the performance techniques of these measurements. The primary school teachers carry out the Move! measurements for fifth graders.

Therefore, the purpose of this study was to discover what kinds of performance technique errors students in primary school teacher education programme are able to observe from the Move! physical functional capacity videos. In addition, the purpose was to investigate if there is a relationship between the observation of the performance technique errors and the student's background. A web-based (Webropol 2.0) questionnaire was developed specifically for this study. First questions in the questionnaire were about the background of the participant: their hobbies, previous and current physical education studies and previous professions. The questionnaire included eight videos of Move! physical functional capacity measurements that were specifically recorded for this study. These videos included different performance technique errors. The students' purpose was to detect the possible performance technique errors in the videos. Data was analyzed with IBM SPSS Statistics version 24. Descriptive analysis included percentages and mean, median, minimum and maximum values. The differences between the groups were analyzed with paired samples t-test, Pearson's r, independent samples t-test and ANOVA.

The total number of participants was 71. Based on the results the students detected on average 71 % of all the errors correct from the Move! physical functional capacity measurement videos. Curl-up (mean 4.3 points), lower back extension (mean 4.3 points) and shoulder mobility (mean 4.1 points) videos were easiest to observe because they reached the highest correct results. Whereas, throw-catch combination (mean 2.5 points), quintuple jump front (mean 2.9 points) and quintuple jump side (mean 2.9 points) videos were the most difficult ones to observe. When comparing the different body parts, students detected the least errors from head positions (mean 4.1 points). There were no statistically significant differences between participants' backgrounds and observation results, thus the background had no effect on the results in this study.

The students detected the errors best from the videos that had a calm pace and included only few moving elements. The errors were detected worst from the videos that were fast-paced and had several moving elements. Least errors were detected from head positions. In Move! education these measurement sections should be at focus. Observation skill is one of the most important skills in the profession of physical education teacher. Good observation skills enable the teacher to give positive and corrective feedback to the students. Through feedback the students are able to improve their fundamental movement skills, which increase their experiences in competence. Experiences in competence bring joy and motivate them to be physically active.

Key words: physical functional capacity, performance technique, teacher student, observation

TIIVISTELMÄ

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Move! –fyysisen toimintakyvyn mittaukset toteutetaan valtakunnallisesti kaikille perusopetuksen 5. ja 8. vuosiluokkien oppilaille. Mittaukset tulee toteuttaa 5. vuosiluokan oppilaille elokuun 2016 alusta ja 8. vuosiluokan oppilaille elokuun 2018 alusta lähtien. Move! -järjestelmän tarkoituksena on auttaa oppilaita ja heidän huoltajiaan ymmärtämään fyysisen toimintakyvyn, terveyden, hyvinvoinnin ja opiskelun yhteys. Jotta voidaan motivoida oppilaita huolehtimaan omasta fyysisestä toimintakyvystä, välttää tuki- ja liikuntaelimistön ongelmia ja taata oppilaiden tulosten tarkkuus, opettajan tulee olla hyvin tietoinen näiden mittausten oikeista suoritustekniikoista. Pääosin luokanopettajat suorittavat 5. vuosiluokkien oppilaiden Move! mittaukset.

Tämän tutkimuksen tarkoituksena oli selvittää, minkälaisia suoritusteknisiä virheitä luokanopettajaopiskelijat havainnoivat Move!-fyysisen toimintakyvyn videoista. Lisäksi, tarkoituksena oli tutkia virheiden löytymisen ja opiskelijan taustan välistä yhteyttä. Internet-pohjainen (Webropol 2.0) kyselylomake kehitettiin tätä tutkimusta varten. Kyselylomake kattoi opiskelijan taustaan liittyvät kysymykset opiskelijan harrastuksista, aikaisemmista ja nykyisistä liikunnan opinnoista sekä aikaisemmasta ammatista. Kyselylomakkeen pääosio sisälsi kahdeksan Move! -fyysisen toimintakykymittariston videota, jotka oli kuvattu tutkimusta varten. Nämä videot sisälsivät erilaisia suoritusteknisiä virheitä. Opiskelijoiden tuli havainnoida mahdolliset suoritustekniset virheet videoista. Aineiston analyysiin käytettiin IBM SPSS Statistics 24 -ohjelmistoa. Aineiston analysoimiseen käytettiin kuvailevista menetelmistä prosenttiosuuksia ja keskiarvo, mediaani, minimi ja maksimi arvoja. Ryhmien välisiä eroja analysoitiin kahden riippuvan otoksen t-testillä, Pearsonin tulomomenttikorrelaatiokertoimella (r), kahden riippumattoman otoksen t-testillä ja yksisuuntaisella varianssianalyysillä (ANOVA).

Tutkimukseen osallistui 71 opiskelijaa. Opiskelijat havainnoivat keskimäärin 71% kaikista virheistä oikein. Eniten virheitä opiskelijat löysivät ylävartalon kohotus (ka 4.3 pistettä), alaselän ojennus täysistunnassa (ka 4.3 pistettä) ja olkapään liikkuvuus (ka 4.1 pistettä) videoista. Vähiten suoritusteknisiä virheitä löytyi heitto-kiinniottoyhdistelmä (ka 2.5 pistettä), vauhditon 5-loikka edestä kuvattuna (ka 2.9 pistettä) ja vauhditon 5-loikka sivusta kuvattuna (ka 2.9 pistettä) videoista. Kun vertailtiin eri vartalonosia keskenään, vähiten virheitä opiskelijat osasivat havainnoida pään asennosta (ka 4.1 pistettä). Opiskelijoiden taustoilla ei ollut yhteyttä virheiden havainnointiin.

Videot, joista opiskelijat havaitsivat suoritusteknisiä virheitä parhaiten, olivat rauhallisia ja sisälsivät vain vähän liikkuvia vartalonosia. Videot, joista opiskelijat havaitsivat vähiten tekniikkavirheitä, olivat nopeatempoisia ja sisälsivät useita liikkuvia vartalonosia. Opiskelijat havainnoivat vähiten virheitä pään asennosta. Move! koulutuksessa tulisikin keskittyä erityisesti näihin mittausosioihin. Fyysisesti aktiivisten suoritusten havainnointitaito on yksi tärkeimmistä liikunnanopettajan taidoista. Hyvä havainnointitaito mahdollistaa myönteisen ja korjaavan palautteen antamisen oppilaille. Palautteen avulla oppilas voi parantaa motorisia perustaitojaan, mikä antaa pätevyyden kokemuksia. Pätevyyden kokemukset tuovat iloa ja motivoivat oppilaita liikkumaan.

Asiasanat: fyysinen toimintakyky, suoritustekniikka, luokanopettajaopiskelija, havainnointi

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1 INTRODUCTION

The physical activity of children and adolescents is decreasing. Reed, Warburton, Whitney & McKay (2006, 364) found that “50th percentile for fitness of children in 2004 was equivalent to that of children in the lowest 20 % of fitness in 1981”. Similarly to other countries, the physical activity in Finland decreases with age. 39 % of Finnish 11-year-old children report at least one hour of moderate-to-vigorous activity daily. At 13-year-old children the number is 26 % and at 15 years of age the number is only 17 %. (Kokko & Mehtälä 2016.) Increasing amount of evidence suggests that there is a relationship between fundamental movement skills and physical activity (Robinson et al. 2015; Stodden et al. 2008).

Fundamental movement skills are organized movement series which consists of the movement combination of two or more body parts. Fundamental movement skills are categorized in stability (e.g. stretching, landing), locomotor (e.g. running, jumping) and manipulative movements (e.g. throwing, catching). (Gallahue & Cleland-Donnelly 2003, 52-54.) Fundamental movement skills increase the experience in competence (Hardy, Barnett, Espinel & Okely 2013). Experiences in competence increase physical activity (Hardy et al. 2013; Haynes & Miller 2014; Logan et al. 2015; Reillo et al. 2010).

Low physical activity has an effect on musculoskeletal disorders. In the beginning of the follow-up study (El-Metwally et al. 2007) 93 % of the children were pain-free but after 1 year 22 % of these children reported new episodes of musculoskeletal pain: 20 % had non-traumatic pain (meaning pain without external impact, mostly on neck) and 4 % had traumatic pain (meaning pain with external impact, mostly on lower extremities). (El-Metwally et al. 2007.) Children with traumatic lower extremity pain had a 50 % lower risk of pain recurrence in 4-year follow-up compared to children with non-traumatic lower extremity pain. Hypermobility predicts pain recurrence at 4-year follow-up in adolescence. (El-Metwally et al. 2005.) Furthermore, musculoskeletal problems in children and adolescents increase with age except for 15-17-year-old girls. Difficulties in upper and lower extremities were the most common followed by spine and trunk conditions. (Henschke et al 2014.)

The physical activity is decreasing which has an effect on the musculoskeletal disorders. Also, the competence in fundamental movement skills has an effect on engaging the children to physical activities. Teachers, therefore, have an important role in motivating children and adolescents to increase their fundamental movement skills. One effective tool for motivation might be physical functional capacity measurements. These measurements provide the comprehensive understanding of one's physical function and fundamental movement skills.

Physical function is described in this thesis as the body's functional capacity to overcome the physical demands and the requirements that are set for the body (Move! 2012; Rissanen 1999). Physical function consists of the functional capacity of respiratory, cardiovascular and musculoskeletal systems, which are the prerequisites for physical performance and physical fitness. (Rissanen 1999.) Physical fitness is the ability to participate in moderate to vigorous physical activity and to maintain it throughout life. It contains health-related components (cardiorespiratory fitness, body composition, flexibility, muscular strength and muscular endurance) and performance related components (balance, reaction time, coordination, agility, speed, power). (American College of Sports Medicine 2008, 2-3). Because children's physical activity has decreased, the ability to participate to moderate to vigorous physical activities has decreased. Therefore, physical functional capacity measurements are more suitable to schools than physical fitness tests. Move! physical functional capacity measurements are utilised in this thesis.

Appropriate physical functional capacity is important to prevent injuries, to maintain good work ability and public health (Jones et al., 1993; Knapik et al., 2001; Mattila, Niva, Kiuru & Pihlajamäki 2007). In order for these children and adolescents to benefit from the measurements, the teacher must instruct the students with care and ensure the correct performance technique of the physical functional capacity measurements. Firstly, the correct performance technique learned in childhood provides us important knowledge for the future. The child learns body control and therefore is able to perform the correct technique. The correct technique prevents injuries in both childhood and adulthood. For example, in Finland, 21 % of children in physical education lessons at schools reported an injury at least once during the previous year (Kokko & Mehtälä 2016). Secondly, when the Move! physical functional capacity measurements are carried out nationally, it is important that the students perform the measurements in similar way to ensure the validity of the results. In addition, if the performance technique is not identical each time the student performs the measurements (on fifth and eighth grades), the results cannot be compared to each other and the student receives incorrect information on his/her physical functional capacity.

When the students are performing the measurements, it provides an opportunity for the teacher to observe the student with care and to ensure correct performance techniques. Therefore teachers' good observation skills are essential. However, the teachers in primary schools often teach several school subjects. Their limited time for physical education during the studies might lead to inadequate knowledge to assess fundamental movement skills (Haynes & Miller 2014). For example, in the department of teacher education in Rauma, Finland the amount of compulsory physical education studies is 6 ECTS credits, which means 8 hours of lectures, 54 hours of group teaching and 98 hours of independent work (Kasvatustieteiden tiedekunta 2016-2018 opinto-opas). Primary school teachers implement Move! physical functional capacity measurements for fifth graders.

Fundamental movement skills and musculoskeletal disorders are related to physical activity. The performance technique that a student implements (and learns for the future) and the physical functional capacity measurement results are dependent on the skills of the observer, in this case the teacher. However, the primary school teacher's abilities to observe might be inadequate. The teacher's good observation skills enable him/her to give feedback to the students. Through feedback the students are able to improve their fundamental movement skills, which increase their experiences in competence. These experiences bring joy and motivate students to be physically active. Therefore, the aim of the thesis was to find out what kind of performance technique errors students in primary school teacher education programme observe from the Move! physical functional capacity videos.

2 MOVE!

Different physical fitness tests have been utilised in schools for a long time. Move! is a Finnish monitoring system that provides equal protocol of measuring pupils’ physical functional capacity. Previous physical fitness tests measure mostly endurance and strength, less velocity and mobility (Keskinen 2007, 195; Nupponen 2007, 198-200). The tests utilised previously are targeted to different age groups. The purpose of Move! physical functional capacity measurement was to select two to three measurements of every physical functional capacity area to cover those physical demands that students encounter daily. The measurements were selected to be suitable for both fifth and eighth graders. Furthermore, Move! measurement must be carried out during three physical education lessons and the measurements must be sufficiently reliable. In addition, the final measurement sections cannot result in additional costs for schools. Therefore, a new monitoring system, Move!, was created. It consists of physical functional capacity measurement, feedback and national follow-up of the results. In contrast to previous physical functional capacity testing, Move! results are not utilised in assessment of physical education subject. (Move! 2013.)

2.1 What is Move!?

Move! is a national follow-up and feedback system utilised to measure physical functional capacity of fifth and eighth grade students. It provides information for the extensive health examinations which are carried out on fifth and eighth grades by school nurses and medical doctors. Move! is implemented in every Finnish school for fifth and eighth grade students from the beginning of August, 2016. The purpose of the Move! system particularly is to assist a student and his/her parents to understand the relationship between physical functional capacity, health, well-being and studying. Move! was conducted by Ministry of Education and Culture together with the Finnish National Board of Education. It was implemented by the Faculty of Sport and Health Sciences in University of Jyväskylä together with Ministry of Social Affairs and Health, National Institute for Health and Welfare and Trade Union of Education in Finland. (Move! 2012.)

The board of specialists in the Faculty of Sport and Health Sciences in University of Jyväskylä analysed the students’ physical functional capacity demands, which are presented by their daily living. The defined daily physical functional capacity demands were recognized as need to travel the way to school by utilising his/her own muscles (walking or cycling minimum of five kilometres), to lift and carry his/her own school and sport equipment, to prevent the effects of sitting posture lifestyle by maintaining the natural range of motion particularly in the upper body and hip area, to observe and react in the road and traffic environment, to move on stairs and different terrain while maintaining balance even on slippery platform and to move in water (aerobic endurance and combination of the movements of upper and lower extremities). (Jaakkola, Sääkslahti, Liukkonen & Iivonen 2012.)

The physical functional capacity measurement system is premised on the previous aspects. The system measures endurance, strength, velocity, range of motion, balance and fundamental movement skills. Afterwards, the results are entered into the feedback system whereupon the student and his/her parents are able to obtain the information of student's physical functional capacity and how to further develop it. (Move! 2012.) Move results provide important information to teachers regarding the students' strengths and weaknesses. Based on this information, teachers can plan specific content to physical education lessons that support the development of the students.

2.2 Measurement sections

The Move! monitoring system includes eight different measurement sections: 20 meter shuttle run (20 meter line run), standing quintuple jump (5 continuous jumps), curl-up (upper body lift), push-up, squat, lower back extension, mobility of the right and left shoulders and throw-catch combination (Move! – monitoring system for physical functional capacity). The board chose these measurements after multiple experiments and preliminary studies (Jaakkola et al. 2012). The purpose of the different varieties of measurements is to obtain an extensive conception of different physical functional capacity areas (Move! 2012).

20 meter shuttle run measures aerobic endurance and locomotor skills (Keskinen, Mänttäri & Keskinen 2007, 111; Move! 2012; Nupponen 1999). Standing quintuple jump measures strength of lower extremities, velocity, dynamic balance and locomotor skills (Kalaja, Jaakkola & Liukkonen 2009; Move! 2012; Nupponen 1999). Curl-up measures strength of abdominals (Move! 2012; The Cooper Institute 2010). Push-up measures strength of upper

extremities and static resistance of trunk muscles (Ahtiainen & Häkkinen 2007, 173; Augustsson et al. 2009; Move! 2012; Pihlainen et al. 2009; Wood & Baumgartner 2004). Squat measures the range of motion of hip flexors, knee extensors, posterior thigh muscles, calf muscles and the surrounding tissues. It also measures the range of motion of calf and ankle area (Move! 2012). Lower back extension measures lumbar spine and hip joint range of motion and the range of motion of lumbar spine, hip and posterior thigh muscles and the surrounding tissues (Move! 2012). Mobility of the shoulders measures the range of motion of shoulder and upper trunk muscles, tendons and joints (Castro-Pinero et al. 2013; Move! 2012; The Cooper Institute 2010). Throw-catch combination measures equipment handling skills, perceptual movement skills and the strength of upper extremities (Move! 2012).

3 MOVE! PERFORMANCE TECHNIQUES

The attention to performance techniques should be emphasized. The correct technique decreases the risk of injuries during the performance but also in the future activities. When a student learns the correct completion method, s/he can adapt the knowledge to other daily functions as well. This might prevent the development of musculoskeletal conditions in the future. In addition, the correct technique often results in a better outcome. Therefore, it is important that the teachers are aware of at least the most common aspects that should be considered prior to and during the physical functional capacity measurements.

3.1 20 meter shuttle run

20 meter shuttle run is performed on a minimum of 25 meter course, where the starting and finishing lines are marked 20 meters apart from each other. The purpose is that a student runs to the next line and crosses it before the sound signal. When the student can no longer follow the pace, s/he must end the measurement. The number of lines crossed is calculated and the running time is estimated according to it. The running speed is accelerated every minute. (Move! 2012; Nupponen 1999.)

When the running speed increases in the 20 meter shuttle run measurement, the students have less time to cross the line making them prone to quick changes of direction (cutting). Cutting is related with non-contact anterior cruciate ligament (ACL) injury (Fox et al. 2014; Havens & Sigward 2015). Hip internal rotation and knee loading in cutting differs at different angles, suggesting that at a 90 degree cutting angle the greater hip internal rotation was more beneficial for knee loading but at a 45 degree cutting angle larger degrees of hip internal rotation in contrast is related to greater knee adductor moments, which increases the risk for ACL injury (Havens & Sigward 2015). In the 20 meter shuttle run, cutting is presumably performed at 180 degree angle. Because the results differ from 45 and 90 degree cutting angles, it is impossible to predict the beneficial hip internal rotation at 180 degree cutting angle.

When the body centre of mass is positioned medially towards the change of direction, it decreases the peak valgus knee moments, which reduces the risk for ACL injury (Donnelly, Lloyd, Elliott & Reinbolt 2012). Systematic review and meta-analysis shows that unplanned sidestepping elevates the knee joint angles and moments compared to planned sidestepping, especially during the loading phases. Thus, unplanned sidestepping may increase the risk for ACL injury. (Brown, Brughelli & Hume 2014). During the 20 meter shuttle run, the cutting manoeuvre can be either planned or unplanned. Unplanned cutting might occur when the running speed is accelerated and the student is not expecting the sound signal yet.

There are multiple biomechanical risk factors for non-contact ACL injury. In landing and cutting kinematics and kinetics it seems that females contact the ground with the hips and knees more extended when compared to men. In addition, females are reported to have greater knee valgus angle and moment in landing/cutting. These factors are presumably reasons for females being more prone to ACL injuries than men. In addition, according to the review, increase in the hamstring muscle strength, trunk flexion and decision making decreases the risk for ACL injury. (Hughes 2014.) Similar to Brown et al. (2014) findings, Hughes (2014) found that planned cutting/landing is beneficial to prevent ACL injury.

Achilles tendon and knee joint are the most common running injuries. Therefore, Kulmala, Avela, Pasanen & Parkkari (2013) studied if the striking method is related to a specific injury. They found that forefoot strikers have reduced patellofemoral stress and knee frontal plane moment, which indicates the decreased risk for knee injuries. Furthermore, rear foot strikers increase achilles tendon loading which might have an effect on ankle and foot injuries. (Kulmala et al. 2013.)

According to these findings, before the 20 meter shuttle run is implemented, it would be beneficial to instruct the students to lean towards the desired direction of travel if cutting is required during the measurement. It is important to instruct the students to flex the knees, hips and trunk during cutting. The students should also observe that hip, knee and toes are in alignment to prevent increase in knee valgus angle. In addition, students with knee, ankle or foot pain should consider their striking method.

3.2 Standing quintuple jump

In standing quintuple jump measurement the first jump is performed with double-leg followed by four single-leg jumps and a double-leg landing. The result is measured and recorded at 10 centimetre accuracy. The measurement is carried out on a 15 meter course either on a gymnastics mat without shoes or on the floor with shoes on. (Kalaja et al. 2009; Move! 2012; Nupponen 1999.)

Reduced ankle dorsiflexion displacement is related to initial ground contact landing with greater hip and knee flexion and dorsiflexion, which are beneficial for the joints to absorb landing forces. However, hip internal rotation and knee varus are also discovered at initial ground contact during landing. Both frontal and transverse plane movements of knee and hip are known to be risk factors for knee injuries. These findings are in contrast with previous research, where is "demonstrated a coupling effect of joint motions, such that less sagittal plane motion at one joint was accompanied by less sagittal plane motion at adjacent joints" (Begalle et al. 2015, 208). Therefore, restricted ankle dorsiflexion displacement might be both beneficial and injurious. (Begalle et al. 2015.)

Several non-contact knee injuries occur during single-leg landing. Furthermore, knee valgus or abduction of tibia in relation to femur might induce ACL injury. (Sinsurin, Vachalathiti, Jalayondeja & Limroongreungrat 2013.) Frontal plane knee movement (varus and valgus) increases the risk for ACL injury (Begalle et al. 2015; Fox et al. 2014). Single-leg jump landing from lateral and diagonal directions increased peak knee valgus angle compared to forward direction landing (Sinsurin et al. 2013). In countermovement jump landing kinematics in early adolescence, male participants demonstrated significantly greater knee flexion prior to initial contact and knee varus displacement compared to female participants, thus displaying more favourable landing biomechanics (Holden et al. 2015). Wang (2011) studied the landing biomechanics on single- and double-leg stop-jump task. The result was that in a single-leg landing the peak hip and knee flexion angles were lower, indicating a greater risk for ACL injury.

These findings state that the students should be advised to pay attention to their jump landing technique. Instructions on hip, knee and toe alignment would be beneficial to avoid frontal and transverse plane movement. Furthermore, the students should be instructed to flex their hips and knees to absorb the forces in landing.

3.3 Curl-up

Upper trunk curl-up is performed in the pace of sound signal up to a maximum of 75 curl-ups. The student is positioned supine with knees bent at approximately to 100 degrees, slightly apart from each other. Feet are flat on the floor, arms are straight and parallel to the trunk, palms are facing the floor with fingers stretched out and the head is resting on the mat on an A4 size paper. Two measuring strips are placed on the mat either 8 centimetres (fifth grade students) or 12 centimetres (eighth grade students) apart from each other. The purpose is that a student curls up according to the first sound signal slowly sliding his/her fingers across the first measuring strip until the farther measuring strip and then according to second sound signal curls down until the head touches the mat. The number of correct curl-ups is calculated. If the student fails to maintain the pace, the heels are not touching the floor or the fingers are not reached until the second measuring strip, the student must end the measurement. (Move! 2012; The Cooper Institute 2010.)

Sit-up tests have been utilised long and extensively in different physical fitness test protocols to measure the strength of hip flexor muscles and abdominals (Nupponen 1999; Pihlainen et al. 2009). MacFarlane (1993) compared sit-ups (where the hands are positioned behind the neck, a partner is securing the feet on the floor and the upper body is lifted near the knees) with curl-ups (where hands are positioned on the floor and the feet are without support). She found multiple factors in favour of curl-up. The hip flexors are not utilised in curl-up in the similar way than in sit-up resulting more specific abdominal endurance test. Parfrey, Docherty, Workman & Behm (2008) found that when the distance that hand travelled on the floor was 10 centimetres, it produced the highest activation of lower abdominal stabilizers. Furthermore, slow expiration is recommended during curl-up to decrease sternocleidomastoid activity and to increase transversus abdominis and internal oblique activity (Yoon, Kim, & Cynn 2014). The performance technique of curl-up decreases the risk of lumbar hyperextension and thus low back pain (MacFarlene 1993). However, special attention should be paid to lumbar spine movement in a curl-up.

Individuals with low back pain have been discovered to have decreased activation of spinal stabilizers. The delayed activation of the local stabilizers (multifidus, transversus abdominis and internal obliques) is especially compound with low back injuries. (Kolber & Beekhuizen 2007.) The local stabilizers are activated in preparation or anticipation of trunk and extremity movements to provide a stable base (Kolber & Beekhuizen 2007; Misuk 2013). A higher transversus abdominis contraction result in higher multifidus contraction, and in addition, the poor ability to contract multifidus is related to poor transversus abdominis contraction (Hides, Stanton, Dilani & Sexton 2011). This finding suggests that transversus abdominis contraction affects multifidus considerably.

Chronic low-back pain patients have thinner transversus abdominis muscle than healthy subjects (Ota & Kaneoka 2011). Furthermore, the increase of transversus abdominis muscle mass improves lumbar stability and balance (Gong 2013). Rahmat, Naser, Belal & Hasan (2014) studied whether core stability exercise programme affects physical fitness in 9-12-year-old children. The programme resulted in significant improvements in shuttle run, long jump, abdominal curl, push-up and trust tests. Thus, core stability exercises seem to be profitable in improving physical fitness.

These results support the importance of instructing the students to activate their transversus abdominis muscle at the beginning of the movement to ensure the safe performance and to avoid the risk of injury. In addition, students would benefit in all physical function movements from the instructions on how to exercise core stability muscles, especially transversus abdominis.

3.4 Push-up

In push-up measurement the student is required to perform as many push-ups as possible in 60 seconds. Toes and palms are the base of support with males and with females the base of support is palms and knees. The body is maintained extended throughout the measurement. The lower position of push-up is marked with 10-centimetre-height object that the student's chest must touch. The student is instructed to position the palms shoulder-wide below the shoulders, fingers pointing forward and the feet are placed at maximum to the width of pelvis. The measurement is ended if the pelvis is dropped, the lower position of push-up is not covered, the upper extremities are not fully extended in the upper position, the placement of palms and feet are incorrect or the head is not in line with the trunk. (Augustsson et al. 2009; Move! 2012; Pihlainen et al. 2009; Wood & Baumgartner 2004.)

An abdominal muscles contribution to vertebral joint rotational stiffness during a push-up was examined. According to the survey rectus abdominis provided stiffness in sagittal plane, external obliques were responsible for stiffness in frontal plane and internal obliques in transverse plane while multifidus and transverses abdominis contributed no support to vertebral joint rotational stiffness. (Howarth, Beach & Callaghan 2008.)

It is important that during the push-up fingers point forward and have a neutral position in forearm rotation. Especially internal rotation of the forearm should be avoided to prevent the excessive shear forces or moments. (Lou et al. 2001.) The placement of hands below the shoulders activates more triceps brachii muscle compared to the wide base position (Contreras et al. 2012). When the hands are placed below the shoulders it decreases the stress on shoulder joint.

Suprak et al. (2013) tested shoulder position effect on scapular kinematics in traditional push-up. The result was that the elevation of shoulder may place the scapula in a position of impingement. (Suprak 2013.) Thus, it is essential to activate serratus anterior to elevate the thoracic spine during the push-up.

Students should be advised to activate all the abdominal muscles throughout the push-up exercise to ensure the stabilization of spinal column. In addition, it is important that the placement of hands (below the shoulders and fingers pointing forward) is carefully advised to the students to prevent the risk of injuries. Furthermore, the students should be instructed to activate the serratus anterior muscle by advising them to lift the thoracic spine towards the ceiling throughout the measurement.

3.5 Flexibility

The following three measurements are designed to measure the natural anatomic range of motion of the body. The measurements are performed in an open space barefoot. It is essential that the position of the back can be seen easily; therefore, the students are instructed to place their shirt in their trousers. (Move! 2012.)

3.5.1 Squat

Squat is performed hip-width, upper extremities extended up near the head and back maintained straight throughout the measurement. The student is instructed to perform a half-squat (knees in 90-degree-angle). The knees are in alignment with toes (knees are pointing the same direction as toes and not crossing over the toes), hip angle is greater than 45 degrees and heels are touching the floor. If the correct position is obtained, the result is 1. If the student fails to perform the correct position, the result is 0. (Move! 2012.)

Deep squat affects increased stress on lower knee joint and spinal joint compared to half and quarter squats. However, deep squats are effective training exercises against injuries if the performance technique is gradually learned and cautiously supervised. (Hartmann, Wirth & Klusemann 2013.) Half-squat is recommended over the deep squat for athletes with healthy knees because of the potential for menisci and cruciate and collateral ligaments injuries (Escamilla 2001). Thus, it is safer if less experienced students do not perform deep squats.

It is essential that feet are flat on the ground; ankle inversion or eversion have an impact on foot and knee stability (Myer et al. 2014). The position with feet pointing straight forward seems to be the most favourable during the squat. Feet rotated inward or outward may increase the occurrence of joint pathologies. (Han, Ge, Liu & Liu 2013.) Shear forces on knees are increased when the forward knee translation on descending phase occurs (Myer et al. 2014; Schoenfeld 2010). Hips, knees and toes should be parallel to the ground and in line with each other to prevent the unilateral dropping of the hip, excessive varus/valgus knee position and the rotational movement between hips, knees and feet (Myer et al. 2014).

The poor flexibility of hip musculature might lead to greater forward lean that increases the stress on spinal column. Natural curve of the lumbar spine should be maintained throughout the movement because it increases the activity of erector spinae and oblique muscles to ensure the support of spinal column. (Myer et al. 2014; Schoenfeld 2010.) Maintaining the head in neutral position in relation to the spine and in line to the plane of the torso decreases firstly the risk for muscle strain or injury to the cervical spine and secondly the compensation mechanisms that might lead to spinal column injuries (Myer et al. 2014).

According to these findings the students should be instructed to place their feet flat on the floor with toes, knees and hips parallel and in alignment. Instructions to sit back into the squat are essential to prevent the knees from moving past the toes. Furthermore, the back is held straight and rigid with natural spinal curves and the head is maintained in neutral position.

3.5.2 Lower back extension

In this measurement a student sits on the floor on the ischial tuberosities. Legs are in extension pointing forward, and they are maintained together throughout the measurement. Hands are placed on the thighs. The student is then asked to extend his/her lumbar spine. If the position is correct the result is 1, incorrect position results in a 0. (Move! 2012.)

Ji-Su and Duk-Hyun (2015) compared the effects of erect sitting, slumped posture with cross-legged sitting and erect posture with cross-legged sitting on the lumbar and pelvic angles. They found that lumbar flexion and posterior pelvic tilt are greater in slumped legs crossed sitting posture and erect sitting posture with legs crossed than erect sitting. An increase in muscle thickness of transversus abdominis, lumbar lordosis and muscle activity (except rectus abdominis) were noticed when the subjects were instructed to co-contract trunk muscles during sitting (Watanabe et al. 2014). Furthermore, specific training and instructions on lumbo-pelvic motor control and education on spinal mechanics for 14-17-year-old females resulted in alleviated low back pain and disability, less anterior tilt of the pelvis and lumbar kyphosis and improved physical fitness levels (Perich, Burnett, O'Sullivan & Perkin 2011).

The study of the relationships between prolonged neck and shoulder pain and sitting spinal posture in 14-year-old adolescents resulted that females reported higher prolonged neck and shoulder pain than males and those adolescents with prolonged pain had more lumbar lordosis (Straker, O'Sullivan, Smith & Perry 2009). In addition, slump sitting increases the head and neck flexion, anterior translation of the head and increased cervical erector spinae muscle activity when compared to thoracic and lumbo-pelvic sitting (Caneiro et al. 2010).

However, neural structures extensibility might limit hamstring flexibility (McHugh, Johnson & Morrison 2012). In addition, neural mobilization with static hamstring stretching is more effective than static hamstring stretching alone (Sharma, Balthillaya, Rao & Mani 2016).

Thus, it is important as a teacher to know the possible neural tissues' influence on this flexibility measurement.

Because "slumped sitting is known to increase disc pressure and aggravate chronic low back pain" (Watanabe et al. 2014, 55) it is important to not only measure but to also give instructions to children and adolescents on how to correct the slumped position. Activation of deep trunk stabilizing muscles corrects the slumped sitting posture and thus decreases the musculoskeletal conditions. Practical training of these muscles and daily consideration of the sitting posture are essential. This measurement provides an excellent opportunity to give advice on these matters.

3.5.3 Mobility of the shoulders

In this measurement the student is standing with their back straight. The student reaches with their right hand over the right shoulder and down the back between the shoulder blades. At the same time s/he places the left hand behind the back trying to reach up to touch the fingers of right hand. The student must perform the measurement calmly and maintain the neutral position of the spinal column; careful observation is required to discover the possible lordosis of lumbar spine. If the correct position is obtained, the result is 1 and otherwise the result is 0. The student performs the measurement in reversed arm positions to measure the left shoulder. (Castro-Pinero et al. 2013; Move! 2012; The Cooper Institute 2010.)

Castro-Pinero et al. (2013) studied the effect of weight status on flexibility in 6-17 years old youths. The results were that overweight and obese participants had lower performance in the mobility of the shoulders measurement than underweight and normal weight participants.

Even a small change in thoracic kyphosis affects the shoulder range of motion. Increased thoracic kyphosis reduces shoulder flexion, abduction and external rotation but increases internal rotation. (Kanlayanaphotporn 2014.) In mobility of the shoulders measurement a careful observation on the position of the back is necessary to ensure the unbiased interpretation of the movement. The previous paragraphs cover the lumbar spine movement, spinal stabilization matters and low back pain. Therefore, they are not included here although lumbar spine posture should be carefully considered when the mobility of the shoulders measurement is performed.

3.6 Throw-catch combination

In this measurement the student performs 20 overhand throws with tennis ball to a specific target that is marked on the wall, and catches the ball after one rebound on the floor. The specific target is 1.5 m x 1.5 m of size and its lower border is 90 centimetres from the floor. The throwing distance is for 5th grade females 7 metres and males 8 metres, and for 8th grade females 8 metres and males 10 metres. The correct number of throws is calculated. (Move! 2012.)

In a correct overhand throw the energy is transferred from the lower body parts to upper extremity. The mechanics initiate with the stride moving to pelvis rotation, upper trunk rotation, elbow extension, shoulder internal rotation and finally to wrist flexion. The shoulder and the elbow are at increased risk of injury due to the energy forces of acceleration and deceleration. (Fleisig, Barrentine, Escamilla & Andrews 1996.) Rotator cuff muscles resist the high shoulder forces and thus the activity of these muscles is extremely high especially during the arm cocking and deceleration (Escamilla & Andrews 2009).

Common shoulder injuries among overhead athletes are rotator cuff tendonitis and impingement, rotator cuff tears, glenohumeral instability and labrum pathologies. Scapular motion is related to shoulder movement mechanics, and its position differentiates significantly during overhead throwing. If the scapular movement is abnormal, it might affect the shoulder movement and lead to shoulder injuries. (Meyer et al. 2008.) Shoulder dysfunction also correlates with greater core stability deficiency (Radwan et al. 2014).

Wicks et al. (2015) studied the longitudinal pattern of change in eye-hand coordination in children aged 8 to 16 years. They discovered that eye-hand coordination improved with age with both males and females, although males were performing better already at the age of 8 and continued to maintain that position to mid-adolescence. Miles et al. (2014) compared quiet eye training to traditional technical training in 10-year-old children. In quiet eye training the children were instructed to carefully focus his/her gaze to an imaginary target on the wall before throwing the ball, then following the ball carefully prior to the catch. The traditional technical throwing emphasized a smooth arm swing before the release of the ball and positioning the hands ready to catch the ball. They found that quiet eye training might be effective in improving the skills of throwing and catching.

According to these findings a proper warm-up of the shoulder, especially rotator cuff muscles, is necessary to decrease the risk of an injury. In addition, the activation of core stability is important to support the shoulder but also it is required to ensure the stabilization of lumbar spine, as discussed previously in this thesis. Furthermore, students could perform better if the quiet eye training instructions are provided prior to the measurement.

4 OBSERVATION

To be able to assess physical functional capacity measurements and performance techniques a person must have good observation skills. Observation is comprehensive and involves several sensory systems. Visual, auditory, somatosensory, olfactory and gustatory sensory systems work simultaneously providing the information for the brain to form an observation. (Neisser 1976, 28-30.) Observation in this thesis means what a person perceives from a physical performance by utilising his/her senses and what kinds of notes s/he makes from them. Thus, observation means the matter that is not only perceived but especially noted. Perception in this thesis means the organization, the sensory information and interpretation that a person requires in order to form an observation. People observe and analyze situations differently. For example if two people detect a climbing frame, the other might find it interesting and challenging while the other one considers it as a place where he can get injured. Another example of this is when two teachers analyze the student’s performance and disagree of the quality of the performance technique. The reason for disagreement might be in their previous experiences.

4.1 Neisser perceptual cycle

According to Neisser perceptual cycle (figure 1) the person explores the object, for example the environment, performer or itself, by utilising several sensory systems and forms a result based on the anticipatory schemata. Schemata are “the cognitive structures that prepare the perceiver to accept certain kinds of information rather than others and thus control the activity of looking” and “because we can see only what we know how to look for, it is these schemata that determine what will be perceived”. The result of an exploration, the new information, forms new schemata or modifies the original schemata. Furthermore, new schemata direct the exploration. (Neisser 1976, 20-21, 30.) Therefore, the previous experiences in for example hobbies, studies or profession affect the observation and might be the reasons for differing results between the two teachers.

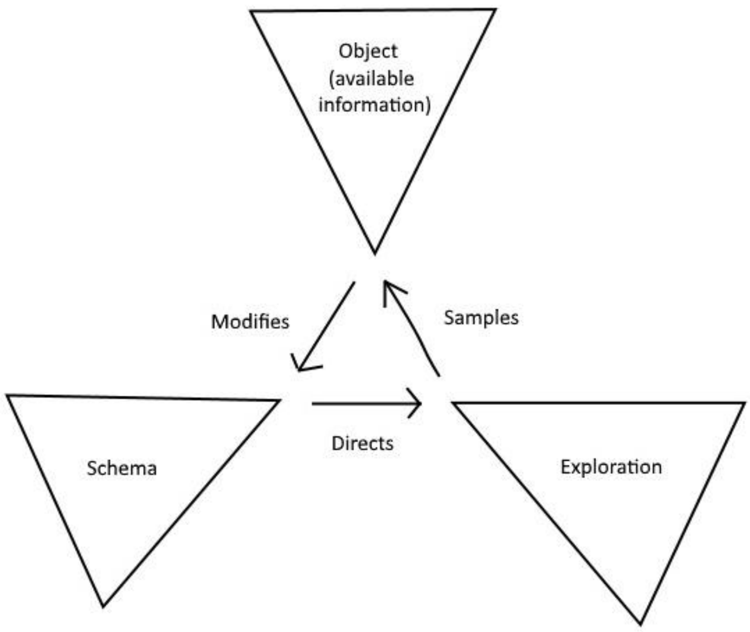

FIGURE 1. The perceptual cycle by Neisser (1976, 21)

4.2 Information processing

Perception in this thesis means the organization, the sensory information and interpretation that a person requires in order to form an observation. Information processing is not a theory but a framework that explains how the information flows through the cognitive system. It begins with an input (an event, picture, a problem) and ends with an output (motor behaviour, decision, information stored in long-term memory). (Miller 2011, 266.) Information processing works in similar ways in different people but the different feature abilities might cause some to have better observation skills than others. This type of feature might be, for example, the different abilities of working memory or the ability to control the attention. Thus, the observation is not only dependant on previous experiences.

Working memory is a temporary workspace where information can be utilised for active information processing such as thinking and learning. (Miller 2011, 272; Nurmi et al. 2014, 57.) Working memory consists of four components: executive control, visuospatial sketchpad, phonological loop and episodic buffer (Miller 2011, 272). Executive control means that the attention can be directed to a correct stimulus in a conflicting stimulus situation (Nurmi et al. 2014, 113). For example, in a conversation it directs the attention to a relevant matter such as speech instead of something irrelevant such as a flashing light in the environment. “The visuospatial sketchpad specializes in processing and retaining visual and spatial information” and “the phonological loop processes and retains speech sounds” (Miller 2011, 273). The episodic buffer is a general memory storage that interfaces between the phonological loop and the visuospatial sketchpad, and long-term memory. Thus, working memory can temporarily store and recall limited amount of information from long-term memory (Nurmi et al. 2014, 57).

Previous information, attainments and experiences that are utilised to process new information and situations are stored in long-term memory. Long-term memory is divided by content to semantic (concepts and its relationships and features) and episodic (experiences in certain time and place) memories. In addition, long-term memory includes procedural memory, which means the control of certain procedures that last throughout the life, such as riding a bicycle. (Nurmi et al. 2014, 57-58.)

Memory and the ability to control the attention partly utilise the same neural network. The information that is stored in our memory directs the attention. The attention can be divided into three components: to maintain the alertness in boring situations, to direct the attention to a specific object and executive control (explained above). Executive control has an important role especially in situations where the motivation is low, and the person has difficulties in maintaining and directing the attention. (Nurmi et al. 2014, 112-113.) Therefore, the ability to control the attention affects observation.

4.3 Observation of performance

If the movement is unfamiliar for the observer it might affect the observation because the observer is unable to link the movement to previous schemata. In addition, the observer’s ability to concentrate on the specific part of the movement while still observing the entire movement pattern might be poor. Furthermore, the observer’s differences in defining the movement, perception, illusions and bias results with different analyzes and conclusions. Defining the movement equally between observers is important and that is why the sheet that describes the performance criteria must be extremely precise. If the observer was utilising the performance criteria sheet while observing, it resulted in better movement diagnosis. (Morrison 2000.) In addition, it is beneficial to familiarize oneself with the performance criteria before the observation (Rintala et al. in print).

Barnett, Minto, Lander & Hardy (2014) studied the interrater reliability of the object control subtest from the Test of Gross Motor Development-2 in live observation. Interrater reliability means how similarly two or more assessors observed the same situation (Muijs 2011). They discovered that between the two assessors the interrater reliability was excellent for the object control subset and for individual skills. Performances of striking a stationary ball and overhand throw had more components with less agreement, suggesting that these might be more difficult to assess. (Barnett et al. 2014). However, it is important to clarify that the assessors were trained by watching videos of children's skill performances on three separate occasions, and by rating the skills against standard rating. "Training was considered complete when each observer's scores for the two trials differed by no more than one unit from the instructor score for each skill (>80% agreement)" (Barnett et al. 2014, 668). Thus, the assessors received comprehensive training prior to the study to ensure the reliability between them. This type of training cannot be implemented among students in teacher education programme. On the other hand, the study revealed that by examining interrater reliability it is possible to discover which kinds of skills are more difficult to assess, and based on that, the scoring and assessment system can be modified (Barnett et al 2014).

In addition, Rintala, Sääkslahti & Iivonen (in print) studied the intrarater and interrater reliability of the Test of Gross Motor Development-3 from video-recorded performances. Intrarater reliability means that the same assessor evaluated the same situations twice having three months between the evaluations. Before the study the observers had established 80% reliability in scoring the movements and had participated in a two-hour training session to familiarize themselves to the performance criteria. They found that the most reliably scored individual skills were skip, two-hand catch and one-hand stationary dribble. The lowest scored skills were hop, horizontal jump and two-hand strike. These findings show that the performance criteria in some of the skills are easier to assess than in other skills, even though the assessors had the possibility to replay the video and watch the performance several times. (Rintala et al. in print).

The interrater reliability between the raters of varied experience was studied. Three novice raters (physiotherapy students) and one expert rater watched videos movement performances. No significant differences were found between the raters when the total scores of all the tests were considered. When comparing the raters according to separate test items, the results showed in shoulder mobility 66 % agreement and in squat test only 33 % agreement. In fact, in squat test the expert rater scored the performance lower than the novice raters. However, the expert possibly became more critical with experience and thus gave lower points. (Gulgin & Hoogenboom 2014.) Similarly, the interrater reliability was studied between two experts and two novices. The novices received a standardized introductory training course. The results showed that the novices and experts demonstrated excellent agreement, thus there were no significant differences between the raters. (Minick, Kiesel, Burton, Taylor, Plisky & Butler 2010.) These results indicate that previous experience doesn't necessarily result in better observation.

However, Palmer & Brian (2016) studied the observation skills of two novice raters and one expert rater. The novice raters received two hour training session, where they practiced observation from videos of movement performances. The result showed that the novice raters were not able to achieve significant agreement with an expert rater. This might be explained by the fact that the experts have more experience with inefficient and proficient performers, thus, they might have more accurate information of correct and incorrect movement performance. (Palmer & Brian 2016).

In the studies all the observers received varied observation training. These studies show that observation training results in better observation skills (high interrater value). However, it is not clear whether the previous experiences in observation always result in better observation.

Other matters that affect observation are background, observation technique, distance, observer's and performer's abilities. The movement is suggested to be performed against a uniform background to avoid illusions. It is important to think in advance about what is observed and what observation techniques utilised. The observer's distance from the performer is suggested to be 10 to 15 meters. Disability in sensory information can affect the perception, for example the observer can have poor vision or problems with hearing. In addition, the performer's current ability to carry out the movement affects the observation and that is why it is recommended to have several observation possibilities. Moreover, people either like or dislike certain people but the observer must analyze the movement objectively throughout the observation. (Morrison 2000.)

Therefore, the teacher must have the knowledge of the key elements of a specific movement pattern and the performance techniques, ensure that the environment is suitable for observing and consider the possible observation techniques in advance. The teacher must consider the optimal observation distance from the student, the student’s ability to perform the movement, his/her own physical condition and observation abilities to be able to observe and analyze every student objectively. Other matters that can be assumed to affect the observation are observer’s motivation, noise and lighting, which might affect the ability to concentrate. In addition, the direction from where the observer observes the movement is relevant. One view angle reveals specific performance techniques but covers others. Therefore, it is beneficial if the observer is able to move and use different view angles. In teacher education it is important to train observation skills.

4.4 Observation and fundamental movement skills

Good observation skills enable the teacher to give positive, corrective and specific feedback. Through feedback the students can improve their fundamental movement skills, which provides experiences in competence. The competence in fundamental movement skills was found low among children and adolescents (Hardy et al. 2013). However, the competence increased when the teaching concentrated to the fundamental movement skills instead of meeting the daily physical activity recommendations. Thus, it is beneficial to teach the fundamental movement skills in the schools especially to children who have a lack of basic physical skills. When the children master the fundamental movement skills they are more likely to be physically active. (Hardy et al. 2013.) Systematic review (Logan et al. 2015) demonstrated low to moderate relationship between fundamental movement skill competence and physical activity. The relationship between manipulative skills and physical activity seems to be stronger among boys than girls. On the other hand, the relationship between locomotor skills and physical fitness is stronger among girls than boys. (Logan et al. 2015.)

There is a weak relationship between health-related fitness components and fundamental movement skills. Also, physical activity level is weakly related to fitness components. (Chen & Housner 2013.) Furthermore, the level of competence in fundamental movement skills is associated with the physical fitness in adolescence and with the participation to leisure activities and sport in adulthood (Haynes & Miller 2014; Reillo et al. 2010). In addition, the development and growth of primary motor cortex correlates with fundamental movement skills development. This finding suggests that physical educators should plan lessons which train motor cortex. (Reillo et al. 2010.) To train the motor cortex and to teach the fundamental movement skills the teacher must have observation skills of the performance techniques for the students to be able to improve and have experiences in competence. Those experiences bring joy and motivate the students to be physically active.

5 AIM OF THE THESIS

The aim of the thesis is to assess students in primary school teacher education programme with the following study questions:

1) What kind of performance technique errors students in primary school teacher education programme observe from the Move! physical functional capacity videos that are specifically recorded for the purpose of this thesis?

2) Is there a relationship between the observation of the performance technique errors and the student’s background including hobbies, physical education studies and previous profession?

6 METHODS

6.1 Participants

The participants were students in primary school teacher education programme in the University of Turku in the department of teacher education in Rauma, Finland. They were mostly second year students (only few third and fourth year students) studying in autumn 2016. The number of participants in this study is 71.

The teacher education programme consists of a total of 360 ECTS credits, which stands for approximately five years of studies. During these studies the students have different levels of physical education courses. Physical and health education (4 ECTS credits) course is part of the pre-school teacher education programme. Some of the participants studied earlier in pre-school teacher education programme and later on changed to primary school teacher education programme. Therefore, some of the students had Physical and health education course as basic information. The compulsory course for all the students in primary school teacher education programme is Physical education at school (6 ECTS credits) course. In addition, the students can apply for free-elective physical education studies that are Physical education basic studies (25 ECTS credits) course and Physical education intermediate studies (35 ECTS credits) course. These courses last a full academic year and thus continued in spring semester.

In this study the participants had all of these different backgrounds of physical education studies (table 1). Some of the participants attended several courses at the same time. For example, a student could have carried out the compulsory course at the same time with free-elective courses. Therefore, the total numbers of participants that were attending (n=72) or had completed (n=19) the courses were not equal to the number of participants (n=71) in the study.

TABLE 1. Participants’ background of the physical education studies

Course	Attending the course n	Course completed n
Physical and health education (4 ECTS credits)	0	3
Physical education at school (6 ECTS credits)	59	10
Physical education basic studies (25 ECTS credits)	6	6
Physical education intermediate studies (35 ECTS credits)	7	0
Total	72	19

6.2 Procedure

The procedure of the study began in January 2016 by writing the background theory of the study. In July the performance technique videos were recorded and edited. In September a contact to the department of teacher education in Rauma was made and the cooperation with them began. After that, the master thesis study group of physical education teacher students (n=12) evaluated the questionnaire draft that included videos and instructions. Based on the comments, a video of 20 meter shuttle run was replaced with a standing quintuple jump with a view angle from the side. Thus, the questionnaire then included two standing quintuple jump measurements but with different view angles. In addition, the terminology, questions and response options of the questionnaire were pre-tested and after that specified until everyone agreed them to be unambiguous. In October some modification to the questionnaire was made and then it was piloted with five volunteers.

During autumn 2016 prior to the study all the participants attended to practical physical education courses that were part of the teacher education programme. Participants in physical education at school course (n=59) completed, prior to the participation for the study, physical education lessons that covered Move! physical functional capacity measurements. The lessons were part of the teacher education programme and they were not related to the study or planned according to the study. In these practical lessons the students carried out the different Move! measurement sections in small groups while the teacher was assisting and supervising the action. At the end of the autumn semester, all the participants carried out the questionnaire. Participants attending the physical education at school course filled in the web-based questionnaire in an auditorium. The response time was approximately 20 to 30 minutes. Some technical issues were the reasons for the response times closer to 30 minutes. This occasion was organized and held by the teacher in the department of teacher education and thus the researcher was not present. The rest of the participants from other physical education courses filled in the questionnaire during their free time. The questionnaire for all the participants was carried out at the end of the autumn semester 2016. After that, the analysis of the results and the conclusions were made.

6.3 Instrument

The instrument of the study was a web-based (Webropol 2.0) questionnaire which was developed specifically for this study (appendix 1). It also included the research permit. In the research permit it was explained what is studied and how the data is collected and analyzed. It also included the contact information of researcher. If the participant agreed with the research permit and was willing to participate in the study, the questionnaire began.

First questions considered the background of the participant: the hobbies, previous and current physical education studies and possible previous profession. It was followed by eight questions that instructed the participant to open a specific video link. Behind each video link the participant found a Move! physical functional capacity video that was specifically recorded for the purpose of this study. The video might or might not have included performance technique errors. After watching the video, the participant returned to the questionnaire and selected, according to his/her observation, in what body part s/he saw the error. The options were head, upper extremities, trunk, lower extremities or no error. The participant was able to select several options.

The videos were in a specific order. First was curl-up measurement followed by mobility of the shoulders, push-up with knees on the floor, squat, throw-catch combination, lower back extension, standing quintuple jump with view angle from the front and standing quintuple jump with view angle from the side. The certain order was selected so that it was easy for the participant to start the observation from slow paced curl-up to fast-paced standing quintuple jump. The duration of the videos varied from 5 seconds to 24 seconds. The participant was instructed in the questionnaire to watch the videos maximum of two times. However, it was impossible to control how many times the videos were viewed. Therefore, after the eight video questions the participant was asked to write how many times on average s/he watched each video. At the end of the questionnaire the participant could leave free comments.

6.4 Reliability and validity

Reliability and validity defines the quality of the measurement instrument in different ways. Reliability can be divided to repeated measurement and internal consistency. Repeated measurement means the ability to measure the same matter several times. Internal consistency means how well the items in the instrument measure a single construct or how homogeneous they are. (Muijs 2011, 56, 61-63.) In this study internal consistency was calculated. There are two ways to measure it: split-half reliability and Cronbach's alpha (Muijs 2011, 63). Split-half reliability means that the instrument is split in half and the respondents' scores are calculated on each half test and then compared to each other. If they are strongly related, the correlation coefficient is over 0.8. Cronbach's alpha means the level of significance or the p-value and it should be over 0.7 before it is safe to say that the instrument is internally consistent. (Muijs 2011, 63-64, 67, 217.)

Cronbach's alpha was utilised in this study to discover how well the participants were able to detect errors when the whole instrument is considered. If Cronbach's alpha was significant then based on all the replies it would be possible to conclude that these primary school teacher students were or were not able to observe Move! physical functional capacity measurements. In this study the Cronbach's alpha was measured and the p-value is 0.359. It was under the recommendation (p-value > 0.7). Thus, it could not be said that students were able to observe all Move! measurements with certain percentage. However, it was possible to analyze how well the students managed in single measurement sections. Based on Cronbach's alpha the instrument, which is the questionnaire, is not reliable. It means that when a participant detects the errors well in one item (video) of the test, s/he necessarily will not succeed in another item (video). It is possible to make the instrument more reliable by excluding some of the items. But in this study, the exclusions of items did not result in better reliability. Furthermore, according to Muijs (2011, 64) “there is not much point in creating an instrument that is reliably measuring something we don’t really want to measure” and therefore considering the aim of the study, all the items were included. Because the instrument was not reliable, in the end it cannot be concluded how well the participants were able to detect the errors when considering the whole questionnaire. On the other hand, it was possible to analyze the items separately and see which kinds of errors participants detected.

Validity means that the utilised instrument measures what we want to measure (Pearson 2010, 48). It can be divided in three aspects: content validity, criterion validity and construct validity. Content validity means that the questions asked measure the concept. (Muijs 2011, 56-58.) In this study the questions in the questionnaire covered the background of the participants and the performance technique videos. Therefore, it can be said that these questions measure the concept (how well students observe the errors and does the background affect observation) because through those questions it was possible to discover whether the participants observed the errors or not and whether the background affects it or not.

Criterion validity means how well the measurement is related to other measures or predicts certain outcomes (Muijs 2011, 58; Pearson 2010, 48). In this study it can be assumed that, based on the Neisser perceptual cycle (Neisser 1976, 20-21, 30), background affects how well the participant observes the videos, and that participants that succeed in the different items of the questionnaire, observe well the similar errors on performance techniques of Move! physical functional capacity measurements at school.

Construct validity means that if a question that is designed to measure a specific matter, measures it and not something else (Muijs 2011, 59). In this study the questions measure the matters that are wanted. For example, the aim of this study was to discover the background of the participants and whether it affects their ability to detect the errors or not. Therefore, the questionnaire included questions regarding previous physical education studies, profession and physical education hobbies. Based on this information it can be analyzed whether this kind of background affects the abilities to detect errors. Content, criterion and construct validities are required to be covered to say the measure is valid (Muijs 2011, 60). Based on these aspects, it can be said that the questionnaire utilised in this study was valid.

6.5 Piloting

Piloting of the questionnaire was made with five volunteers that had different backgrounds. Two of them were students in physical education, two of them have a background in business and one of them is a physiotherapist. Some variation but also some unity of the results was seen. Mainly, it was seen that the most relevant performance mistakes in the videos were detected but the minor mistakes not. The contact person in the department of teacher education in Rauma evaluated the questionnaire too. Based on the piloting and the other comments, few changes in the questionnaire instructions were made. For example, two comments suggested that it is fair to recommend the participants to watch the videos maximum of two times rather than to inform them that they are only able to watch the videos two times. They felt that the participants are misled with the original instruction, because the number of times cannot, in fact, be restricted.

The physiotherapist that participated to the piloting works in LIKES, Research Centre for Physical Activity and Health. Before that she worked 17 years as a physiotherapist, specialized in musculoskeletal physiotherapy. In addition, she is a master of health sciences. Since autumn 2015 she has carried out Move! physical functional capacity measurements in schools that are part of the national action programme Finnish Schools on the Move. Therefore she was asked to participate to the piloting. Her results were compared to the researcher's (a physiotherapist) previously analyzed mistakes. Three of the answers were a little different. In mobility of the shoulders measurement her answers for the body parts that make mistakes were upper extremities and trunk, while the researcher's answer was specified only in trunk. After a discussion it was concluded by the researcher that the mistake is only trunk. The second difference was with a squat measurement: her answer was lower extremities while the researcher's answer was lower extremities and head. After a conversation she agreed with the mistake of a head but thought that when teaching the correct performance technique to the students it would be better to instruct them to look up for the better control of the back. However, based on the theory it is mentioned that maintaining the head in neutral position in relation to the spine and in line to the plane of the torso, decreases firstly the risk for muscle strain or injury to the cervical spine and secondly the compensation mechanisms that might lead to spinal column injuries (Myer et al. 2014). Thus, mistake of the head is included in the correct answer in this study. The third difference was with the throw-catch combination when she had not mentioned trunk as a mistake but agreed it afterwards. It is mandatory to mention that while she kindly accomplished the questionnaire, she was in an extreme hurry with other work tasks.

Piloting was made to find out the matters that should further be developed prior to the implementation. The utilisation of an external physiotherapist ensured that the performance technique mistakes in the questionnaire can be assumed to be correct. These previously defined performance technique mistakes were compared to the participants responds. Thus, it would have given false results if the standard performance technique mistakes had been defined incorrectly.

6.6 Data Analysis

The results were compared to the previously defined performance technique mistakes (appendix 1) to find out what kind of mistakes participants detected. In addition, the background of a participant and the participant's answers were compared to define the relationship between them. The analyses were carried out with IBM SPSS version 24.

To discover how well each participant detected the errors in different videos, the answers were coded so that each correct answer resulted in one point. After that the results were summarized in each video. The maximum points of each video were 5 and the maximum overall result of all videos was 40 points. Then, the participants' results were grouped to eight different variables named after each video. Descriptive statistics such as mean, median, minimum and maximum results were calculated of each variable to detect in which videos the participants succeeded best. The same method was utilised to discover in what body parts the participants detected the errors best. The significance of the differences was analyzed with paired samples t-test. All the videos were compared and all the body parts were compared with each other.

The correlations between the videos and also between the body parts were calculated. Pearson's r is utilised to analyze the relationship between two variables. "The Pearson r coefficients vary between -1 and +1, with +1 indicating a perfect positive relationship, -1 indicating a perfect negative relationship, and 0 indicating no relationship" (Muijs 2011, 125). In addition to this, the statistical significance of the relationship (p-value) was determined. Significance level (p-value) can vary between 0 and 1, and the commonly utilised cut-off point for the significance level is less than 0.05. Two matters define the size of the significance level: the size of the relationship and the size of the sample. (Muijs 2011, 67-68).

Independent samples t-test was utilised to discover if hobbies, physical education studies or previous profession associated in how well the participant detected the errors. Hobbies were divided to physical activity and other variables, because it can be thought that if the participant is physically active, he may have better ability to observe the performance techniques. Physical education studies were divided to the compulsory physical education course and free-elective advanced level courses. Profession was divided to variables previous profession and no previous profession. In addition, hobbies were divided in three groups: ball games, jogging and gym. ANOVA (analysis of variance) was utilised to discover the effect of different physical activity background on the ability to detect errors.

The participants were asked to write how many times on average s/he watched each video. The relationship between the amount of views and the ability to detect the errors was calculated with Pearson's r.

6.7 Ethical issues

This study was carried out following the responsible conduct of research, which provides the guidelines for ethically acceptable and reliable research, and ensures the quality of researches. The responsible conduct of research is promoted by the Finnish advisory board on research integrity (TENK), which is appointed by the Ministry of Education and Culture. (Finnish advisory board on research integrity.)

In the beginning of the questionnaire there was a research permit, which explained the purpose of the study and the contents of the questionnaire. It explained that the data was utilised only for the purpose of this study and the results were anonymously analyzed and could not be linked to the participant. The data was maintained and reported according to the responsible conduct of research. In addition, it was mentioned that the participation for this study was voluntary. All the participants were over 18 years of old and therefore were able to decide of their participation on their own.

7 RESULTS

The aim was to discover the students' abilities to observe errors from eight different Move! videos, and to see if the background had an effect on the ability to detect errors. The number of the participants (primary school teacher students) was 71.

7.1 Students' observations on performance technique errors

Firstly, the aim of the study was to discover what kind of performance technique errors students in primary school teacher education programme observe from the Move! physical functional capacity videos that were specifically recorded for the purpose of this study. The students' results were coded so that every correct answer gave 1 point and every fault answer 0 point. When analyzing the videos, the maximum result of each video was 5 points and the total maximum of all correctly detected techniques in the videos was 40 points.

All the students' results were summarized and categorized to eight variables that covered each video. Mean, median, minimum and maximum results were calculated from the video variables (table 2). Curl-up (mean 4.3 points), lower back extension (mean 4.3 points) and shoulder mobility (mean 4.1 points) videos scored the highest results. Whereas, throw-catch combination (mean 2.5 points), quintuple jump front (mean 2.9 points) and quintuple jump side (mean 2.9 points) videos got the lowest points. Throw-catch combination video scored the lowest mean but the median was 3 points. When, quintuple jump front video median was 2 points. The minimum result (1 point) of all the videos was in throw-catch combination. Minimum results of all other videos were 2 points, except in shoulder mobility video where it was 3 points, while 5 points was a maximum. The results mean that the students detected the errors best from curl-up, lower back extension and shoulder mobility videos and least errors they detected from throw-catch combination, quintuple jump front and quintuple jump side videos. When considering the whole questionnaire the mean result of correct answers in all participants was 71 % and even the weakest participant detected 53 % of the errors. The maximum result of correct observation was 88 %.

The significance of the differences in detecting the errors from the videos was analyzed. Most of the differences between the videos were significant ($p<0.05$). If the result was significant between the videos, it means that the mean results differed significantly from each other. For example when the curl-up mean result was 4.3, it differed significantly from quintuple jump (front) mean result 2.9 (table 2). This means that students succeeded significantly better in curl-up video than in quintuple jump (front) video. If the result was not significant between the videos, for example between curl-up (mean 4.3) and shoulder mobility (mean 4.1), the difference between their mean results was not significant. This means that it cannot be said that the students detected errors better from curl-up video than from shoulder mobility video. In the following videos the differences were not significant: curl-up and shoulder mobility (t (70)=1.432, p=0.157), curl-up and lower back extension (t (70)=-0.104, p=0.917), shoulder mobility and push-up (t (70)=1.982, p=0.051), shoulder mobility and lower back extension (t (70)=-1.741, p=0.086), throw-catch combination and quintuple jump front (t (70)=-1.689, p=0.096), throw-catch combination and quintuple jump side (t (70)=-1.921, p=0.059), and, quintuple jump front and quintuple jump side (t (70)=-0.527, p=0.6).

TABLE 2. The participants' abilities to detect errors in different videos.

	Mean points	Median points	Minimum points	Maximum points
Curl-up	4.3	5	2	5
Shoulder mobility	4.1	4	3	5
Push-up	3.8	4	2	5
Squat	3.4	4	2	5
Throw-catch combination	2.5	3	1	5
Lower back extension	4.3	5	2	5
Quintuple jump (front)	2.9	2	2	5
Quintuple jump (side)	2.9	3	2	5
Total	28.2	29	21	35
Total %	70.5 %		52.5 %	87.5 %

The maximum result in each video was 5 points. The total maximum was 40 points.
Total % is the total divided by the maximum points (40).

Analysis of the different body parts gave information on which body parts the students concentrated on when observing the performance techniques. When analyzing the body parts (head, upper extremities, trunk and lower extremities) the maximum result of each body part was 8 points and the total maximum of all the videos was 32 points. All the students' results were summarized and categorized to four variables that covered each body part. Descriptive statistics such as mean, median, minimum and maximum results were calculated from the body part variables (table 3). Lower extremities (mean 6.1 points) scored the highest results. Head (mean 4.1 points) scored the lowest results. Head median was 4 points when all the other body parts' median was 6 points. The minimum result was 2 points also in head variable. The maximum results (8 points) were scored in upper extremities and lower extremities. When considering the body parts the mean result of correct answers in all participants was 68 %, the weakest participant detected 53 % of the errors in different body parts correct and the maximum result was 84 %. All the differences between the body parts were significant ($p<0.05$) except between upper extremities and trunk ($t(70)=1.991$, $p=0.05$) and between upper extremities and lower extremities ($t(70)=-1.435$, $p=0.156$).

TABLE 3. The participants' abilities to detect errors in different body parts.

	Mean points	Median points	Minimum points	Maximum points
Head	4.1	4	2	7
Upper extremities	5.9	6	3	8
Trunk	5.6	6	4	7
Lower extremities	6.1	6	4	8
Total	21.9	22	17	27
Total %	68.4 %		53.1 %	84.4 %

The maximum result in each body part was 8 points. The total maximum was 32 points.
Total % is the total divided by the maximum points (32).

The correlations between the video variables were calculated (table 4). Pearson's r was utilised to discover the significant relationships between the video variables. Statistically weak negative correlation ($r=-.38$, $p=0.01$) was found between the curl-up and throw-catch combination videos. This means that when the student was able to detect the errors in curl-up, he did not manage well in throw-catch combination. Statistically significant weak positive correlation was found between quintuple jump front and quintuple jump side ($r=.35$, $p=0.003$), push-up and throw-catch combination ($r=.34$, $p=0.004$), throw-catch combination and quintuple jump front ($r=.28$, $p=0.019$) and squat and quintuple jump side ($r=.24$, p=0.041). These results mean that when the students managed well in one video they managed well in the other video too.

TABLE 4. The relationships between the video variables (Pearson's r correlation coefficient)

	1	2	3	4	5	6	7	8
1.Curl-up	-							
2.Shoulder mobility	-.16	-						
3.Push-up	-.16	.17	-					
4.Squat	.06	.04	-.04	-				
5.Throw-catch combination	**-.38***	.08	**.34****	.10	-			
6.Lower back extension	.16	.08	-.13	.05	-.09	-		
7.Quintuple jump (front)	.10	.07	-.02	.20	**.28***	-.02	-	
8.Quintuple jump (side)	-.00	.16	.14	**.24***	.14	.07	**.35****	-

* p < 0.05; ** p < 0.01

The correlations between the body parts variables were also calculated (table 5). Statistically significant weak negative relationship was found between head and upper extremities (r=-.26, p=0.032). This means that when the students detected errors in head well, they did not detect them well in upper extremities. Statistically significant weak positive relationship between head and lower extremities was found (r=.28, p=0.020). This means that when the students detected errors well in head they also detected them well in lower extremities.

TABLE 5. The relationships between the body part variables (Pearson's r correlation coefficient).

	1	2	3	4
1.Head	-			
2.Upper extremities	**-.26***	-		
3.Trunk	.09	.23	-	
4.Lower extremities	**.28***	-.18	.12	-

* p < 0.05

7.2 Relationship between the students' observations and their backgrounds

Secondly, the aim of the study was to discover the relationship between the observation of the performance techniques and the student's background including hobbies, physical education studies and previous profession. Independent samples t-test was utilised to find out the relevance of the hobbies, physical education studies and profession (table 6). Hobbies were divided to two categories: physical activity (n=64) that included ball games, dance, jogging, walking etc. and other (n=7) that included music, handicraft, household work and baking. There was no difference in detecting the errors between the students with physically active hobbies and other hobbies (t (69)=1.465, p=0.147). The result means that physically active hobbies did not provide better abilities to the students to detect the errors better than the students that had no physically active hobbies.

Hobbies were also divided to three categories: ball games (n=25), jogging (n=14) and gym (n=17). Most of the students (n=56) had hobbies from these categories. ANOVA was utilised to discover the effect of different physical activity background on the ability to detect errors. There were no differences between the hobbies (F (2,53)=0.958, p=0.390). Thus, the different physically active hobbies did not have an effect on how well the students detected the errors.

Physical education studies were divided to two categories based on what course the student was attending at that moment: compulsory course (n=59), which means the basic level of the physical education studies, and free-elective courses (n=11), which included the advanced level courses. There was no difference between the physical education studies (t (69)=0.542, p=0.590). This means that the students did not detect the errors better even though they had more physical education studies behind than the students that attended to the compulsory course.

Profession was divided to two categories: earlier profession (n=28) and no profession (n=43). Earlier profession included for example kindergarten teachers (n=6), teachers (n=5), physical education instructors (n=4), plumber (n=1) etc. The result was that the profession had no effect on detecting the errors between these categories (t (69)=-0.006, p=0.995). This means that the possible previous profession did not assist the students to detect the performance technique errors better than the students with no previous profession.

TABLE 6. The influence of the participants' background to the ability to detect errors.

	n	Mean	std	t	df	p
Hobbies						
Physical activity	64	28.41	3.50	1.465	69	.147
Other	7	26.43	1.99			
PE studies						
Compulsory course (basic level)	60	28.12	3.33	0.542	69	.590
Free-elective courses (advanced level)	11	28.73	4.03			
Profession						
Earlier profession	28	28.21	3.55	-0.006	69	.995
No profession	43	28.21	3.37			

At the end was analyzed if the amount of views that the student watched the videos had an effect on detecting the errors. The students wrote how many times on average they watched the videos before responding to the question. Mainly students watched the video on average one or two times, only one student watched the videos three times. The correlation between the times watched and the errors detected was statistically significant but the relationship was weak ($r=0.266$, $p=0.025$). The result means that the more the student watched a single video the better the student detected the errors. Even though the result was significant the correlation was weak, which means that the result only provides some direction.

8 DISCUSSION

In this study the aim was to find out what kind of performance technique errors students in the primary school teacher education programme observe from the Move! physical functional capacity videos that were specifically recorded for the purpose of this study. Another aim for the study was to find out if there is a relationship between the observation of the performance technique errors and the student's background including hobbies, physical education studies and previous professions. The students detected on average 71 % of all the errors correct. The students observed most errors from curl-up, lower back extension and shoulder mobility videos, which were calm and had only few moving elements. The students observed least errors from throw-catch combination, quintuple jump front and quintuple jump side videos, which were fast-paced and had several moving elements. When comparing the body parts with each other, the students observed least head related errors. The background had no effect on detecting the results.

8.1 Student's observations on performance technique errors

When analyzing video variables, the result was that the weakest student detected over half of the errors correct. The average result was 71 % correct of all the errors, and the best was 88 % correct. If teachers at schools observed on average 71 % of the errors correct, it would significantly misrepresent the results and the students' level of physical function, and thus provide false information. Furthermore, with correct results of children's physical function, the teacher can plan individual exercises for the children to develop their skills. In this study the students had possibilities to watch the videos several times (although most of them watched the videos once or twice) and still the results were quite low (Barnett et al. 2014; Rintala, Sääkslahti & Iivonen 2016; Rintala et al. in print). In real situations at schools the teachers only have one possibility to assess the performance. In addition, most of the students just completed the studies that covered Move! physical functional capacity measurements and it can be assumed that they had the latest information on correct performance techniques. After all, it is important to remember that the ability to observe develops through practice and the students can be thought to be quite in the beginning in this process. Experienced observers can be thought to have more experience with inefficient and proficient performers, thus, they might have more accurate information of correct and incorrect movement performance when compared to novices. (Palmer & Brian 2016). However, previous observation experiences not necessarily result in better scores (Gulgin & Hoogenboom 2014; Minick et al. 2010).

The observations were made through videos, which excluded the possibilities to move and watch the performance from different points of views. However, this type of video training for observers is common when interrater reliability is studied. (Barnett et al. 2014; Gulgin & Hoogenboom 2014; Palmer & Brian 2016). Through video trainings (three two hour occasions) the observer's abilities to observe developed, which indicates that it would be beneficial also in teacher education (Barnett et al. 2014). In conclusion in primary school teacher education it is important to train observation several times in different situations for the students to be able to develop their skills. In addition, teaching of observation techniques and matters that should be considered while observing (background, distance and angle of view) is important (Morrison 2000).

It must be remembered that based on the result of all the errors it cannot be concluded that the students' ability to observe Move! physical functional capacity measurements was on average 71 %. In this study the reliability of the questionnaire was analyzed with Cronbach's alpha and the p-value was under the recommendation (Muijs 2011, 217). It means that when a participant detects the errors well in one item (video) of the test, s/he necessarily will not succeed in another item (video). These videos included only certain errors which were decided in advance. That is why it is impossible to say how well the students would have detected the errors from different situations with different errors. On the other hand the study shows which kinds of errors the students detected and which kinds of errors were difficult to detect or might require additional training. Furthermore the result provides information that there is a requirement to train more the observation of Move! physical functional capacity measurements in the primary school teacher education.

When analyzing the items (videos) of the questionnaire separately students reached the highest results from curl-up, lower back extension and shoulder mobility videos. This indicates that those performance techniques in the videos were easiest to assess. It was easy to direct the attention in these videos, because the videos had only few moving elements and the pace was calm when the movement was performed. Still, one student left a comment where s/he considered whether there was an error in performer's lower back in shoulder mobility video because the performer had a lumbar hyperextension. Indeed, this was the error and it is quite general error that people make if they have no control in lumbar area. Thus, it is one of the most important errors that teachers should detect and correct with their students. Therefore it is highly recommended to teach the students in primary school teacher education the most common performance technique errors in all measurement sections. The teacher can assist the students to direct the attention to essential body parts. By guiding the students' attention (exploration) the teacher assists the students in building new schemata. According to Neisser (1976, 20-21, 30) the result of an exploration, which is the new information, forms new schemata or modifies the original schemata. Thus, new schemata direct the exploration. This way the students learn to observe the essential parts in Move! performance techniques.

Throw-catch combination, quintuple jump front and quintuple jump side videos received the lowest scores. However, overhand throw is difficult to assess even between the two experienced observers (Barnett et al. 2014). The students can thought to be inexperienced in observation thus if experienced observers have difficulties to rate overhand throw movement, it is not a surprise that the students had difficulties in it. One student commented that throw-catch combination video was unclear because the performer's position was not correct if the correct throw technique is considered. S/he brought up that in Move! physical functional capacity measurement instructions the correct position of the performer is not defined. Only the amount of correct throws is calculated, and this part could not be seen in the video. The student is correct with his/her comment and throw-catch combination video was the one that was considered troubled by the researcher. However, the video was included because it is important that the students at schools are instructed of the correct throw technique and its biomechanics even though it is not part of the Move! measurement evaluation. In addition, the instructions in the questionnaire included that the videos might include both general performance technique errors and errors mentioned in Move! guidelines. On the other hand this video might have confused other students too and thus students gained low points. In primary school teacher education correct throw techniques should be taught despite of the fact that they are not mentioned at Move! guidelines. As the shoulder and the elbow are at increased risk of injury due to the energy forces of acceleration and deceleration (Fleisig et al. 1996).

In quintuple jump measurements the performance time of the jump videos was only five seconds, which makes them difficult to assess. In real life, the time is approximately the same and it is performed only once. Thus, the teacher must be able to analyze these movements as well. However, in Rintala et al. (in print) study the lowest reliability scores were in hop and horizontal jump skills, which means that jump movements are difficult to observe also for trained observers. The three videos that scored the lowest points had several moving elements which might be the reason that they were the most difficult to observe. The observer must be alert during quintuple jump measurement because false performance technique might result in injuries. Several non-contact knee injuries occur during single-leg landing (Sinsurin et al. 2013). Frontal plane knee movement (varus and valgus) increases the risk for ACL injury (Begalle et al. 2015; Fox et al. 2014). Therefore, students in primary school teacher education should be taught which kinds of errors they must concentrate on. For example the observation of correct landing technique and knee positions should be carefully taught at slow paced movements then gradually increasing the pace. Students could for example record each other's jump techniques and then analyze them in slow motion.

When analyzing the body part variables, the weakest participant detected little over half of the errors correct, the average was 68 %. If this result is compared with the video variable results, it can be seen that some of the students knew slightly better the parts that were not the reason for the errors than the parts that were the reason for the errors. The errors in lower extremities were easiest to detect and the errors in head were the most difficult ones. The ability to detect errors in upper extremities and trunk did not considerably differ from the lower extremities. This indicates that the students are not probably used to observe the head and that is why the attention was not directed to it. Also, in general, head might not be regarded as a body part that is significant in performance techniques. However, maintaining the head in neutral position in relation to the spine and in line to the plane of the torso, decreases firstly the risk for muscle strain or injury to the cervical spine and secondly the compensation mechanisms that might lead to spinal column injuries (Myer et al. 2014). The primary school teacher students concentrated on upper extremities, trunk and lower extremities quite evenly but more information on the significance of the head alignment should be provided.

Curl-up and throw-catch combination videos had a statistically significant negative correlation. In these videos the body parts that make the error are different. In curl-up the errors are in lower extremities and in throw-catch combination in upper extremities, trunk and lower extremities. It can be that the students detect better either the upper or the lower part of the body, which could explain these results. Statistically significant positive correlation was found between quintuple jump front and quintuple jump side, push-up and throw-catch combination, squat and quintuple jump side, and, throw-catch combination and quintuple jump front. Quintuple jump videos were extremely similar and thus it is reasonable that if the student detected the errors in one, it was easier to detect them in the other one too. In push-up and throw-catch combination the errors were in similar body parts (upper extremities and trunk), and in the same way in videos squat and quintuple jump side (lower extremities). It is difficult to say why there was a relationship between throw-catch combination and quintuple jump front. However, it is important to remember that these relationships were weak and they can only show some direction. It could be thought that if the student detects errors well in one video s/he would detect them well in similar types of videos. It would be good to challenge the students to reflect their abilities to observe, to challenge them to think which types of errors are easy or difficult for them to detect. Then the student could concentrate on the weaknesses that s/he has while observing.

Correlations between the body parts were also calculated. Statistically significant weak negative relationship was found between the head and upper extremities and weak positive relationship between the head and lower extremities. Based on these results it could be said that the students detected better body parts that are further away from each other. Possibly the body parts that are further away from each other catches the eye easier if the body part makes the error. On the other hand it should be remembered that the relationships were weak. In primary school teacher education this could mean that they detected well gross errors but had difficulties in detecting specific minor errors. In practice this means that the students require more training in observation to be able to develop in it.

8.2 Relationships between the student's observations and their backgrounds

The relationships between the abilities to detect the errors and the background were discovered. The previous experiences might affect where the observer direct the attention in observation (Neisser 1976, 20-21, 30). On the other hand previous observation experiences not necessarily have an effect on how well the observer observes (Gulgin & Hoogenboom 2014; Minick et al. 2010). When the relationship between student's hobbies and the abilities to detect errors was discovered, there were no differences between the results. The problem of this was that the groups were extremely uneven: students with physically active hobbies (n=64) and students without physically active hobbies (n=7). The hobbies were furthermore divided to three variables to see if there was a difference between different types of physically active hobbies, but no differences were found. It is known that when the children master the fundamental movement skills, they are more likely to be physically active (Hardy et al. 2013). In other words it could be thought that physically active people have good fundamental movement skills, and thus it was presumable that in this study, students that had more experience in physical activities would be better at detecting errors. However, in this study it seems that even though the student was physically active it did not affect the abilities to observe physical activity performances. The weakness in this test was that the groups were extremely uneven and thus it is impossible to rely on these results.

Physical education studies were divided to two categories: students that attended the compulsory course in autumn 2016 (n=59), and students that attended free-elective courses in autumn 2016 (n=11), which includes the advanced level courses. One student replied that s/he was not attending any of the physical education courses at the time. There was no difference between the physical education studies and the error detection. The amount of students that participated in advanced level courses was small which might be the reason that no difference was found. Students that attended the compulsory course in autumn 2016 filled in the questionnaire with a teacher in an auditorium. The students that participated to advanced level courses filled in the questionnaire at home. This explains why there were responds mostly from the compulsory course students and why the amount of responds from advanced level students remained small. According to Haynes & Miller (2014) primary school teacher education students' limited time to physical education during the studies might lead to inadequate knowledge to assess fundamental movement skills. Thus, it was presumable that students that attended advanced level of physical education studies would have detected the errors better than students that attended basic level of physical education studies. However, in this study the groups were extremely uneven which probably misrepresented the results. In addition several other reasons might affect the results.

Students in compulsory course had just introduced themselves in Move! physical functional capacity measurements, and had the latest experience on it. Even though the advanced level students had more physical education studies behind, it is difficult to say how well they had familiarized themselves with Move! physical functional capacity measurements, because it is not known when these measurements became part of the compulsory course. For example one student commented that s/he does not know how the movements are performed correctly. In their compulsory course they did not have Move! physical functional capacity measurements because of the absence of the teacher. Another student commented that s/he is not familiar with Move! physical functional capacity measurements. These comments show that it would have been better to ask in the questionnaire if the student had familiarized him/herself with the Move! measurements or not, and when s/he had done it. This would have provided more accurate information on how many of the students are, in fact, familiar with these measurements. On the other hand, the teacher told that all the students that participated to the compulsory course in autumn 2016, which is 59 of the students, are familiar with the measurements.

When considering the profession and the abilities to detect errors, the earlier profession did not make a difference. The amount of students with earlier profession and without earlier profession was quite even. Professions included for example kindergarten teachers, teachers, two physical education instructors and a plumber. It can be thought that students with these professions do not necessarily have knowledge of physical activity performances or experience in observing them.

Based on these results the background including hobbies, physical education studies and earlier profession had no effect on the ability to detect errors in this study. The weaknesses in these tests were that the hobby groups and physical education study groups were extremely uneven and they would have required more participants to the minor groups to be able to rely on these results.

In the end, the results of view times of the videos were calculated. The amount of time the students watched the videos had a slight effect on the ability to detect the errors. The more the students watched the video, the better they discovered the errors. This finding was presumable as the students had more time and possibilities to direct the attention to different errors and body parts. Also, it indicates that the repetitions teach the eyes to direct the gaze.

8.3 Limitations of the study

With careful preparations the study would have provided more reliable results. For example, the students should have been asked how well they had familiarized themselves with Move! physical functional capacity measurements previously. It would have provided more specific information on the background.

The recruitment of the students should have been more carefully thought. That way it would have been possible to avoid extremely uneven groups when the backgrounds (previous studies and hobbies) were considered. For example, part of the students could have been from primary school teacher education programme and part of the students from physical education teacher programme to be able to have greater differences between the groups based on the background.

Also, the questionnaire was rather restricted. The students were only able to select different body parts from pre-made list in a questionnaire, which might have assisted them but also restrict their observations, because they were not able to describe their observations with own words. As, one student commented that it was difficult to choose the body part. S/he would rather have explained the errors with own words.

Furthermore, the videos did not include sounds, which might affect the abilities to observe for students that are auditory learners. In addition, most of the students responded to the questionnaire in an auditorium, which might affect concentration. In the end, the researcher should have been present when the students participated to the questionnaire to be able to assist if questions arouse. With these considerations the study could have been improved.

8.4 Research proposal

Next, it would be interesting to study what kinds of errors students who major in physical education would detect. Those results could be compared with the results of this study. Another option could be to study what kinds of errors physical education teachers at schools detect. This would provide information on whether there is need for additional training for teachers in the field or not.

8.5 Conclusions

The performance techniques of each Move! physical functional capacity measurements presented in this thesis are partly from the researches performed in athletes. Therefore, the risks of injuries in physical education lessons are presumably considerably less than with trained athletes who push themselves to the maximum performance. However, the students have less experience in physical measurements than athletes, which might in fact increase the risks of injuries. For example, in Finland 21 % of children in physical education lessons at schools reported an injury at least once during the previous year (Kokko & Mehtälä 2016). Furthermore, the activation of deep abdominal muscles, the correct alignment of lower extremities and head, and the correct jump and throw techniques reduce the musculoskeletal conditions effectively (Begalle et al. 2015; Fleisig et al. 1996; Fox et al. 2014; Gong 2013; Holden et al. 2015; Kolber & Beekhuizen 2007; Misuk 2013; Myer et al. 2014; Ota & Kaneoka 2011; Sinsurin et al. 2013; Wang 2011). The specific errors chosen for the study and the performance techniques presented in this thesis are considered to be the ones that everyone should learn at an early stage. Therefore these should be taught to primary school teacher education students for them to able to teach them to the students at schools.

In spite of the limitations, the study provided important information to the primary school teacher education programme. With the questionnaire it was possible to establish students' strengths and weaknesses in observations. Based on these results the teachers can in further teaching cover and concentrate more on matters that were difficult for students and thus plan individual exercises for them. The study raised the requirement for several observation possibilities. The videos that students observed included basic performance technique errors that according to literature might lead to injuries. These types of videos that were utilised in the study could also be utilised in primary school teacher education. The teacher could instruct the students to observe the videos alone and afterwards discuss with them which types of errors they detected, or the teacher could together with the students observe different videos and discuss what they observe at that moment.

The physical activity among children and adolescents is decreasing. At the same time musculoskeletal conditions are increasing and fundamental movement skills declining. Increasing amount of evidence suggests that there is a relationship between fundamental movement skills and physical activity. Better fundamental movement skills increase the physical activity. Therefore, it is important to teach students already at young age different fundamental movement skills. When the child is physically active, s/he is presumably physically active in adulthood. The physical activity is important to attain physical fitness. It prevents injuries, maintains good work ability and public health. Thus, physical functional capacity measurements are utilised not only to provide students important information on their health but also on the correct performance technique. Therefore, in primary school teacher education programme it would be essential to concentrate on the performance techniques of Move! physical functional capacity measurements, and not only how to measure the physical functional capacity. Especially performance techniques in measurement sections that are fast-paced and contain several moving elements should be at focus. In addition, the importance of head alignment in performance techniques should be emphasized. The utilisation of these types of videos, which were in the study, is beneficial in teacher education. Observation requires practice so that the eyes gradually become accustomed to see the errors. Move! physical functional capacity measurements provide excellent opportunity for that. Observation skill is one of the most important skills in the profession of physical education teacher and thus it should be at focus also in primary school teacher education. Good observation skills enable the teacher to give positive and corrective feedback to the students. Through feedback the students are able to improve their fundamental movement skills, which increase their experiences in competence (Hardy et al. 2013). Experiences in competence bring joy and motivate them to be physically active (Hardy et al. 2013; Haynes & Miller 2014; Logan et al. 2015; Reillo et al. 2010). Furthermore correct observation ensures the correct results of children's physical function. With correct results the teacher can plan individual exercises for the children to develop their skills.

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APPENDIX 1

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Move! mittausosioiden suoritustekniikat

Tutkimuslupa

Opiskelen Jyväskylän yliopistossa ja pääaineeni on liikuntapedagogiikka. Teen pro gradu -tutkielmaa siitä miten luokanopettajaksi opiskelevat havainnoivat Move! –fyysisen toimintakyvyn mittausosien suorituksia videoista. Tutkin myös sitä, onko opiskelijan taustalla (harrastukset, liikuntaopinnot tai aikaisempi ammatti) yhteyttä havainnointiin. Tutkielman ohjaajana toimii dosentti Arja Sääkslahti Jyväskylän yliopiston liikuntatieteellisestä tiedekunnasta.

Move! on fyysisen toimintakyvyn valtakunnallinen tiedonkeruu- ja palautejärjestelmä. Elokuusta 2016 alkaen mittaukset tulee toteuttaa 5. vuosiluokalle ja elokuusta 2018 alkaen 8. vuosiluokalle. Oppilaan turvallisuuden ja tulosten luotettavuuden vuoksi on tärkeää, että opettajat osaavat havainnoida suorituksia.

Aineisto kerätään sähköisellä kyselylomakkeella. Kyselylomakkeesta löytyy videolinkit Move! mittausosioihin, joiden pohjalta havainnointi ja vastaus annetaan. Kyselylomakkeessa tulee vastata jokaiseen kohtaan muuten lomake ei päästä sinua eteenpäin. **Saadut vastaukset käsitellään anonyymisti.** Saatua tutkimusaineistoa käytetään vain tätä tutkielmaa varten. Tutkijana sitoudun noudattamaan tutkimusaineiston säilyttämiseen ja raportoimiseen liittyviä eettisiä ohjeita. Osallistuminen tutkimukseen on vapaaehtoista.

Lisätietoja saa:
Linda Nikula
linda.k.nikula@student.jyu.fi

1. Valitsemalla 'kyllä' suostut osallistumaan tutkimukseen, ja siirryt kyselylomakkeeseen.*

○ KYLLÄ, osallistun tutkimukseen.

2. Mitä harrastat? Mainitse max. 2 asiaa. Jos sinulla ei ole harrastuksia, vastaa 'ei ole'. *

40 merkkiä jäljellä

3. Valitse listasta kaikki ne liikunnan opinnot, jotka olet jo suorittanut. *

- [ ] VK9 Liikunta- ja terveyskasvatus, 4 op
- [x] MO11 Liikunta, 6 op
- [ ] Liikunnan perusopinnot, 25 op
- [ ] Liikunnan aineopinnot, 35 op
- [ ] Ei mitään edellä mainituista opinnoista

4. Valitse listasta kaikki ne liikunnan opinnot, joita suoritat tällä hetkellä. *

- [ ] VK9 Liikunta- ja terveyskasvatus, 4 op
- [ ] MO11 Liikunta, 6 op
- [x] Liikunnan perusopinnot, 25 op
- [ ] Liikunnan aineopinnot, 35 op
- [ ] Ei mitään edellä mainituista opinnoista

5. Onko sinulla aikaisempi ammatti? Jos on, mikä? Jos ei ole, vastaa 'ei ole'. *

44 merkkiä jäljellä

Katso jokaisen kysymyksen kohdalla oleva video linkin kautta. Palaa takaisin kyselyyn, ja valitse omien havaintojesi pohjalta mikä vartalon osa tekee mahdollisen suoritusteknisen virheen. Voit valita useamman vaihtoehdon. Jos suorituksessa ei mielestäsi ole virheitä, valitse 'ei virhettä'. Keskity videoissa katsomaan suoritusteknisiä asioita, ei sitä suorittaako oppilas testin loppuun asti. Mahdolliset suoritustekniset virheet voivat olla joko mittausosion oikeaan Opettajan käsikirjassa mainittuun suoritustapaan liittyviä asioita tai yleisiä suoritustekniikkaan liittyviä asioita. Videot ovat 5-30 sekunnin mittaisia, joten ole tarkkana. Katso kukin video max. 2 kertaa.

6. Ylävartalon kohotus *

https://drive.google.com/open?id=0B6xpLacvX19wTWFHYWxnc0puRFk

☐ pää

☐ yläraajat

☐ keskivartalo

☒ alaraajat

☐ ei virhettä

7. Olkapään liikkuvuus *

https://drive.google.com/open?id=0B6xpLacvX19wSUg1Ui1DZ0phTjg

☐ pää

☐ yläraajat

☒ keskivartalo

☐ alaraajat

☐ ei virhettä

8. Etunojapunnerrus polvet maassa *

https://drive.google.com/open?id=0B6xpLacvX19wN2VmNlNrNjFZdUE

☒ pää

☒ yläraajat

☒ keskivartalo

☐ alaraajat

☐ ei virhettä

9. Kyykistys *

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☒ pää

☐ yläraajat

☐ keskivartalo

☒ alaraajat

☐ ei virhettä

10. Heitto-kiinniottoyhdistelmä *

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☐ pää

☒ yläraajat

☒ keskivartalo

☒ alaraajat

☐ ei virhettä

11. Alaselän ojennus *

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☐ yläraajat

☒ keskivartalo

☐ alaraajat

☐ ei virhettä

12. Vauhditon 5-loikka edestä *

https://drive.google.com/open?id=0B6xpLacvX19waE9zWXg5czRNdFU

- ☒ pää
- ☐ yläraajat
- ☐ keskivartalo
- ☒ alaraajat
- ☐ ei virhettä

13. Vauhditon 5-loikka sivusta *

https://drive.google.com/open?id=0B6xpLacvX19wcEVoLUNkdE8xU2c

- ☒ pää
- ☐ yläraajat
- ☐ keskivartalo
- ☒ alaraajat
- ☐ ei virhettä

PALAUTE

14. Kuinka monta kertaa keskimäärin katsoit yksittäisen videon? *

0-15 ________________________________

15. Halutessasi voit jättää vapaata kommenttia kyselylomakkeesta. Kiitos.

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