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Original Article

Effects of school-based intervention program on motor performance skills

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Abstract:
The purpose of this study was to identify the effects of a four-week intervention program on motor skill performance in primary school children. Twenty-one children with mean age of 6.5 ± 0.7 years participated. The experimental group (EG) followed a specific movement program in three basic tasks: throwing, climbing, and jumping. The control group (CG) carried out an ordinary physical education program. Results indicated that the experimental group significantly improved their performance compared to the control. It seems that the performance of motor skills can be improved through task-specific organized practice in physical education programs in primary school.
Key words: physical education, motor learning, task-specific program, primary school children

Introduction

It is crucial for children to master motor performance skills, such as running, jumping, climbing and throwing. The skills do not, however, come naturally, but need to be learned, practiced and reinforced (Gallahue et al., 2012; Logan et al., 2015)**.** Research shows a positive relationship between physical activity and motor development (Fisher et al., 2005) and fitness (Stodden et al., 2007; Barnett et al., 2009; Lubans et al., 2010). Improvement of motor skills is associated with positive health-related outcomes, and with increased physical activity engagement (Okely et al., 2001; Lubans et al., 2010; Livonen et al., 2013: Catuzzo et al., 2016). Moreover, fundamental motor skills are the building blocks of more complex movements, which enable children to participate in sport and games that require more advanced movements (Logan et al., 2011). Therefore, it is important to promote physical activity and programs for the development of motor skills performance (Rietmuller et al., 2009).

In school, motor performance skills not only allow children to carry out everyday practical tasks, but are also an important determinant of their level of self-esteem, and of their popularity and status in their peer group (Skinner & Piek, 2001). There is a suggestion that children having low skill performance may be drawn into a 'negative spiral of disagreement,' where low skill contributes to low perceived physical competence (Stodden et al., 2007; 2008). Motor skill competency is identified in the curriculum for the 10-year compulsory schooling in Norway as a quality goal in primary school physical education. However, motor skill performance mastery among children appears in some cases inadequately low, and children who lack the opportunity to practice often demonstrate delays in motor skill development (Erwin et al., 2008; Lubans et al., 2010; Mathisen, 2016).

When teaching motor skill, educators strive to apply the best practice, and selected methods of learning and teaching may not have a strong scientific evidence base. One method of delivering instruction by physical education (PE) teachers is direct instruction, a method that is teacher-centered, goal-directed and orderly. Research in PE pedagogy has consistently provided support for the use of direct instruction to develop motor skills (Sweeting & Rink, 1999). However, creating a climate that supports the learning of motor skills, which gives the learner more freedom of choice and in decision-making, has been shown to be equally helpful in developing motor skills (Valentini et al., 1999). In accordance with the dynamical system approach, it is suggested that motor skill development is based on the interaction between constraints from the task, the organism, and the environment (Newell, 1984; Davis & Burton, 1991). Motor skills emerge within a dynamic system consisting of a specific task, performed by a learner with given characteristics, in a particular environment (Newell, 1984; Davis & Burton, 1991). Task-specific intervention was put forward by Revie & Larkin (1993) as a method for use with poorly coordinated children, and in contrast to those methods which focus on general 'abilities' or 'processes'. The approach is founded on the assumption that multiple subsystems must be organized and constrained in specific ways for a solution to the task to emerge (Revie & Larkin, 1993; Davis & Burton, 1991).

Motor skills can be described as object control, e.g. skills like overarm throw, or locomotor skills, e.g. skills like jumping or climbing (Gallahue et al., 2012). The task indicate how the subjects must behave to complete the movement successfully. Competence in the different motor skills is positively associated with

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increased physical activity engagement (Lubans et al., 2010; Livonen et al., 2013), and it appears that improved performance in motor skills among children is positively correlated with participation in organized sport (van Beurden et al., 2002). However, there is not much empirical evidence on the practical learning effects situations in the school. Therefore, the aim of the current study was to assess the effectiveness of interventions designed to improve some fundamental movement skills in primary school children using a specific task teaching approach based on a theoretical framework of the dynamic system approach. The purpose of the present study was to evaluate the effects of short-term training programs with primary school children. The effect of the intervention was hypothesized to be effective for the experimental group.

Materials and Method

Participants

The participants of the study were selected from children enrolled in the first stage of primary school in Norway. The experimental group (EG) consisted of 21 participants, 12 girls and 9 boys, with a mean age of 6.5 (± 0.7 years) from one class. The control group (CG), with a mean age of 6.6 (±0.6 years), consisted of 22 students, 9 girls and 13 boys, from another class. Permission for the study was granted from the parents or legal guardians, and the study was approved by the school administration and by the local ethics committee according to the Declaration of Helsinki.

Intervention program

This study utilized a pre-test to post-test quasi-experimental design due to the lack of random assignment of participants to groups consisting of intact classes at primary school. The intervention program consisted of 20 sessions during a four-week period, with one hour practice per day. A typical session started with warm-up activities such as run- and catch-games. A station-organization approach was carried out, by assigning each skill or activity to a separate location in the gymnasium. Each session lasted 60 minutes and consisted of a 15-minutes period of jumping activities, 15 minutes of climbing, and 15 minutes of throwing. Warm-up activities lasted about 10 minutes, and about two minutes were allowed for transition between each activity station. A task-specific approach was used, in which the instructor provided the task presentation, followed by the student activities individualized at their own level. Jumping tasks was practiced by single foot jumping, or both feet simultaneously in different ways or through games. Throwing was practiced with overarm throw, by working two together throwing to each other, throwing to hit a target or by different games. The climbing activity was practiced on the wall bars or in the climbing wall with different routes or free climbing. The control group followed an ordinary PE program with the same number of lessons with, one hour practice per day. All sessions took place in an indoor gymnasium.

Test procedure

The three test items were taken from the new test battery designed for testing everyday activities for children, like jumping, throwing, climbing and running (Fjørtoft et al., 2011). The test is designed for 5- to 12-years-olds, most of the test items have appeared in other test batteries. The three items used for this study was:

a) Jumping a distance of seven meter on one foot as fast as possible. The test item score is the time needed to cross the distance (measured in seconds).

b) Throwing a tennis ball with one hand as far as possible. The child stands with the contralateral foot in front of the ipsilateral foot. The test item score (better of two attempts) is the distance thrown (measured in meters).

c) Climbing up wall bars, crossing over two columns to the right, and climbing down the fourth column as fast as possible. Each of the wall bar is 2.55 m high and 0.75 m wide. The test item score (better of two attempts) is the time to completion (measured in seconds).

Each test was explained and demonstrated before the child started, and the children were tested individually. If a child made a procedural error, instructions and demonstrations were repeated, and the child made a new attempt (Fjørtoft et al., 2011).

Statistical analysis

A two-way analysis of variance with repeated measures was used to determine the pairwise differences between the intervention group and the control group. When a significant F value was achieved, appropriate Tukey post hoc tests procedures were used to locate the difference between the means. Data are presented as mean ± SD, and statistical significance was set at $p < 0.05$. Test-retest reliabilities for the experimental test have shown high interclass correlation (Fjørtoft et al., 2011).

Results

Table I. Pre- and post-test results for motor skill performance (mean ±SD) for training group (TG) and control group (CG).

	Training Group (n=21)		Control Group (n=22)	
Test	Pre	Post	Pre	Post
Jumping task (sec)	4.55 (0.89)	3.56 (0.41) #	4.55 (0.76)	4.33 (0.74)
Climbing task (sec)	17.6 (2.56)	14.07 (2.64) #	16.64 (3.13)	16.65 (2.87)
Throwing task (sec)	8.07 (2.73)	10.33 (3.05) #	9.45 (3.26)	9.22 (3.30)
Pre- and post-tests between-groups, significant # $p<0.05$				

At the end of the training period, the training group displayed a significant improvement in both jumping-, throwing- and climbing skills. After four weeks of training, the group average jumping skill improved significantly by 16.1 % from 4.55 (±0.41) seconds to 3.56 (±0.41) seconds, climbing skills improved significantly by 17.2 % from 17.6 (±2.56) seconds to 14.07 (±2.64), and throwing skills increased significantly by 28 % from 8.07 (±2.73) meter to 10.33 (±3.05) meters.

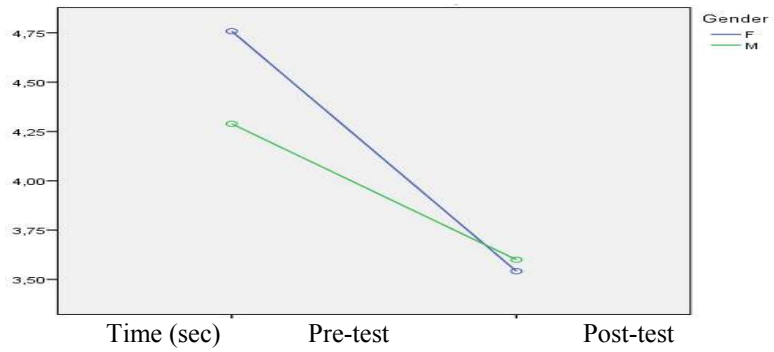

Fig. 1. Pre- and post-test for jumping distance. Gender difference.

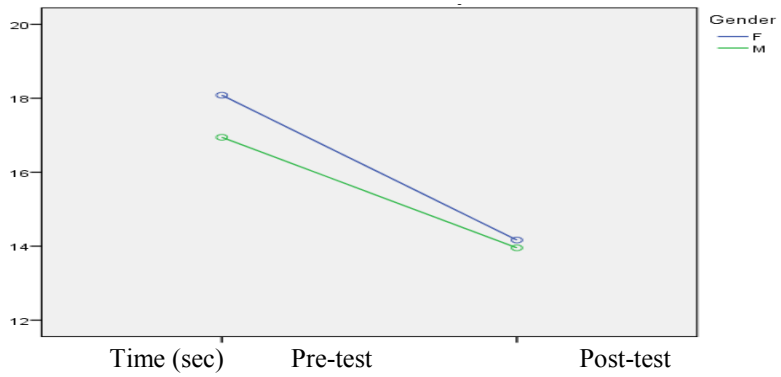

Fig. 2. Pre- and post-test for climbing in wall bar. Gender difference.

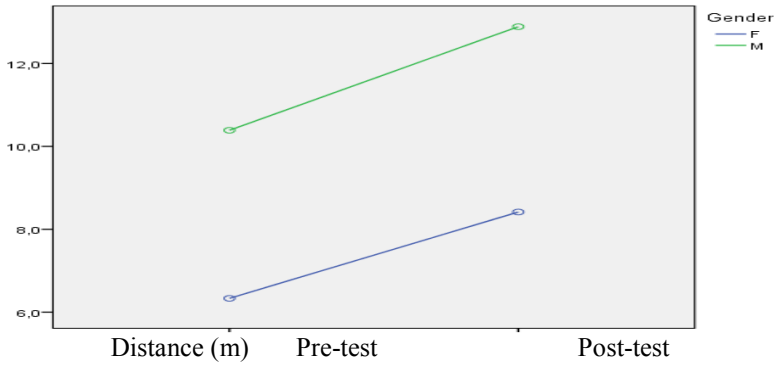

Fig. 3. Pre- and post-test for throwing. Gender difference.

Significant improvement was found in females' jumping performance: pre 4.7 sec (±0.96), post 3.85 sec (±0.73), and in males result were: pre 4.4 sec (±0.64), post 4.05 sec (±0.69) (p<0.05). Significant improvement was found in females' climbing performance: pre 17.9 sec (±2.57), post 15.5 (±3.20) and in males result were: pre 16.6 sec (±2.97), post 15.2 (±2.91) (p<0.05). Females throwing performance also showed significant improvement: pre 6.9 (±1.29), post 7.6 (±1.99) and in males result were: pre 10.5 (±3.21), post 11.8 (±2.73) (p<0.05). Gender difference in pretest performance was found in jumping and throwing skills, although not in climbing skills (p<0.05).

Discussion

The results of the current study showed an improvement of children's performance in jumping, climbing and distance throwing for the EG, while the CG did not improve in the motor skill tasks (Table I). The most noticeable improvement was found in overarm throwing with a 28% increase, followed by climbing with a 17.6 % increase and jumping with a 16.1% increase; not surprisingly, the biggest change was found in the individuals at the lowest start level. This is in line with previous reports, which have shown improvements in motor skills in the first four to six weeks of training (Beck et al., 2007). Thus, the hypothesis, that children who followed the task-specific program would improve their performance more than those who were engaged in ordinary PE sessions activities was verified for the above skills. Although time spent on task and practice trials was not calculated in this study, it seems reasonable to suggest that children in the EG could have spent more time on tasks and persisted for longer at tasks, obtaining many repetitions at each skill, thus helping to improve their motor skill performance. It is claimed that the key variable in determining skill improvement is the number of correct practice trials a student accumulates (Silverman et al.,1991; Siedentop et al., 2002). In the current study, the CG were probably not so focused on each of the specific motor skills, and they did not spend enough time practicing each skill to significantly improve their performance in this short-term program. Although the EG' results were very positive in this study, individual differences were apparent. The task-specific approach has the advantage of dealing directly with the issues of motor skill performance, and general motor skill interventions have not clearly demonstrated gains in performance in gross motor skills (Revie & Larkin, 1993; Beck et al., 2007). Both boys and girls showed significant improvement in all tasks (Figures 1, 2, 3); interestingly, girls showed better post-test performance in jumping (Figure 1). The most significant gender difference in pre-test for the skills was in throwing, boys showed much better performance (Figure 3). This is in line with previous studies, and it has been concluded from meta-analysis that the forceful overarm throw was one of the few motor skills in which gender difference were clearly evident from the youngest ages (Thomas & French, 1985; Roberton & Konczak, 2001; van Beurden et al., 2002; Barnett et al., 2010). It has been argued that this difference between boys and girls is due to the effect of greater practice by the boys (Roberton & Konczak, 2001).

It has been suggested that learning basic motor skills does need not much instruction and other feedback from teachers; the individual will find the optimal solution based on inner feedback, and that having enough time to practice many repetitions is essential (Siedentop, 2002). It is important to understand the factors influencing motor skill development and how to accommodate motor skill performance by manipulating the instructional environment and equipment, and modifying the task, so that effective instruction can be provided (Newell, 1984; Davis & Burton, 1991). Several factors can influence motor skill performance, such as the time spent in practice, intensity of exercise, quality of instructions and learning method, and it is difficult to identify specific intervention components that may contribute to success (Rietmuller et al., 2009). However, in primary schools, many teachers are not sufficient educated in PE. Thus, the PE teacher can accommodate the child's developmental level by 'manipulating' the instructional environment and equipment and modifying the task (Siedentop et al., 2002; Beck et al., 2007). For example, distance throwing can be 'manipulated' by the need to control the throw in order to hit a target at the appropriate height using the overarm technique.

The findings from this study have educational implications, and are in line with previous school- and community-based programs delivered by physical education- or trained classroom teachers (Morgan et al., 2013; Philip et al., 2013). Results from the current study support the findings from previous reports that indicates the necessity of professional physical educators the in preschool and in primary stages in schools (Livonen et al., 2009). Another interesting observation was that the form teacher claimed that the intervention period had a positive influence on the learning environment. This is in accordance with research showing that motor skills influence concentration and social settings (Skinner & Piek, 2001).

Due to the small sample size and because only three motor skills were assessed, the results from the study should be interpreted with caution. A more sophisticated modelling test battery, consisting of more tasks, would be more appropriate; however, these three tasks in the current study come from different parts of motor competence; object control skill, throwing and locomotor and balance skill, jumping and climbing. PE teachers may not be knowledgeable with regard to how to design and implement appropriate instruction. There is a need for future research to investigate the effectiveness of motor skill interventions in children. It is important to study

the components of the interventions such as approach, amount of instruction time, and the content of the curriculum.

Conclusion

In summary, the result from this study suggest that a four-week specific training program can contribute to improved performance in gross motor skills like jumping, climbing and throwing. The teaching approach used here, with specific training in the motor skills, would probably have contributed to the gain made by the groups given intensive teaching of jumping, throwing and climbing. This is in accordance with previous research showing task-specific motor training programs to have a positive effect on motor skill performances.

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