

Fundamental Movement Skills and Game Performance in Invasion Game Activities

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Abstract: Many studies showed that fundamental movement skills (FMS) proficiency have positive effect on regular physical activities. As a consequence, researchers compete on creating games activities to improve FMS. However, relationship between FMS and games performance at games activities are still unexplored. The purpose of this study was to examine the correlation between fundamental movement skills and games performance of elementary students in the modified invasion game activities. Correlational approach was used to analyze the results of this study. Third grade elementary school students (n=40) were enrolled in this study. FMS was measured by Gross Motor Development-Second Edition (TGMD-2) Test consisting of locomotor and control object skills. Student's games performance were evaluated through a modified invasion game, where the technical and rules were minimized and adjusted to the developmental characteristics of the participants. Game performance consisted of games involvement (GI) and games performance (GP), and it was measured using the observation format of Game Performance Assessment Instrument (GPAI). This was achieved by selecting three components that were adjusted to the research needs of decision making component, skill execution and support on invasion game activities in the form of modified handball and soccer games. The results indicated that all correlation between FMS toward GI and GP in both games were statistically significant. Student who have better FMS will perform better. When viewed from the type of invasion game, the dominant game of the leg (soccer games) tend to be more difficult to be performed by students. Therefore simple invasion games are more suitable for students of this age especially for girl's student.

1 INTRODUCTION

Fundamental movement skills (FMS) could be divided into three aspects, namely object control skills, such as throwing and catching; locomotor skills such as running and leaping; and stability skills like bending and twisting (Gallahue, Ozmun, and Goodway 2012). One of the strategies to develop FMS learning is through playing, which can facilitate children's motoric learning ability because it is a core part of a child's world. Children's play is the primary means by which they learn about their bodies and movement (Gallahue (2006:29). Games approaches are developed as a result of dissatisfaction with the emphasis on technique-based approaches especially for children (1). Many studies have investigated the role of games or gaming console activity to increase children's FMS (Barnett 2015a; Papastergiou 2015;

Akbari et al. 2009; Johnson et al. 2016; Barnett 2015b) and motor skill or physical activity programme (Brian et al. 2016) (Bryant and Duncan 2016). In order to increase a child's interest and physical activity behavior, intervention programs such as manipulative skills are developed in physical education (Mazzardo et al. 2008). Game-focused teaching strategies appear to promote a mastery oriented motivational climate and, therefore, have the potential to increase pupils' motivation in PE (Gray et al. 2009) and possibility to increase school performance (Ericsson and Karlsson 2012).

Proficiency in FMS and early motor skills positively contribute to enrolment in regular physical activities (Iivonen et al. 2013; Barela 2013) and body mass index (De Meester et al. 2016; Okely 2012). It is also beneficial in sport activities during adolescence and may have implications for talent identification purposes as well as potential health-

related benefits (Vandorpe et al. 2012). However, getting used to and involved in physical activities is a long process (Barela 2013). Therefore interesting activities are possibly required to make children want to remain in physical activities; for example by humor-presented activities when playing the games (Aggerholm and Ronglan 2012). Better motor skills development is correlated with higher physical activity in children (Cliff, Okely, Smith, and McKeen, 2009). Moreover FMS proficiency can also improve physical self-confidence (Mcgrane et al. 2016). To get the children involved and stay active in longer periods, the teacher needs to set physical activities to games-like situation. Teachers must be aware that children require free play to develop their motor skills. Through games activities, FMS are mastered by the children as they play along. Additionally, objects and manipulative skills which also have big impact to physical activity can be achieved (Carl 2015). Therefore, physical educators at primary school should reinforce learning of object manipulation skills in the PE curriculum (Barnett et al. 2016).

In opposite to the opinion above, some studies suggested that FMS could be acquired by specific activities, and hence this could improve physical activity (Bryant and Duncan 2016; Ericsson and Karlsson 2012; Anon 2013; Lander et al. 2017). To achieve competence in sport, FMS must be mastered prior to doing sport activities, and there is evidence that FMS is related to physical activity level (Barnett, Ridgers and Salmon 2015). In other words, children who have better FMS tend to be more active and involved in physical activity. There have been many reasons for little attention being paid for FMS, including that, again, children acquire these FMS without specific requirement activity. This study aims to investigate the contribution of FMS (locomotor and object control) to invasion games activities and explore how FMS contribute to games performance and games involvement in modified invasion games (football and handball) among elementary school children, ranging from 9-11 years old.

2 METHOD

2.1 Participants

Forty 3rd grade students from a state elementary school in Bandung who were studying physical education (21 female; 19 male) participated in this correlational study. Student's physical characteristics

(mean \pm standard deviation) were: age = 9,1 \pm 0.54 years; height = 1,25 \pm 0,3; and weight = 27,4 \pm 0,3).

2.2 Procedure

The first test to be conducted was The Test of Gross Motor Development (TGMD-2), which measures Fundamental movement skills (FMS) of children from 3 - 10 years (Mazzardo et al. 2008; Bardid, Huyben, et al. 2016). Among the primary goals of the TGMD-2 is to serve as a measurement tool in research involving gross motor development. Locomotors (Loc) skills were defined as running, galloping, hopping on one foot, jumping with both legs, and jumping side-wise. Object control skills (OC) were defined as hitting, bouncing, catching, kicking, throwing and rolling ball. According to Ulrich and Wouter, (De Meester et al. 2016; Barnett, Ridgers, Zask, et al. 2015) each child was given two trials for each skill assessment, where scores of both trials were then summed up to obtain a raw score. The raw scores of the locomotor and object-control skills were added to provide an overall score which was then converted to a percentile score, standardized for age and sex. The construct validity of the TGMD-2 test for locomotors component is $r = .68 - .78$ and for manipulative component $r = .66 - .87$. The overall value of Cronbach Alpha test TGMD-2 for each test item range between .82 to .83. The TGMD-2 was conducted one week prior to the game performance assessment.

One week later, games performance was assessed in invasion games activities. The design of the modified invasion game for novices was adapted from those used in similar research in educational contexts (20). Subjects were evaluated through small-side games 4 vs 4 invasion games without goal keeper (del Campo et al. 2011; Gutiérrez et al. 2014). Before games, student followed a standard 10-minutes warming-up consisting of juggling, passing and passing-intercepting. All students participated in the invasion games for 8 minutes, which was divided into two rounds, each round lasts for 4 minutes. Fields and rules were modified in order to adapt with the students' games skills and hence, high-skilled and less-skilled children could be differentiated. This small-sided game can improve students' involvement in the game, either they control the ball or not (Mitchell et al., 2003). The objective of the game was to score goals by throwing the ball into the modified goal post. In this game, each team has 2 goal posts, where goalkeeper were not present. Moving with the ball was possible just by bouncing; and stealing from an opponent and physical contact were not permitted.

In case of foul play, the game will be restarted from the place where the infraction took place. In order to evaluate the overall performance, the games were recorded with a video (Gray and Sproule 2011) camera located behind and above the court. (García-López et al., 2013) (Gutiérrez et al. 2014).

To characterize game play performance in invasion games, it is necessary to identify nonspecific observable components of game performance (Memmert, 2004, 2005; Mitchell et al., 2006) (Memmert and Harvey 2008) Mitchell et al. (2006). The tally scoring method was applied in this modified invasion game and was assessed from components from videotapes, which consisted of decision-making, skill execution, and support that were adjusted with students’ abilities (Memmert and Harvey 2008). Tally systems can also be used in peer assessment procedures (Memmert and Harvey 2008). Among “decision-making” and “skill-execution” components, one or several elements were selected to evaluate the performance of individuals, reflecting their ability. The “support” component could be assessed when children tried to acquire the ball from their opponents, both during attack or defence. All of the 3 components could be adapted to various sports and game activities, and they did not only depend on on-the-ball skills, but also off-the-ball skills (both offensive and defensive; Mitchell et al., 2006) (Gray et al. 2017; Memmert and Harvey 2008). More detail about decision making, skill execution and support see table 1.

Table 1: Decision-making and skill execution categories.

Decision	Point	No point
On-the ball	- Pass the ball when team mates is open. - Attempt to shoot on goal appropriate	- Pass the ball when team mate covered. - Blocked while trying to shoot
Off-the-ball	- Moving into a position to receive a pass (appropriate distance).	- No movement when needed
Skill Execution	Point	No point
Passing	Team mate receive ball easily	Team mates hard to get passed
Shoot	On the target	No target
Support		
Attack	Go forward and open space to receive ball or shoot	
Defence	Try to cover opposite team	

3 RESULTS AND DISCUSSION

Testing results for the subject (n=40) r was used to examine the correlation between FMS (TGMD-2) and games performance (GPAI) which are reported in mean ± SD and shown in table 1. The correlation between variables were determined using Pearson’s correlation coefficients (for parametric data), and Spearman’s correlation coefficients (for non-parametric data). SPSS software (version 22.0, IBM) was used in all the above calculations. To determine data normality, Kolmogorov-Smirnov on each correlational calculation was used.

Table 2: Mean values (± SD) for all tests in modified handball games.

Variable	Mean ± SD
FMS	14.22 ± 13.2
GI HB	15.25 ± 18.1
GP HB	0.64 ± 0.014
GI S	15.07 ± 25.8
GP S	0.633 ± 0.005
Loc	7.7 ± 2.87
OC	6.5 ± 7.17

3.1 Correlation between FMS toward GP and GI in Modified Handball (HB) and Soccer (S) Games

Table 3: Correlation between FMS, GP and GI.

FMS	HB GI	HB GP	S GI	S GP
Correlation Coefficient	.434**	.337*	.674**	.316*
Sig. (2-tailed)	.005	.033	.000	.047
N	40	40	40	40

** . Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed).

Table 3 showed Spearman’s Rho correlations, calculated to investigate relationship between fundamental movement skills (FMS) towards game performance (GP) and games involvement (GI). All correlations were statistically significant between FMS and GI (P < .01; r = .434) and between FMS and GP (P < .05; r = .337). In modified soccer games, showed Spearman’s Rho correlations, that was calculated to investigate relationship between fundamental movement skills (FMS), game performance (GP) and games involvement (GI). All correlations were statistically significant between

FMS and GI ($P < .01$; $r = .674$) and GP ($P < .05$; $r = .316$).

3.2 Correlation between Subdominant FMS (Locomotor and Object Control) towards GP and GI in Modified Handball and Soccer Games

Table 4: Correlation between locomotor and object control toward games performance and games involment.

Correlations						
			HB GP	HB GI	S GP	S GI
Spearman's rho	LOC	Correlation Coefficient	.320*	.219	.397*	.494**
		Sig. (2-tailed)	.044	.174	.011	.001
		N	40	40	40	40
	OC	Correlation Coefficient	.356*	.495**	.231	.660**
		Sig. (2-tailed)	.024	.001	.152	.000
		N	40	40	40	40
	**. Correlation is significant at the 0.01 level (2-tailed).					
	*. Correlation is significant at the 0.05 level (2-tailed).					

Table 4 showed Spearman's Rho correlations, calculated to investigate relationship between Locomotor (Loc) and Object control (OC) skills towards game performance (GP) and games involvement (GI) in modified handball games. Correlations between Loc and GP were statistically significant ($P < .05$; $r = .320$). The difference between Loc and GI was that the Correlations were statistically not significant ($P < .05$; $r = .219$). Furthermore, all correlations were statistically significant between OC and GP ($P < .01$; $r = .356$) and between OC and GI ($P < .05$; $r = .495$). In modified soccer games showed Spearman's Rho correlations, calculated to investigated relationship between Locomotor (Loc) and Object control (OC) skills towards game performance (GP) and games involvement (GI) in modified soccer games. All correlations were statistically significant between Loc and GP ($P < .05$; $r = .397$) and between Loc and GI ($P < .01$; $r = .494$). Furthermore correlations between OC and GP were statistically not significant ($P < .01$; $r = .231$) and contrast between OC and GI had significant correlation ($P < .01$; $r = .660$).

3.3 Correlation between FMS towards GI and GP based on Gender

Table 5: Correlation FMS toward GP and GI based on gender.

Correlations					
		HB GP	HB GI	S GP	S GI
Boys	Pearson Correlation	.642**	.659**	.160	.530*
	Sig. (2-tailed)	.002	.001	.489	.013
	N	21	21	21	21
Girl	Pearson Correlation	.200	.066	.161	.541*
	Sig. (2-tailed)	.412	.788	.509	.017
	N	19	19	19	19
**. Correlation is significant at the 0.01 level (2-tailed).					
*. Correlation is significant at the 0.05 level (2-tailed).					

Table 5 showed Pearson Correlation, calculated to investigate relationship between fundamental movement skills toward game performance (GP) and games involvement (GI) in both games based on gender. In boys sample, the correlations between FMS and GP were statistically significant ($P < .01$; $r = .642$), for modified handball contrast with modified soccer games that is not significantly correlational with GP ($P < .05$; $r = .160$). Otherwise, all correlations were statistically significant between FMS and GI in handball and soccer games ($P < .01$; $r = .659$) and ($P < .01$; $r = .530$). While in the girls, showed relationship between FMS and GP were statistically insignificant ($P < .05$; $r = .200$) for modified handball and soccer games ($P < .05$; $r = .161$). Similarly between FMS and GI, correlations were not statistically significant in handball and soccer games ($P < .05$; $r = .066$) but significant in modified soccer games ($P < .01$; $r = .541$).

4 CONCLUSIONS

All correlation between FMS toward GI and GP in both games were statistically significant. Student who have better FMS will perform better. When viewed from the type of invasion game, the dominant game of the leg (soccer games) tend to be more difficult to be performed by students. So that the GP of play was better shown when playing dominant hand (handball games). However, in soccer games children are more likely to be more involved in the game than handball games. The better students' object control ability, the better their games performance is, but overall 9-year-old elementary school students have not been able to perform well at the leg dominant game (soccer). Therefore simple invasion games are more suitable for students of this age especially for female students.

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