



ORIGINAL SCIENTIFIC ARTICLE

INCREASING PHYSICAL ACTIVITY AND FUNDAMENTAL MOVEMENT SKILLS OF PRIMARY SCHOOL STUDENTS DURING THE COVID-19 THROUGH EXERGAME

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Abstract

Study purpose. The low physical activity and fundamental movement skills of students in the COVID-19 era are gaps in this study. This study aims to exam the effects of exergame on the physical activity and fundamental movement skills of students during the COVID-19 era.

Materials and methods. Quantitative research with experimental methods was used in this study. The subjects of this study came from students at primary schools 1 and 2 in Karawang (n = 120). Subjects from primary school 1 Karawang entered the experimental group (n = 60), namely getting treatment in the form of exergame, and subjects from primary school 2 Karawang were included in the control group (n = 60) who did not receive any treatment and only carried out physical education learning activities. The intervention program was carried out for seven weeks. To measure the physical activity of the students, the ActiGraph GT9X Link accelerometer was used, and the fundamental movement skills of the children were assessed using the TGMD-3.

Results. The results showed that the implementation of exergame was proven to significantly improve physical activity ($p < 0.05$) and the same results show that exergame has a significant effect on fundamental movement skills ($p < 0.05$). However, there was no increase in physical activity and fundamental movement skills in the control group ($p > 0.05$).

Conclusions. This research is evidence that exergame is an effective tool to improve physical activity and fundamental movement skills students during the COVID-19 era.

Keywords: exergame, fundamental movement skills, physical activity, experimental.

Introduction

COVID-19 still has a negative impact on all people in the world including the field of physical education in elementary schools, for example the experience of student movement is hampered and the student's physical activity (PA) are low (Xin et al., 2020). Survey data shows that the

level of PA carried out by students by 60.0% has decreased to 17.7% due to fear of contracting COVID-19 (Xiang, Zhang & Kuwahara, 2020). Other data reports that the inactivity of community CL in the world globally during the COVID-19 pandemic is estimated at 28% (1.4 billion people) (Puccinelli et al., 2021). Previous studies reported that the decline in the level of PA was due to several factors, such as the policy of staying at home orders, closures of parks, gymnasiums, fitness centers and prohibitions from doing sports or mass PA in public places (Woods et al., 2020). In addition, according

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to Violant-Holz et al., (2020) that the decline in PA was due to the effect of lock down (Violant-Holz et al., 2020) and social distancing during a pandemic.

Another factor affected by the COVID-19 pandemic is the fundamental movement skills (FMS) of students. FMS is the ability to perform three basic movement skills such as locomotor skills, stability skills (Dobell, Pringle, Faghy, & Roscoe, 2020) while aiming to perform sufficient physical activity (PA and manipulative or object control skills (Foulkes et al., 2020; Jones, Innerd, Giles & Azevedo, 2020)). Previous studies have found that the development of well-established FMS has the potential to create a healthy lifestyle in the future (Bai et al., 2020). Another benefit of FMS is that it can reduce overweight or obesity in students (O'Brien, Belton, & Issartel, 2016) skip and kick. Previous studies in the UK and internationally reported that the rates of FMS among primary school students has decreased over time (Grainger, Innerd, Graham, & Wright, 2020). Similar to data found in Indonesia, the FMS of primary school students is still low and continues to decline due to an unhealthy lifestyle and rarely doing sports (Burhaein, 2017). Therefore, developing FMS in elementary school children is a very important goal and a priority, because FMS is very useful for them to participate in sports and even non-sports activities.

A potential new training strategy to improve PA and FMS is through exergames (i.e., Xbox 36). Exergame is an innovative and interactive video game that combines training and video (Kappen, Mirza-Babaei, & Nacke, 2019). It requires full body movement from the player. Activities in exergame include cycling (Moholdt et al., 2017a), fitness games, tennis, baseball, dancing, soccer, basketball, boxing, dance, snowboarding. The advantages of exergame are being able to conduct training at home safely (Adcock et al., 2020) and comfortably without being disturbed by bad weather (Yu et al., 2020) especially avoiding the transmission of COVID-19. Exergame has been shown to be a fun activity for children, adolescents, young adults and older adults (Monedero, Murphy, & O'Gorman, 2017)(ii. Research by Andrade et al., (2020) reports that exergame causes boys and girls to have positive improvements in psychological aspects, namely mood and self-esteem. Some researchers claim that exergame is attractive to children and effective in helping them improve motor skills and develop motivation to participate in PA (Soltani, Figueiredo, & Vilas-boas, 2020)). However, different results reported by the study of Wu, Li, & Theng, (2015) found that exergame can cause lower motivation compared to traditional training methods for exercise and exergame can also cause poor motor skills (Gao, Zeng, Pope, Wang, & Yu, 2019), so it is difficult to repair (Pedersen, Cooley, & Cruickshank, 2016) it is less clear whether they can provide skill acquisition benefits that are similar to those found in traditional physical education. Purpose: In a previous experiment from our laboratory, we found that deliberate practice can significantly reduce the planning time required for lateral arm movements. The purpose of this study was to determine if exergames can produce a similar effect, by reducing the processing time required for children to initiate arm movements to the contralateral and ipsilateral space. Participants and setting: Thirty children (boys = 15, girls = 15). Then recent studies have shown that exergames have an inconsistent impact on children's motor skill competence in the short term (Hulsteen et al., 2018).

With the results of previous exergame with the gap, it is the reason for us to uncover this problem. Many previous studies have examined exergame (Vernadakis et al., 2015; Villafaina et al., 2020; Polechoński, Dębska, & Dębski, 2019). However, there is no research that explores how the effects of exergames on PA and FMS of students during COVID-19 era. The this study will implicated the development of PA and FMS provide information knowledge to teachers, lecturers and practitioners about the benefits obtained from the exergames. Therefore, the aim of this study was to test the effectiveness of exergames to increase PA and FMS student during the COVID-19 era.

Materials and Methods

Study participants

All subject came from two primary school in the region Indonesia. The school was selected because it has quality teachers and one of the largest and most structured schools with ideal facilities for implementing sports games and for offering PE classes three times a week of 60 minutes each. Subject are first explained about the rules for carrying out research and asked to make written agreements. The sampling technique used to select subject was random assignment. Subject characteristics are presented in Table 1.

Instruments

Physical Activity Levels. To measure PA students can use the ActiGraph GT9X Link accelerometer, namely ActiGraph light and resembles a watch. This instrument is valid and reliable. Students are instructed to use the accelerometer in their arms every time they go to school. The activity counts recorded were interpreted using empirically based cut points

Table 1. Socio-demographic of subjects

Variables	n(%)
Gender	
Male	50(41.67%)
Female	70(58.33%)
Age (y)	
10	35(29.17%)
11	27(22.50%)
12	58(48.33%)
Weight (kg)	
25	30(25.00%)
30	38(31.67%)
35	52(43.33%)
High (cm)	
125	37(30.83%)
130	40(33.33%)
135	43(35.83%)
School	
Primary School 1 Karawang	60(50.00%)
Primary School 2 Karawang	60(50.00%)
Class	
5	46(38.33%)
6	74(61.67%)

that defined different intensities (sedentary: 0820; light PA: 8212830; moderate-to-vigorous PA (MVPA): 2831 for Acti-Graph vector magnitude) of preschool children's PA. Student average percentages of time in MVPA at school were used as the outcome. Notably, the accelerometers were not allowed to be taken home given the following considerations: (1) additional burden for underserved families, (2) possibility of lost or stolen devices, and (3) incomplete and inaccurate measurements. Therefore, only PA during school time was used for the current study (Gao, Zeng, Pope, Wang, & Yu, 2019).

Fundamental Movement Skill. Test of Gross Motor Development-3rd Edition (TGMD-3). The TGMD-3 is comprised of locomotor (run, skip, leap, hop, and horizontal jump) and object-control (catch, kick, underhand roll, one-hand strike and two-hand strike) skill subtests. While the TGMD is a common assessment tool used in many studies worldwide, some would criticise the lack of a stability component. To this end, a subtest of the Bruininks-Oseretsky Test of Motor Proficiency 2 (BOT-2) Short Form was utilised to assess the participants' balance. The balance assessment consists of two tasks, walking forward along a straight line, and standing on one leg (Behan et al., 2019) complex movements required to participate in physical activity. This study examined FMS proficiency across the full range of Irish primary school children ($n = 2098$, 47% girls, age range 5-12 years. Each FMS in TGMD-3 is accompanied by performance criteria. For example locomotor motion with criteria if the movement of running, leap, jumping, and jumping horizontally is done correctly according to the assessment norm, then it gets a value of 1 to 4 and if it does not match the assessment norms it is given a value of 0. As for control objects, there are three performance criteria to capture: a) the preparatory phase in which the hands are in front of the body and the elbows are bent, b) the arms are outstretched as they reach the ball as it comes in, and, c) the ball is caught with the hands only. Each child is evaluated against these criteria. If the performance criteria are met, grades 1 to 4 are assigned. If a performance criterion is not met, a score of 0 is assigned. Meanwhile, the assessment for stability component balance is by assessing how long the child can do walking straight lines, and standing on one leg. Each child tried two experiments for each movement skill and was assessed based on performance criteria (Vernadakis et al., 2015). The total score of the child (the sum of their individual scores) is calculated.

Study organization

This research has been approved by the Ethics Committee of Public primary school, Karawang, Indonesia (approve number: 126/11/2021) and this research is in accordance with Helsinki declaration. Parental consent forms and subject' consent forms regarding participation in this study were collected before the intervention program began. This research was conducted in the new normal era and implemented the COVID-19 protocol, where each child was checked for body temperature first, then given a hand sanitizer. Subjects from the primary school 1 Karawang entered the experimental group ($n = 60$), namely getting treatment in the form of exergame and subjects from primary school 2 Karawang were included in control group II ($n = 60$) who

did not receive any treatment and only carried out physical education learning activities. The intervention program was carried out for 7 weeks, three times per week and 60 minutes per week. The intervention program began with pre-test activities on November and ended in post-test on December, 2021. All data collection procedures were recorded via video, then the video would be analyzed by researchers and experts. Flow studies are presented in Figure I.

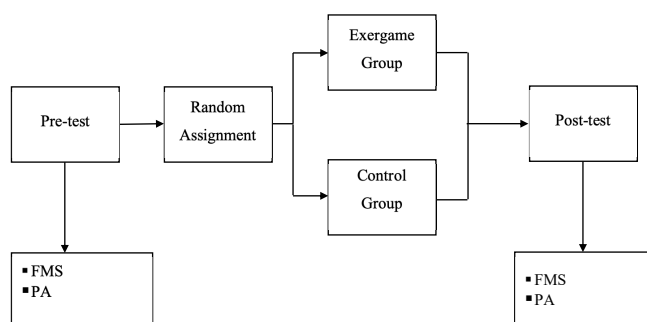


Fig. 1. Study flow

Exergame Program. For the experimental group, the exergame was conducted on Thursday, Friday and Saturday from 08.00-09.00 hours, for 7 weeks, it aims to develop PA and FMS owned by children aged 10-12 years. The program is carried out in the gym three times a week for 60 minutes. The Exergame program is presented in Table 2.

Table 2. Exergame program

Training component	Exercise activities	Duration
Warm-up	Proprioceptive neuromuscular facilitation (PNF) and jogging.	10 min
Focus on practice	The Exergame program items used are (1) Volleyball, (2) Tennis games, (3) Basketball games, (4) Standing twists games, (5) Running games, (6) Dancing games.	40 min
Cool-down	Stretching.	10 min

Statistical analysis

Statistical analysis was performed using the IBM SPSS application Version 25.0 for Windows. Descriptive statistic was presented as mean±standard deviations. The normality of the data was evaluated using the Shapiro-Wilk test. If the normal distribution is found to be parametric, the statistics are used analysis. Paired samples t-test are used to determine differences between baseline values. The statistical significance level was set a $p < 0.05$ for all analyses.

Results

The results of the normality test of the data in this study were declared normal. The statistical descriptive values in the exergame and control groups are presented in Table 3.

Table 4 shows that exergames have a significant effect on increasing PA and FMS ($p < 0.05$). While Table 5 shows the opposite result, namely the control group has no effect on increasing PA and FMS ($p > 0.05$).

Table 3. Descriptive statistics

	Pre-Test	Post-Test
	M(SD)	M(SD)
Exergames (n = 60)		
MVPA (min/day)	49.23(7.97)	58.37(8.79)
FMS	52.03(8.37)	63.18(10.82)
Control (n = 60)		
MVPA (min/day)	47.67(9.77)	47.82(9.18)
FMS	45.18(8.20)	46.33(9.38)

Note: M = Mean; SD = Standar deviasi; MVPA = Moderate-to-vigorous physical activity; FMS = Fundamental movement skills

Discussion

The purpose of this study was to examine the effects of exergame and traditional game interventions on increase PA and FMS in student during the COVID-19 era. The results of this study showed that exergame intervention can improve the PA component. The increase in PA occurred because exergames had interesting games (e.g., bowling games, tennis games, basketball games, standing twists games, running games, dancing games), so that through these games inactive students became more enthusiastic (Huang, 2020) few

studies investigated whether combining exergaming with VR would be more effective. This study seeks to (a) have the motivation to move (Soltani, Figueiredo, & Vilas-boas, 2020). One of the keys to changing PA behavior is because exergames offer an interesting, safe game experience that can be played at home, so students can continue to actively move. The results of this study support previous research which reported that exergame can be used as a tool to encourage students to participate in PA (Soltani, Figueiredo, & Vilas-boas, 2020).

The second finding in this study proves that exergame can positively increase the FMS of students during the COVID-19 era to be higher. Exergame had the characteristics of a very fun game, easy to play and can be done at any time (Lee, Kim, Park, & Peng, 2017) complex movements required to participate in physical activity. This study examined FMS proficiency across the full range of Irish primary school children (n = 2098, 47% girls, age range 5-12 years, so that children who are not interested in sports activities become more enthusiastic and actively move in PE class. Fogel, Miltenberger, Graves, & Koehler, (2010) confirmed that exergame can provide opportunities to engage in higher physical activity than doing standard exercise programs. Exergame had been proven to be an effective game and worthy of use in PE class, because it has the power to trigger interest, motivation and the ability to move children to sustainably participate in sports activities. Previous studies conducted in a school context have identified that the exergames practice can increase physical activity, mental health, and motor skill competence in children (Andrade et al., 2020) complex movements required to participate in physical activity. This study examined FMS proficiency across the full range of

Table 4. Differences values in pre-post of PA, FMS in exergames group (n = 60)

		Paired Samples Test					t	df	Sig
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PA	Pre-Test Post-Test	-9.133	5.936	0.766	-10.667	-7.600	11.918	59	0.000
FMS	Post-Test Pre-Test	-11.150	7.876	1.017	-13.185	-9.115	10.966	59	0.000

Note: PA = Physical activity; FMS = Fundamental movement skills

Table 5. Differences values in pre-post of PA, FMS in control group (n = 60)

		Paired Samples Test					t	df	Sig
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PA	Pre-Test Post-Test	-0.150	10.581	1.366	-2.883	2.583	-0.110	59	0.913
FMS	Post-Test Pre-Test	-1.150	9.260	1.196	-3.542	1.242	-0.962	59	0.340

Note: PA = Physical activity; FMS = Fundamental movement skills

Irish primary school children (n = 2098, 47% girls, age range 5-12 years as well as becoming a potential educational tool today. Exergame is a great activity for children to use in the long term and on a sustainable basis. The results of this study are in line with the research of Vernadakis et al., (2015) who reported that the XbK-based balance exergame program was significantly more enjoyable than traditional physiotherapy. The main reason why exergame programs were more fun than traditional physiotherapy was that exergames provide more interesting challenges for athletes. Exergame activities are fun psychological teaching activities for children that can help improve their physicality (Van Santen et al., 2018). According to Moholdt et al., (2017b) the use of fun exergames can be a useful strategy for promoting physical activity, especially for those who were less motivated by traditional sports. The results of this study support previous research that has shown that children's FMS was more developed through exergame than traditional sports (Moholdt et al., 2017b) and that subject PA levels were higher for exergames than traditional activities. One reason for answering these results is because children in the current era are more familiar with exergame than traditional games, besides that the number of children's movement activities is more often in exergame than traditional games.

Conclusions

The main conclusion in this study shows that the implementation of exergame can positively improve PA and FMS student during the COVID-19 era, but not for the control group. The limitations in this study are: (1) the sample of the study is relatively small, (2) the subjects only are only from two urban primary school in region (Indonesia). Then the further must use more subjects and come from several elementary schools in Indonesia. Apart from the limitations of this study, several implications arise from this study, namely that exergame can be used as an effective pedagogical tool to increase PA and FMS in student during the COVID-19 era, besides that the results of this study provide important information for teachers, lecturers and practitioners about the advantages of exergame. The findings of this study could potentially be applied to future studies involving exergame with other platforms, such as: Wii (Nintendo, Kyoto, Japan) Just Dance for Kids (Ubisoft, San Francisco, CA, USA), Wii Nickelodeon Fit (Nickelodeon, New York, NY, USA), and Just Dance or using other games such as: biking, yoga, walking, weight training, softball.

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Conflict of interest

No conflict of interest.

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ПІДВИЩЕННЯ РІВНЯ ФІЗИЧНОЇ АКТИВНОСТІ ТА ОСНОВНИХ РУХОВИХ НАВИЧОК УЧНІВ ПОЧАТКОВИХ КЛАСІВ ПІД ЧАС ПАНДЕМІЇ COVID-19 ШЛЯХОМ ЗАСТОСУВАННЯ ФІТНЕС-ГРИ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

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Мета дослідження. Низький рівень фізичної активності та основних рухових навичок учнів в епоху COVID-19 є прогалинами в цьому дослідженні. Це дослідження має на меті вивчити вплив фітнес-гри на фізичну активність та основні рухові навички учнів в епоху COVID-19.

Матеріали та методи. У цьому дослідженні було використано кількісний аналіз із застосуванням експериментальних методів. Учниками цього дослідження були учні початкових шкіл № 1 і № 2 міста Караванг, Індонезія (n = 120). Учасники з початкової школи № 1 міста Караванг увійшли до експериментальної групи (n = 60), а саме отримували експериментальні процедури у формі фітнес-гри, а учасники з початкової школи № 2 міста Караванг були включені до контрольної групи (n = 60), які не отримували експериментальних процедур та проводили лише навчальну діяльність із фізичного виховання. Інтервенційну програму проводили протягом семи тижнів. Для вимірювання фізичної активності учнів використовували акселерометр ActiGraph GT9X Link, а основні рухові навички дітей оцінювали за допомогою тесту на розвиток великої моторики TGMD-3.

Результати. Результати показали, що впровадження технології фітнес-гри статистично значуще покращує рівень фізичної активності (p < 0,05), і ті самі результати показують, що фітнес-гра має статистично значущий вплив на основні рухові навички (p < 0,05). При цьому в контрольній групі підвищення рівня фізичної активності та основних рухових навичок не спостерігалось (p > 0,05).

Висновки. Це дослідження є доказом того, що фітнес-гра є ефективним інструментом для покращення показників фізичної активності та основних рухових навичок учнів під час пандемії COVID-19.

Ключові слова: фітнес-гра, основні рухові навички, фізична активність, експериментальний.

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