The effect of circuit games on manipulative movement for elementary school students aged 9-10 years

El efecto de los juegos de circuito en el movimiento manipulativo de estudiantes de primaria de 9 a 10 años

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Abstract

Objective. The purpose of this study was to analyze the effect of circuit games on improving manipulative motor skills in elementary school students aged 9-10 years based on gender.
Methods. This type of research is experimental; the sample consists of 20 male students and 20 female students aged 9-10 years. Data collection using throwing tests, catching tests, kicking tests. This circuit-training program is, post 1) Fabric Volleyball Game, post 2) Football Circuit Game, post 3) Suki Basketball Circuit Game, post 4) Quickie (Who's Fast?) Game. Each post is done for 10 minutes, recovery 5-6 minutes, and this program is implemented for 16 meetings.
Results: Analysis based on t-test results in male students showed: throwing 0.003<0.05, catching 0.005<0.05, kicking 0.001<0.05, and in female students showed: throwing 0.032<0.05, catching 0.021<0.05, kicking 0.039<0.05. Independent t-test results on throwing, catching, and kicking showed (p>0.05) between male and female students.
Conclusions. The findings of this study provide strong evidence that circuit-based games are an effective intervention for enhancing manipulative movement skills such as throwing, catching, and kicking in 9-10-year-old elementary school students, regardless of gender. Incorporating such activities into physical education curriculum can contribute to the development of fundamental motor skills.

Keywords

Circuit Game, motor skills, elementary school, physical education.

Resumen

Objetivo. El propósito de este estudio fue analizar el efecto de los juegos de circuito en la mejora de las habilidades motoras manipulativas en estudiantes de primaria de 9 a 10 años en función del género.
Métodos. Este tipo de investigación es experimental, la muestra consta de 20 estudiantes varones y 20 estudiantes mujeres de 9 a 10 años. Recopilación de datos mediante pruebas de lanzamiento, pruebas de recepción, pruebas de patadas. Este programa de entrenamiento en circuito es, post 1) Partido de voleibol de tela, post 2) Partido de circuito de fútbol, post 3) Partido de circuito de baloncesto Suki, post 4) Partido Quickie (¿Quién es rápido?). Cada publicación se realiza durante 10 minutos, la recuperación de 5 a 6 minutos, y este programa se implementa durante 16 reuniones.
Resultados: El análisis basado en los resultados de la prueba t en estudiantes varones mostró: lanzamiento 0,003<0,05, recepción 0,005<0,05, patadas 0,001<0,05, y en estudiantes mujeres mostró: lanzamiento 0,032<0,05, recepción 0,021<0,05, patadas 0,039<0,05. Los resultados de la prueba t independiente sobre lanzamiento, recepción y patadas mostraron (p>0,05) entre estudiantes varones y mujeres.
Conclusiones. Los hallazgos de este estudio proporcionan evidencia sólida de que los juegos basados en circuitos son una intervención eficaz para mejorar las habilidades de movimiento manipulativo como lanzar, recibir y patear en estudiantes de escuela primaria de 9 a 10 años, independientemente del género. La incorporación de tales actividades en el currículo de educación física puede contribuir al desarrollo de habilidades motoras fundamentales.

Palabras clave

Juegos De circuito, habilidad motriz, escuela primaria, educación física.

Introduction

In physical education, the development of children's motor skills is one of the important aspects that needs special attention, especially at an early age and elementary school. Motor skills can be divided into two, namely manipulative motion and locomotor motion (Anugrah et al., 2023). Manipulative motion involves the ability to control objects using the hands or feet, such as throwing, catching, and kicking (Chen et al., 2021). These three activities train important hand-eye coordination, balance, and motor control, which not only affect physical performance but also support cognitive development.

Upper-grade elementary school students, with an average age of 9 to 10 years, are at an important stage in the development of their motor skills. Previous research studies have shown that enjoyable and structured physical activities can improve coordination and balance, helping individuals better control their body movements (Wibowo et al., 2021). Then, physical activity also has an impact on muscle development, supporting cardiovascular health and preventing obesity (Wang & Zhou, 2023). Activities involving motor skills are often group-oriented, which not only enhance social skills but also teach the value of teamwork (Mulyk et al., 2024), so it benefits their overall mental health. Therefore, intervention through structured physical activities, such as circuit games, can be an effective method to improve their motor skills (Yudanto & Utami, 2021).

Circuit training is a training method involving various stations, each with a different physical activity. This method is not only appealing to children due to its varied and enjoyable nature, but is also effective in enhancing various aspects of motor skills, including manipulative movements (Yudanto & Utami, 2021). Based on previous research, circuit training programs offer a variety of activities such as throwing, catching, kicking, and hitting, allowing children to hone various skills in one fun session (Ardanari et al., 2023). The number of repetitions that occur can strengthen the neural pathways involved in movement execution (Arga et al., 2024). The playful aspect of circuit training can also enhance children's motivation to participate due to its engaging and non-repetitive nature (Arga et al., 2023). However, there are still problems in the study regarding how effective circuit games are in improving manipulative movement skills and whether there are significant differences based on gender.

Research examining the influence of circuit games on manipulative motions by gender is particularly important, given that men and women may have differences in physical development and motor skills at this age. The results of previous studies in the form of experiments, traditional games can increase manipulative motion in male and female students aged 9-12, but in the study, the form games used traditional games and not in circuit models (Santoso et al., 2024). Then, the results of the study were found to explain that the manipulative movements of male students were better than female students (Irwandi et al., 2023). Therefore, the purpose of this study was to investigate the effect of circuit games on the improvement of manipulative movement skills in elementary school students aged 9-10 and evaluate whether there were differences in these effects between male and female students. The results of this study are expected to provide useful information for educators and trainers in designing physical activities that not only support children's physical development but also pay attention to gender-based needs.

Method

Research Procedure

This research was an experiment design, with two pretest-posttest groups, without control variables. Data collection during the pretest and posttest referred to the results of previous research, which contained three types of tests, throwing, catching, and kicking (Santoso et al., 2024 & Setyawan et al., 2024). Based on the results of the study, in the throwing test, prepare a ball the size of a tennis ball and prepare a target in the form of a cone on a 150-centimeter-high block or a 150-centimeter-high wall. The distance between the student and the target is 5 meters. Students are asked to throw to hit the target with a total of 10 attempts, then the assessor records the number of cones that fall hit by the ball. In the catching test, prepare a ball the size of a tennis ball. The examiner stands facing the student 5 meters away. Then, the examiner throws the ball to the student and the student is asked to catch it. The examiner gives 10 opportunities, then the assessor records how many balls are successfully caught. In the kicking test,

prepare a soccer ball and a target in the form of a cone. The distance between the student and the target is 5 meters, then the student is asked to kick to hit the target 10 times. The assessor records the number of cones that fall hit by the soccer ball.

The training program had four posts so that the daily training program could run efficiently, and the researchers divided the number of students into four groups. The group filled the post provided and then rotated according to the procedure. This division method used a ball in which there was a paper with the group number written on it. In addition, with different friends in each training program, students can work together with other friends and not create a competitive attitude between friends so that students can undergo this training program with pleasure. This circuit game training program, held in 16 meetings on Monday, Wednesday, and Friday, at 07.30 – 09.00. The training place was held at the Sports Court at Yogyakarta State University because the place was spacious and indoor, so it would be easier to supervise each student.

Participants

The sample of this study were students from SD Muhammadiyah Jogokaryan, SD Muhammadiyah Wirobrajan, SD Muhammadiyah Bausasran, and SD Muhammadiyah Sokonandi. The four elementary schools were located in Yogyakarta City, Indonesia. Then, the students were in 4th grade elementary school aged 9-10 years. Sample selection used random sampling so that the total sample participating was 40 students. Student characteristics were analyzed based on gender and age (mean±SD). In male students, there were 20 students aged 9-10 years (10.22±0.3), then 20 female students aged 9-10 years (9.71±8.8). This research has received an official letter from the university with number B/1552/UN34.16/PT.01.04/2024 which will be given for approval by the school and parents. In addition, students have also received written approval from their parents.

Training Program on Circuit Game

The program in this circuit game had 4 posts, the name of the first post was Fabric Volleyball Game, and the duration of this game was 10 minutes. The instructions of the game are that players are divided into groups. Each group holds one large piece of fabric together. At the start signal, the first group throws the ball to the group next to it using a fabric. The intended group must catch the ball with their fabric. Make sure the ball does not touch the ground. After catching, the group immediately throws the ball back to the other group. Continue to throw and catch the ball between groups until the time is up.

The name of the second post was Football Circuit Game, and the duration of this game is 10 minutes, and the duration of this game was 10 minutes. Players were divided into two groups with a balanced number. Prepare a field with small wickets (120 centimeters long, 60 centimeters high) as many as the number of students in two groups, where each group protects the goal. On the starting signal, both groups attempt to attack the opponent's goal and defend their own. Each player can act as a striker or goalkeeper, depending on the situation of the game. Points are scored by successfully kicking the ball into one of the opponents' goals. Count the points scored to determine the winner.

The name of the third post was Suki Basketball Circuit Game, and the duration of this game was 10 minutes. Players were divided into two groups after entering the game area. One team is in the middle of a defending group to guard the ring, and the other team is an attacker. The attacking team tries to get the ball into the ring guarded by the defending group. Each time the ball is successfully inserted into the ring, the group that scores a point becomes the defending group, and the previous group becomes the attacker. Scores are recorded each time the ball is successfully inserted into the ring.

The name of the fourth post was Quickie (Who's Fast?) Game, and the duration of this game was 10 minutes. Divide students into two teams, each team makes a line and each student gets a sequence number. The first sequence number student from each group starts with a ball in hand. On the signal from the teacher, the first student dribbles around the predetermined trajectory. After completing the track, students first give the ball to student number two and then rejoin at the end of the group line. The second student and so on repeat the same process. This process is repeated until the ball returns to student number one or until time runs out. Each student who completes this series of games is given 1 point, the more students in the team who complete the game the higher the points will be.

Before the program started and ended, 10 minutes of warming-up and cooling-down sessions were given, and the recovery between each post was 5 – 6 minutes. This training program had been validated

by physical education lecturers at the elementary school level and physical education teachers at each school with the number 0201/UN34.16/Val/2024. This research program was carried out one week after the validation results.

Data analysis

The data analysis of this study used a paired t-test for the pretest-posttest, and then an independent t-test to analyze the differences between male and female students after treatment. The significance value used is ($p<0.05$). Before the analysis is applied, the study will test the normality and homogeneity to ensure that the students come from the same population. This research software uses the help of SPSS version 26.

Results

The following were the research data based on Statistical Analysis, which aimed to analyze circuit game programs against manipulative motion based on gender. The first analysis was the assumption test through the normality test and homogeneity test.

Description of research data

Based on the results of Table 1, male and female students showed pretest and posttest on the throwing, catching, and kicking test a significance value of $p>0.05$. Thus, the test data on male and female students showed that the data were normally distributed through the Shapiro-Wilk test. After the data was normally distributed, then a homogeneity test was carried out.

Table 1. Normality Test Results

Gender	Test	Test Type	Shapiro-Wilk		
			Statistic	df	Sig.
Male	Pretest	Throwing	0.074	19	0.091
		Catching	0.101	19	0.088
		Kicking	0.143	19	0.101
	Posttest	Throwing	0.067	19	0.103
		Catching	0.342	19	0.158
		Kicking	0.351	19	0.131
Female	Pretest	Throwing	0.093	19	0.093
		Catching	0.287	19	0.082
		Kicking	0.432	19	0.094
	Posttest	Throwing	0.073	19	0.186
		Catching	0.398	19	0.181
		Kicking	0.288	19	0.193

Based on the results of Table 2, male and female students showed pretest and posttest on the throwing, catching, and kicking test a significance value of $p>0.05$. Thus, male and female students showed that they were from the same population. After the data were known to be normally distributed and came from the same population through homogeneity testing, the data of this study was continued with hypothesis testing.

Table 2. Homogeneity Test Results

Gender	Test	Test Type	Levene Statistic	df1	df2	Sig.
Male	Pretest-Posttest	Throwing	0.798	1	39	0.247
		Catching	0.867	2	38	0.311
		Kicking	0.394	1	39	0.447
Female	Pretest-Posttest	Throwing	0.582	1	39	0.257
		Catching	0.822	2	38	0.386
		Kicking	0.441	1	39	0.488

Based on the results of Table 3, male students showed pretest-posttest results on the throwing test $0.003<0.05$, catching test $0.005<0.05$, kicking test $0.001<0.05$. Then, the female students showed pretest-posttest results on the throwing test $0.032<0.05$, catching test $0.021<0.05$, kicking test $0.039<0.05$. It can be explained that circuit games affect the manipulative movements of male and female students aged 9-10. Subsequent analysis by comparing test results in the male and female gender groups aimed to analyze the effect of circuit gaming methods on the two groups.

Table 3. T-test Results

Gender	Test	Test Type	t	df	Sig. (2-tailed)
Male	Pretest-Posttest	Throwing	2.605	39	0.003
		Catching	2.932	39	0.005
		Kicking	3.144	39	0.001
Female	Pretest-Posttest	Throwing	2.274	39	0.032
		Catching	2.119	39	0.021
		Kicking	2.645	39	0.039

Based on the results of Table 4, the result on throwing test of male and female students showed the significance value of 0.088>0.05. The result on catching test of male and female students showed the significance value of 0.102>0.05. The result on kicking test of male and female students showed the significance value of 0.094>0.05. Based on the results of Table 4, there were no differences in throwing, catching, and kicking tests in the group of male students and female students. Thus, circuit games are effective for improving the manipulative movements of male and female students aged 9 – 10.

Table 4. Independent T-Test Results

Male-Female Test Differences		t	df	Sig. (2-tailed)
Throwing	Equal variances assumed	1.399	39	0.088
	Equal variances not assumed	1.399	7.677	0.088
Catching	Equal variances assumed	1.289	39	0.102
	Equal variances not assumed	1.289	7.032	0.102
Kicking	Equal variances assumed	1.356	39	0.094
	Equal variances not assumed	1.356	7.366	0.094

Discussion

The results of this study indicate that circuit games have a significant effect on the development of manipulative movement skills, namely throwing, catching, and kicking, in both male and female students. The results of this study are also supported by research conducted by Setyawan et al. (2024) the results of this study also support that the sports group of games that have a clear program is more influential than the control group whose sports are not programmed or exercised based on the wishes of the child. Then, the results of a similar study on the manipulative motion showed that traditional games also had an impact on the manipulative motion of male and female students (Santoso et al., 2024). This study confirms that circuit games can be considered an effective training method for improving manipulative motion skills in primary school children, regardless of gender. The findings of another study showed that circuit games made individuals increase the variety of movements, thus stimulating most of the ability of muscles and nerves to work (Yachsie et al., 2023 & O'Connor et al., 2024). These skills are important because they contribute to better motor coordination, which is essential in many aspects of daily life and sports contexts.

Researchers also conducted in-depth observations of each child, revealing that biological factors play a significant role in influencing manipulative motor skills in elementary school children. These biological factors include brain development, which contributes to increased neural connectivity and motor coordination, as well as the development of the motor cortex, which is essential for movement control (Adhe et al., 2024, Hadyansah et al., 2024, & Susiono et al., 2024). Mature sensory-motor coordination allows for better integration of sensory information and motor responses, while increased muscle strength and endurance support more controlled movement execution (Septianto et al., 2024, Syahriadi et al., 2024, & Alex et al., 2024). Furthermore, it is suspected that developing balance and coordination also affect manipulative abilities, along with physical growth such as height and body proportions that affect the way children throw or catch (Krasova et al., 2023 & Wedi et al., 2024). In addition, neurological maturity and genetic factors also play a role in determining a child's motor skills (Gastélum-Cuadras, 2022 & Kurniawan et al., 2024), both of which together influence how children develop and display manipulative motor skills during their growing years.

Furthermore, the results of the analysis also showed no significant difference in the results of manipulative movements between male and female students. Some factors in the absence of differences based on the analysis of this first study are that at primary school age, physical and biological differences be-

tween genders have not been very significant, allowing both groups to have similar capacities in developing skills such as throwing, catching, and kicking. The findings of previous studies also explain that hormones that affect physical differences between genders, such as testosterone and estrogen, have not peaked before puberty (Herting et al., 2021 & Jeong et al., 2023). Therefore, skills such as throwing, catching, and kicking are not strength or muscle mass at this age. In the second analysis, the circuit games used focused more on coordination, accuracy, and technique, which can be learned by all children regardless of gender. In the analysis, it focuses more on instruction orders from the teacher or coach, because the child must see examples of movements before performing (Gearity & Kuklick, 2022). Some literature explains the involvement of exercise in physical education for children aged 9 – 10 years is liking commands with simple instructions, and many variations of challenges but with low and pleasant levels of difficulty (Jerina et al., 2018; Mozolev et al., 2019; Shuba & Shuba, 2020, & Polevoy et al., 2023). Thus, children will be enthusiastic to try repeatedly until they succeed in achieving the target without boredom. The third analysis is the social and psychological drive for healthy participation and competition among all children, without gender bias. It is because the education and training children receive at school are usually uniform and not differentiated by gender (Syaukani et al., 2023 & Fierro-Suero et al., 2023). Then, this circuit training program requires the children to work together and each group does not come from the same school. So that children will better know and understand each child's character, which in turn can increase sports motivation and self-confidence in children (Dahlan et al., 2022, Silva et al., 2022, Latief et al., 2024, Mandan et al., 2024, & Djaba et al., 2024).

The importance of these results lies in their implications for the design of physical education curricula in schools, where circuit games can be integrated as part of regular programs to develop children's motor skills. Educators can use this information to design exercise sessions that promote gender equality and provide equal opportunities for all students to improve their physical skills. The limitation of this study is that the number of samples in students is small, so it will determine the number of games designed. It is hoped that future research can increase the number of students and increase the number of games. Then it is also important to monitor the heart rate while the child is playing and consider the intensity of training to improve student fitness.

Conclusions

In conclusion, this study shows that circuit games are effective in improving manipulative motion skills such as throwing, catching, and kicking in elementary school children, regardless of gender. This activity provides a variety of movements that stimulate muscle and nerve abilities and support the development of motor coordination which is essential in everyday life and sports contexts. Biological factors such as brain development and motor cortex also play an important role in children's motor skills. In addition, the analysis showed that at primary school age, physical and biological differences between genders were not yet significant, allowing both groups to have similar capacities in developing these skills. Well-programmed circuit games that focus on coordination, accuracy, and technique, support effective learning for all children. These results provide important implications for physical education curriculum design, suggesting the integration of circuit games as part of a regular program to develop children's motor skills by promoting gender equality and equal opportunity for all students. This study also suggests the need for further research with a larger sample and a wider variety of games to reinforce these findings.

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Conflict of interest

The author has no conflict of interest regarding the author or results of other studies.

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