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Enhancing learning interest and physical fitness through game-based physical activities among elementary school students

Ilmul Ma'arif*[1], Risafandi Setyawan[1], Rendra Wahyu Pradana[1]

[1]Department of Physical Education, Faculty of Education, Universitas PGRI Jombang, Jombang, East Java, Indonesia

*Correspondence: ma87arif@gmail.com

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Abstract

This study aimed to determine the impact of game-based movement activities on learning interest and physical fitness. It employed a quantitative descriptive approach using a one-group pretest-posttest design. The population consisted of 55 fourth-grade students, and the sample was selected using purposive sampling; specifically, the study participants were fourth-grade students from Pandanwangi State Elementary School. Physical fitness was measured using a five-item field test battery (body composition, flexibility, abdominal muscle endurance, arm muscle strength, and cardiorespiratory endurance), with results classified according to established norms. Learning interest was assessed via a questionnaire covering four indicators: (1) attention to learning material, (2) interest in the assigned activities, (3) perseverance in participating in activities, and (4) active involvement during the learning process; a 1–4 rating scale was used for each indicator. Data analysis involved descriptive statistics and hypothesis testing using a paired-samples t-test to examine differences between pre-test and post-test results. The paired-samples t-test revealed a significance level of < 0.05, indicating improvements in both physical fitness (reaching the "good" category) and learning interest (reaching the "high" category). Physical fitness results showed a shift to the "good" category, with initial and final assessment figures of 7.2% and 29.1%, respectively. Data on learning interest also indicated a high category, with 18.18% in the pre-test and 54.5% in the post-test. In conclusion, the study demonstrates that game-based movement activities influence learning interest and physical fitness. It is recommended that Physical Education (PE) instruction at the elementary school level incorporates game-based activities, given that elementary students naturally enjoy movement and play.

Keywords: Game-Based Physical Activity; Learning Interest; Physical Fitness.

INTRODUCTION

Physical education (PE) is an essential component of elementary education because it contributes to children's physical development, motor competence, health awareness, and social development. Through structured physical activities, students have opportunities to develop physical fitness, acquire movement skills, and understand the importance of maintaining an active and healthy lifestyle. Effective PE instruction should therefore provide learning experiences that accommodate children's developmental characteristics while encouraging active participation and meaningful engagement. In elementary schools, the

selection of appropriate teaching strategies is particularly important because learning activities need to be accessible, enjoyable, and relevant to students' needs (Artiluhung et al., 2024).

Physical fitness is one of the important outcomes of PE and reflects students' capacity to perform physical activities effectively. Components of physical fitness, including muscular endurance, flexibility, and cardiorespiratory endurance, contribute to children's ability to participate in various physical activities. Previous research has examined physical fitness and anthropometric characteristics among school-aged children, highlighting the importance of assessing students' physical condition during their development (Emeljanovas et al., 2020; Maisaroh et al., 2020). Furthermore, physical fitness, nutritional status, and learning motivation have been investigated in relation to students' PE learning outcomes (Kapti & Winarno, 2022; Osrita et al., 2020). These findings underscore the importance of considering physical and motivational factors when designing PE learning experiences. However, physical fitness alone does not fully represent the quality of students' learning experiences, as their willingness to participate and interest in learning are also important considerations.

Learning interest is an important factor in students' engagement in educational activities. Students who are interested in learning are more likely to pay attention to instructional tasks, participate actively, and respond positively to learning experiences. In PE, learning interest may be particularly important because students are expected to engage directly in movement-based activities rather than rely exclusively on verbal instruction or classroom-based tasks. Learning experiences that encourage enjoyment, participation, and interaction may therefore help teachers create a more engaging learning environment. Research on game-based learning in PE has highlighted the potential of games to shape students' learning experiences and support active participation (Culajara, 2022). Similarly, studies examining game-based activities and traditional games have explored their potential to improve students' interest in PE, although the findings should be interpreted in relation to the specific participants and instructional contexts investigated (Firnanda et al., 2026; Yuliana et al., 2024).

Despite the importance of physical fitness and learning interest, implementing effective PE instruction in elementary schools remains a challenge. Learning activities that provide limited opportunities for movement, interaction, and enjoyment may not adequately accommodate the characteristics of young learners. Consequently, students may participate less actively or demonstrate limited enthusiasm during PE lessons. A teaching approach that integrates games and physical movement may offer a practical alternative because it combines physical engagement with enjoyable and purposeful learning experiences. Previous research has explored active and creative learning strategies in elementary school PE, as well as game-based approaches designed to support students' engagement in physical education (Artiluhung et al., 2024; Culajara, 2022). Research on physical activity interventions has also examined their potential to improve students' physical fitness (Han et al., 2021). Nevertheless, the effects of specific interventions depend on their design, duration, implementation, and the characteristics of the participating students.

Although previous studies have examined game-based learning, physical fitness, and students' interest in PE, these outcomes have often been investigated separately or in different educational contexts. There remains a need for research that examines changes in physical fitness and learning interest simultaneously following a structured game-based physical activity intervention among elementary school students. Investigating both outcomes within the same

study may provide a more comprehensive understanding of the potential contribution of game-based activities to PE learning, encompassing both physical and affective dimensions. This approach is particularly relevant for elementary education, where effective instruction should encourage the development of physical capabilities while fostering positive learning experiences.

Therefore, this study aimed to examine changes in physical fitness and learning interest among fourth-grade students at Pandanwangi Public Elementary School following an eight-week game-based physical activity intervention. Using a one-group pre-test–post-test quasi-experimental design, the study compared students' physical fitness and learning interest before and after the intervention. It was hypothesized that students would demonstrate higher physical fitness scores and greater learning interest following participation in the program. By examining these two outcomes concurrently, this study seeks to provide practical evidence to inform the development of engaging and physically active PE instruction in elementary schools.

METHODS

Research Design

This study employed a quantitative approach using a quasi-experimental design with a one-group pre-test–post-test design. No control group was included. The study aimed to examine changes in students' physical fitness and learning interest following an intervention involving game-based physical activities. Measurements were conducted before and after the intervention to identify differences in the outcome variables.

Participants

The study population consisted of 55 fourth-grade students. Participants were selected using purposive sampling based on the characteristics and suitability of the students for the research objectives. The participants were fourth-grade students at Pandanwangi Public Elementary School, which served as the research site. The final sample consisted of students who met the established inclusion criteria.

Instruments

Two instruments were used to collect data on students' physical fitness and learning interest. Physical fitness was assessed using several physical fitness tests, including body weight, height, and body mass index (BMI) to assess anthropometric characteristics; the Sit and Reach test to measure flexibility; the 60-second sit-up test to assess abdominal muscle endurance; the modified pull-up test to measure arm muscle strength; and the 20-meter multistage shuttle run test to assess cardiorespiratory endurance (Emeljanovas et al., 2020). The test results were classified according to established assessment norms.

Learning interest was measured using a questionnaire comprising four indicators: (1) attention to the learning material, (2) interest in the assigned activities, (3) determination to participate in the activities, and (4) active involvement during the learning process (Darajat & Septiadi, 2026). These indicators were used to assess students' interest and engagement in physical education learning activities.

Procedure

The research was conducted through three main stages: pre-test, intervention, and post-test. First, a pre-test was administered to assess students' baseline physical fitness and learning interest before the intervention. Second, students participated in game-based physical activities

integrated into physical education lessons over eight weeks, with one 70-minute instructional session per week. The activities were designed to provide engaging and active learning experiences through games. Third, a post-test was administered using the same instruments to measure changes in physical fitness and learning interest following the intervention. The pre-test and post-test results were subsequently compared to evaluate changes in the measured variables.

Data Analysis

Data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to summarize students' pre-test and post-test scores for physical fitness and learning interest. A paired-samples t-test was conducted to determine whether statistically significant differences existed between pre-test and post-test scores following the intervention. The analysis was performed by comparing the scores obtained before and after the eight-week program. Statistical significance was determined based on the p-value, using a significance level of .05.

Catatan metodologis: Sebelum naskah dikirim ke jurnal, pastikan jumlah sampel akhir dinyatakan secara eksplisit karena populasi 55 siswa tidak otomatis berarti seluruh siswa menjadi sampel. Selain itu, laporkan hasil uji normalitas dan ukuran efek (effect size, misalnya Cohen's d) jika tersedia. Karena penelitian tidak menggunakan kelompok kontrol, interpretasi hasil sebaiknya berfokus pada perubahan sebelum dan sesudah intervensi, bukan menyimpulkan hubungan sebab-akibat secara definitif.

RESULTS

The results of the study present the descriptive analysis of physical fitness and learning interest among fourth-grade students at Pandanwangi Public Elementary School before and after the implementation of game-based physical activities. The data were obtained through pre-test and post-test assessments involving 55 students. Physical fitness was assessed using several physical fitness components, while learning interest was measured using a questionnaire. The results are presented in Table 1, which summarizes the frequency and percentage of students across five categories, ranging from very low to very high, for both variables before and after the intervention.

Table 1. Descriptive Results of Physical Fitness and Learning Interest Before and After the Intervention

Category	Physical Fitness Pre-test, n (%)	Physical Fitness Post-test, n (%)	Learning Interest Pre-test, n (%)	Learning Interest Post-test, n (%)
Very High	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
High	4 (7.3%)	16 (29.1%)	10 (18.2%)	30 (54.5%)
Moderate	27 (49.1%)	28 (50.9%)	35 (63.6%)	15 (27.3%)
Low	24 (43.6%)	11 (20.0%)	10 (18.2%)	10 (18.2%)
Very Low	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total	**55 (100%)**	**55 (100%)**	**55 (100%)**	**55 (100%)**

The descriptive results indicate improvements in both physical fitness and learning interest following the intervention. For physical fitness, the proportion of students in the high

category increased from 7.3% at pre-test to 29.1% at post-test, while the proportion in the low category decreased from 43.6% to 20.0%. For learning interest, the proportion of students in the high category increased from 18.2% to 54.5%, whereas the proportion in the moderate category decreased from 63.6% to 27.3%. These findings suggest positive shifts in the categorical distributions of physical fitness and learning interest after the game-based physical activity intervention. However, inferential statistical analysis is required to determine whether the observed changes were statistically significant.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre_Physical Fitness	55	10	19	13.85	2.36
Post_Physical Fitness	55	11	20	16.10	2.67
Pre_Learning Interest	55	47	61	52.60	2.62
Post_Learning Interest	55	59	81	72.83	4.75

Table 2 presents descriptive statistics for the pre-test physical fitness data, showing N = 55, min = 10.00, max = 19.00, mean = 13.85, and standard deviation = 2.36031. For the post-test data, N = 55, min = 11.00, max = 20.00, mean = 16.11, and standard deviation = 2.67826. Whereas for the pre-test data on learning interest, N = 55, min = 47.00, max = 61.00, mean = 52.6, and standard deviation = 2.62185. For the post-test data, N = 55, min = 59.00, max = 81.00, mean = 72.8364, and standard deviation = 4.75225.

Table 3. Percentage

Variable	Mean Pre	Mean Post	Mean Difference	Percentage
Physical Fitness	13.85	16.11	2,25	16,27%
Learning Interest	52.60	72.84	20,24	38,47%

The results of the descriptive analysis show an increase in average physical fitness from 13.85 to 16.11, representing a 16.27% increase. Meanwhile, the average level of interest in learning increased from 52.60 to 72.84, representing a 38.47% increase.

Table 4. Normality Test of Physical Fitness

	Shapiro-Wilk		
	Statistic	df	Sig.
Pre_Physical Fitness	.962	55	.081
Post_Physical Fitness	.936	55	.063

A normality test was conducted using the Shapiro–Wilk test, with the p-value for the pre-test being 0.081> 0.05 and for the post-test's p-value being 0.063 > 0.05, suggesting that the data from the pre-test and post-test are normally distributed.

Table 5. Normality Test of Learning Interest

	Shapiro-Wilk		
	Statistic	df	Sig.
Pre_Learning Interest	.947	55	.171
Post_Learning Interest	.943	55	.166

Table 8 presents the results of the Shapiro–Wilk normality test. The significance values for the pretest (0.171) and the posttest (0.166) are both greater than 0.05; therefore, the data from the pretest and posttest are normally distributed.

Table 6. Homogeneity Test of Physical Fitness

	Levene Statistic	df1	df2	Sig.
Pre_Physical Fitness	1.633	7	42	.153
Post_Physical Fitness	.642	7	42	.719

Based on the analysis results, the significance value for the pretest fitness test was 0.153 > 0.05, and for the posttest was 0.719 > 0.05. It can be concluded that the variance of the data in both the pretest and posttest fitness tests is homogeneous.

Table 7. Homogeneity Test of Learning Interest

	Levene Statistic	df1	df2	Sig.
Pre_Learning Interest	1.654	8	45	.136
Post_Learning Interest	.986	8	45	.460

The results of the analysis show that the significance values for both the pretest and posttest measures of learning interest are greater than 0.05, with 0.136 for the pre-learning interest and 0.460 for the post-learning interest. Thus, it can be concluded that the variances of the pretest and posttest data on learning interest are homogeneous.

Table 8. Paired Samples t-Test Physical Fitness and Learning Interest

Pair	Paired Differences				T	Df	Sig	Note
	Mean	Std. Deviation	95% CI Lower	95% CI Upper				
Physical Fitness	2.25	1.99	1.71	2.79	8.391	54	.000	difference
Learning Interest	20.23	5.40	18.77	21.69	27.745	54	.000	difference

Based on the data in Table 11, it can be concluded that this t-test indicates an effect of game-based physical activity on students' interest in learning and physical fitness, given the significance level of < 0.05. It emphasised that game-based physical activity influences students' interest in learning and physical fitness. Moreover, the analysis of physical fitness data from the pre-test and post-test results also showed an increase in the "good" category from 7.2% to 29.1%, while the analysis of learning interest in the "high" category increased from 18.18% to 54.5%. Therefore, it can be concluded that the intervention produced changes that contributed to improvements in physical fitness and learning interest.

DISCUSSION

Based on the research findings, the implementation of game-based physical activities has a positive effect on elementary school students' interest in learning and physical fitness. Descriptively, the average physical fitness score increased from 13.85 to 16.11, while the average interest in learning score increased from 52.60 to 72.84 after the intervention. These findings indicate that game-based physical activities can create a more active, enjoyable, and meaningful physical education learning experience, thereby increasing students' physical activity and engagement in the learning process. The paired-sample t-test revealed that the results were statistically significant at p-value < 0.05 and showed an increase in physical fitness in the "good" category and in learning interest in the "high" category. Therefore, implementing games can enhance students' engagement in physical activity and support the development of

students who tend to enjoy play-based activities. it can be interpreted that there is a positive effect from the implementation of game-based physical activities on students' physical fitness and interest in learning. According to a study by Firnanda et al. (2026), game-based activities are effective in increasing students' interest in Physical Education (PJOK) lessons. Furthermore, according to Sibero et al. (2024), the use of games in Physical Education and Health (PJOK) instruction can increase elementary school students' interest in learning. When a game-based learning approach is incorporated into PJOK activities, students learn through meaningful and purposeful play; therefore, game-oriented learning can enhance students' interest in learning. It is apparent that game-based learning is highly effective in increasing elementary school students' interest in physical education (Al-Adawiah, 2026). When students have a high level of interest in physical education, they will enjoy learning each topic during instructional activities and will also concentrate on every task (Firman et al., 2025).

In the learning process, enthusiasm and a high level of interest in learning can help students better understand the material presented by educators during learning activities (Syifa & Rizal, 2024). Learning interest, in this context, refers to an individual's conscious willingness to learn. Aji and Rahayu (2023) explain that learning interest is correlated with the learning process, since individuals engaging in learning activities and instructional strategies integrated with games foster students' learning interest. The implementation of game-based learning can cultivate students' willingness to learn as well as provide an interactive and joyful learning experience.

The use of fun physical activities can make students enthusiastic to participate in learning and foster their interest to continuing learning (Angraini et al., 2024). In each learning session, implementing game-based activities can increase students' enthusiasm for participating in physical education classes and positively impact physical fitness; such game designs have been proven effective in focusing students' attention, so game-based physical activities can improve components of physical fitness. The use of a game-based learning approach has been proven effective in improving physical fitness levels (Samosir & Aditya, 2022). Every teacher should incorporate games into the learning process, as they can have a significant impact on physical fitness; these game-based activities have a positive effect in improving students' physical fitness (Salim et al., 2025). Fitness, defined as an individual's ability to perform activities without excessive fatigue, enabling the human body to carry out daily activities effectively and efficiently, has been shown to be improved through game-based learning in elementary school students (Yuliawan et al., 2025).

Physical fitness is an important factor for school children, and fitness training can be conducted to help them build physical strength and perform their schoolwork effectively (Hasmara & Ma'arif, 2022). Physical fitness improves through structured activities, which positively enhance blood flow to the brain and support concentration and cognitive performance during learning. Physical fitness can be defined as an individual's capacity to perform daily activities optimally (Surfiyah & Kurniawan, 2023). Physical fitness is a person's ability to carry out daily routines without causing fatigue (Putri et al., 2021). Good physical fitness is a desirable condition for every individual in their daily learning activities, as physical fitness plays a crucial role in supporting daily activities. Physical fitness, therefore, refers to moderate physical activity without fatigue. In other words, it is an individual's ability to engage in daily

activities without becoming fatigued, while still having energy to tackle subsequent activities, and serves as a means of optimizing bodily functions to perform tasks effectively.

The practical implications of this study are that PE teachers can utilize game-based movement activities as a learning strategy and an alternative to stimulate students' interest in PE, as well as foster a more active, collaborative, and student-centered learning environment. Eventually, this will contribute to improving students' physical fitness, thereby serving as a foundation for developing more innovative PE teaching materials tailored to the developmental characteristics of elementary school students.

CONCLUSION

This study found significant improvements in physical fitness and learning interest among fourth-grade students following an eight-week game-based physical activity intervention. Physical fitness scores increased by 16.27%, while learning interest scores increased by 38.47% ($p < .001$). These findings suggest that game-based physical activities may be a promising approach to enhancing students' physical fitness and engagement in physical education. However, further research using a randomized controlled design, a larger and more diverse sample, and longer follow-up periods is needed to confirm the effectiveness and sustainability of these improvements.

ETHICAL STATEMENT

This study was conducted within a school-based physical education learning environment using non-invasive procedures involving physical activities and questionnaire completion. The research implementation followed applicable administrative procedures established by the school. Participant identities were protected through coding procedures, and all findings were reported in aggregated form. The available research documentation did not include a formal ethical clearance number. Therefore, no ethical approval certificate number is reported in this article.

ETHICS STATEMENT

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Permission to conduct the study was obtained from Pandanwangi Public Elementary School, and informed consent was obtained from the students' parents or guardians before participation.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this research.

AUTHOR CONTRIBUTIONS

IM: Conceptualization, data collection, data analysis, and writing – original draft. RS: Supervision, methodological review, interpretation of findings, and writing – review and editing. All authors reviewed and approved the final version of the manuscript.

AI DISCLOSURE STATEMENT

The authors used AI-based tools, namely ChatGPT and Grammarly, for language editing, structural improvement, and readability checking. All scientific content, data analysis, interpretation of findings, citations, and conclusions were reviewed and validated by the authors. The authors take full responsibility for the accuracy and integrity of the article content.

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