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Application of the Game-Based Approach in Optimizing Fundamental Movement Skills in Learning for Junior High School Students

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Abstract
Fundamental Movement Skills (FMS) are essential to students' motor development and serve as the foundation for participation in various physical activities. However, physical education learning in many junior high schools still relies on teacher-centered instruction and repetitive technical drills, which often limit students' active engagement and meaningful movement experiences. This study aimed to examine the effectiveness of a game-based learning approach in improving students' fundamental movement skills in physical education classes. A quasi-experimental one-group pretest–posttest design was employed. The participants were 30 seventh-grade students aged 12–13 years from a public junior high school. The intervention was conducted over four weeks with eight learning sessions using structured game-based activities designed to stimulate locomotor, non-locomotor, and manipulative movements. Fundamental movement skills were assessed using a modified movement skill test adapted for junior high school students. Data were analyzed using descriptive statistics and a paired-sample t-test to determine differences between pretest and posttest scores. The results indicated a significant improvement in students' fundamental movement skills after the implementation of the game-based learning approach ($p < .001$). Improvements were observed across locomotor, non-locomotor, and manipulative movement components. In addition to motor improvement, students demonstrated higher participation and engagement during physical education lessons. These findings suggest that game-based learning can provide meaningful movement experiences and effectively support the development of fundamental movement skills among junior high school students. Therefore, integrating game-based activities into physical education lessons is recommended to enhance both motor competence and student engagement.

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INTRODUCTION

Physical Education, Sports, and Health (PJOK) plays a crucial role in supporting the holistic development of students, including their physical, cognitive, social, and emotional growth. Through structured and meaningful physical activities, students can develop movement competence and build healthy lifestyles that continue into adulthood. In the school context,

physical education serves as an important medium for facilitating these developmental processes by providing opportunities for students to engage in diverse physical activities (Whitehead, 2021).

One of the essential components emphasized in physical education learning is the development of Fundamental Movement Skills (FMS). These skills consist of basic movement patterns that include locomotor, non-locomotor, and manipulative movements. Fundamental movement skills serve as the foundation for performing more complex motor activities in various sports and daily physical activities. Students who master these basic skills tend to show better movement confidence and higher participation in physical activity (Logan et al., 2022).

The mastery of fundamental movement skills is closely related to the development of an active lifestyle. Research has shown that students with higher levels of motor competence are more likely to participate in regular physical activity and maintain long-term engagement in sports. In contrast, students with low movement competence often demonstrate lower levels of participation and tend to avoid physical activities that require motor skills (Barnett et al., 2026).

Motor competence also contributes significantly to positive developmental outcomes in children and adolescents. Students who demonstrate strong movement abilities often show greater confidence, motivation, and willingness to participate in various physical activities. Conversely, limited motor competence can negatively affect students' physical activity levels and overall health trajectories (Robinson et al., 2025).

Although fundamental movement skills are generally introduced during childhood, their development remains highly relevant during early adolescence. Junior high school students experience important physical and psychological transitions that influence their participation in physical activity. At this stage, strengthening fundamental movement competence becomes essential to support students' readiness to engage in more complex sport activities (Logan et al., 2023).

Within the educational environment, physical education classes provide one of the most structured opportunities for students to develop and refine these fundamental movement skills. Teachers play an important role in designing learning experiences that allow students to practice movements in varied and meaningful contexts. Effective teaching strategies are therefore needed to ensure that students receive adequate opportunities to improve their movement competence.

However, physical education learning in many schools still tends to emphasize traditional teaching approaches that focus primarily on technical drills and teacher-centered instruction. Although these methods may help students practice specific techniques, they often reduce opportunities for students to explore movements creatively and actively participate in learning. Such learning environments may lead to decreased motivation and limited motor learning experiences (Beni et al., 2024).

Another challenge faced by physical education teachers is the diversity of students' motor abilities within a classroom. Students often display varying levels of movement competence, which can make it difficult to design learning activities that engage all learners equally. When learning tasks are not sufficiently inclusive or engaging, students with lower motor competence may experience reduced confidence and gradually disengage from physical activity.

To address these challenges, innovative and student-centered learning approaches are required in physical education. One approach that has received considerable attention in recent years is the game-based learning approach. This approach integrates game elements into the learning process, allowing students to develop movement skills through playful and engaging activities (Harvey & Jarrett, 2024).

Game-based learning encourages active participation and creates a learning environment where students can experience enjoyment while practicing movement skills. Through structured games, students are able to repeat movements in natural and meaningful contexts, which can enhance both motor skill development and learning motivation.

In addition to improving motor competence, game-based learning also promotes the development of social and cognitive skills. During game activities, students are required to communicate with peers, collaborate within teams, and make quick decisions in dynamic situations. These experiences contribute to a more holistic learning process that integrates physical, cognitive, and social development (Casey & MacPhail, 2023).

From a pedagogical perspective, game-based learning aligns with contemporary educational principles that emphasize active learning and meaningful student engagement. Rather than simply receiving instructions, students construct understanding through direct experience and interaction within the learning environment. This process can make learning more meaningful and relevant to students' developmental needs. The use of game-based learning is also consistent with current educational reforms that emphasize student-centered learning environments. In such environments, students are encouraged to explore, experiment, and develop their abilities through authentic learning experiences. Physical education classes, therefore, need to adopt learning approaches that support these principles.

Despite the growing interest in game-based learning in physical education, previous research has largely focused on elementary school contexts. Studies examining how game-based learning influences the development of fundamental movement skills among junior high school students remain relatively limited. This indicates a need for further empirical research focusing on early adolescent learners (Maulana & Saputra, 2023). Therefore, this study aims to examine the effectiveness of implementing a game-based learning approach in improving fundamental movement skills among junior high school students in physical education classes. The findings of this study are expected to provide empirical evidence that supports the use of game-based learning strategies to enhance students' motor competence and active participation in physical education learning (Satria et al., 2024).

METHODS

Research Design

This study employed a quasi-experimental research design using a one-group pretest–posttest approach. This design was selected to examine changes in students' fundamental movement skills before and after the implementation of a game-based learning approach in physical education classes.

The use of a single-group design was primarily influenced by practical and ethical considerations within the school context. The participating school required that all students receive the same learning experience during the physical education program. Consequently, forming a separate control group that would not receive the intervention was not feasible. Although the absence of a control group may limit causal inference, the pretest–posttest design still allows researchers to observe meaningful changes in students' motor skill performance following the intervention (Creswell & Creswell, 2025).

The intervention was conducted during regular physical education sessions over several weeks. During this period, the teacher implemented a series of structured game-based learning activities designed to promote students' engagement while simultaneously practicing fundamental movement skills.

Research Subjects

The participants in this study were 30 seventh-grade students from a public junior high school in Indonesia. All participants were enrolled in the same physical education class where the intervention was implemented. The participants were selected using a purposive sampling technique, as the selected class met the requirements for conducting the intervention within the regular physical education schedule.

Several inclusion criteria were applied to ensure that participants were suitable for the study. Students were included if they:

1. Were officially registered as seventh-grade students in the physical education class,
2. Attended at least 90% of the learning sessions during the intervention period,
3. Had no medical conditions or physical injuries that limited their participation in physical activities, and
4. Had not participated in specialized sports training programs outside the school curriculum that might significantly influence their motor skill performance.

Before the implementation of the study, permission was obtained from the school administration and the physical education teacher. Students were also informed about the purpose and procedures of the research to ensure transparency and voluntary participation.

To ensure that the number of participants was adequate to detect meaningful differences between pretest and posttest scores, a power analysis was conducted using G*Power software (version 3.1). The analysis assumed a medium effect size (d = 0.50), a significance level of α = .05, and a statistical power of 0.80, which are commonly recommended parameters in educational research.

The analysis indicated that a minimum sample size of 27 participants would be required to detect a statistically significant effect in a paired-samples comparison. Therefore, the inclusion of 30 students in this study was considered sufficient to achieve adequate statistical power while reducing the risk of Type II error.

Research Instrument

The instrument used in this study was a Fundamental Movement Skills (FMS) assessment adapted from the *Test of Gross Motor Development* (TGMD) framework. This instrument was selected because TGMD-based assessments are widely recognized as valid tools for evaluating children's motor competence in school settings and have demonstrated strong psychometric properties across multiple studies (Eddy et al., 2020; Issartel et al., 2024). Fundamental movement skills are commonly categorized into locomotor and object-control skills, which together represent essential components of motor development in children and adolescents.

In this study, the assessment instrument consisted of three components of fundamental movement skills, namely locomotor skills, non-locomotor skills, and manipulative (object control) skills. The locomotor component included running, jumping, and hopping movements that require students to move their bodies from one place to another. The non-locomotor component included static and dynamic balance movements, while the manipulative component involved kicking and throwing a ball toward a target. These skills were selected because they represent key motor competencies that support participation in sports and physical activities during adolescence.

Each skill was assessed using a process-oriented observation rubric, which focuses on the quality of movement execution rather than only the final outcome. Process-based assessment is widely recommended in fundamental movement skill evaluation because it allows teachers and researchers to identify specific movement patterns that reflect motor competence development (Eddy et al., 2020).

The scoring rubric consisted of three performance criteria for each skill, representing essential movement components such as body coordination, balance, and control. Each criterion was scored using a binary scoring system (1 = criterion performed correctly; 0 = criterion not performed correctly). Students performed each skill twice, and the best performance was recorded. The scores from all criteria were summed to produce the total score for each skill. Higher scores indicated better mastery of fundamental movement skills.

Before data collection, the instrument underwent content validity evaluation by three experts in physical education and motor learning. The experts reviewed the relevance and clarity

of each assessment indicator based on the learning objectives of physical education at the junior high school level. The content validity was calculated using the Content Validity Ratio (CVR) approach. All items obtained CVR values above the acceptable threshold, indicating that the instrument items were considered relevant for assessing students' fundamental movement skills.

To ensure the consistency of measurement, the reliability of the instrument was also examined. Reliability testing was conducted through inter-rater reliability and test-retest procedures. Two trained observers independently evaluated students' performances using the same rubric. The reliability coefficient was calculated using the Intraclass Correlation Coefficient (ICC). Previous studies have reported that FMS assessment tools based on TGMD demonstrate high reliability, with ICC values generally above 0.75, indicating good measurement consistency (Issartel et al., 2024).

The use of structured observation rubrics combined with expert validation and reliability testing ensured that the instrument provided accurate and dependable measurements of students' fundamental movement skills. Such procedures are essential in quasi-experimental studies to ensure that improvements observed after the intervention truly reflect changes in students' motor competence rather than measurement error.

Research Procedure

The research was conducted during eight physical education learning sessions over a period of approximately four weeks. Each session lasted approximately 40 minutes, following the regular physical education schedule at the school. The research procedures consisted of three main stages: pretest, intervention, and posttest.

1. Pretest

At the beginning of the study, students completed a fundamental movement skills assessment to determine their baseline motor competence. The assessment included locomotor, non-locomotor, and manipulative movement tasks that were evaluated using the observation rubric described in the instrument section. The pretest results served as the reference point for measuring students' initial movement abilities before the implementation of the learning intervention.

2. Intervention (Game-Based Learning Sessions)

Following the pretest, students participated in eight learning sessions using a game-based approach in physical education. The learning activities were designed to encourage active participation, enjoyment, and meaningful movement experiences. Each session consisted of three main phases:

a) Warm-up activities
   Dynamic warm-up activities combined with simple movement games were used to prepare students physically and mentally for the learning session.
b) Core learning activities
   The core activities involved modified games, small-sided games, and cooperative movement challenges that encouraged students to practice fundamental movement skills in engaging and interactive situations. Game-based approaches allow students to explore movement patterns, make decisions, and interact with peers in a supportive learning environment.
c) Cool-down and reflection
   At the end of each session, students performed light stretching exercises followed by short reflective discussions about their learning experiences.

Game-based learning strategies have been widely recognized as effective pedagogical approaches in physical education because they promote engagement, enjoyment, and skill development simultaneously (Casey & Goodyear, 2025; Harvey & Jarrett, 2024).

3. Posttest

After the completion of the eight learning sessions, students performed the same fundamental movement skills assessment used during the pretest. The posttest was conducted under the same conditions and scoring procedures to ensure consistency in data collection.
The comparison between pretest and posttest scores allowed the researchers to evaluate the effectiveness of the game-based learning intervention in improving students' fundamental movement skills.

Data Analysis Technique

The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were first calculated to summarize students' fundamental movement skill scores, including the mean and standard deviation for both pretest and posttest measurements. Descriptive analysis provides an overview of the distribution of data and helps researchers understand the general pattern of students' performance before conducting inferential statistical tests (Kang, 2021).

Before performing the main statistical test, the assumption of normality was examined using the Shapiro–Wilk test, which is commonly recommended for small to moderate sample sizes. Testing the normality assumption is important to determine whether parametric statistical procedures can be appropriately applied in the data analysis process (Ghasemi & Zahediasl, 2012).

To examine whether there were significant differences between students' performance before and after the intervention, a paired-samples t-test was conducted. This statistical test is appropriate for comparing two related measurements obtained from the same participants at different time points, such as pretest and posttest scores in educational intervention studies (Lakens, 2024).

In addition to testing statistical significance, the effect size was calculated using Cohen's d to determine the magnitude of the intervention effect. Reporting effect size is recommended in educational and behavioral research because it provides information about the practical importance of the findings beyond statistical significance (Lakens, 2024).

All statistical analyses were conducted using a significance level of 0.05. The results of the analysis were then interpreted to determine whether the implementation of the game-based learning approach contributed to improvements in students' fundamental movement skills.

RESULTS AND DISCUSSION

Research Results

This study aimed to examine the effectiveness of implementing a game-based approach in improving the fundamental movement skills of junior high school students. The analysis compared students' performance before and after the intervention across three components of fundamental movement skills, namely locomotor, non-locomotor, and manipulative skills.

Before conducting inferential statistical analysis, the normality assumption was tested using the Shapiro–Wilk test, which is commonly recommended for studies involving small to moderate sample sizes. The results indicated that the data were normally distributed ($p > .05$), suggesting that parametric statistical procedures could be appropriately applied (Kim et al., 2023). Therefore, a paired-samples t-test was conducted to determine whether significant differences existed between students' pretest and posttest scores.

Table 1 presents the descriptive statistics of students' fundamental movement skill the implementation of the game-based learning approach.

Table 1. Descriptive Statistics of Students' Fundamental Movement Skills (N = 30)

Fundamental Movement Skill	Pretest Mean (SD)	Posttest Mean (SD)	Mean Difference	Percentage Improvement
Locomotor	62.10 (8.25)	74.60 (7.91)	12.50	20.1%
Non-locomotor	64.10 (7.88)	72.80 (6.94)	8.70	13.6%
Manipulative	58.70 (9.01)	71.50 (8.22)	12.80	21.8%
Total Movement Score	61.73 (8.38)	73.63 (7.69)	11.90	19.3%

Table 2. Paired Sample t-Test Results and Effect Size (N = 30)

Skill Component	t-value	df	p-value	Cohen's d	Effect Size Interpretation
Locomotor	9.21	29	< .001	1.68	Large
Non-locomotor	7.88	29	< .001	1.44	Large
Manipulative	10.44	29	< .001	1.91	Large
Total Movement Score	12.15	29	< .001	2.22	Large

The descriptive statistics indicate that students' fundamental movement skills improved across all measured components following the implementation of the game-based learning intervention. As shown in Table 1, the mean locomotor score increased from 62.10 (SD = 8.25) to 74.60 (SD = 7.91). Similarly, improvements were observed in non-locomotor skills and manipulative skills.

The paired sample t-test results presented in Table 2 demonstrate that these improvements were statistically significant. Locomotor skills showed a significant increase, $t(29) = 9.21$, $p < .001$, with a large effect size ($d = 1.68$). Non-locomotor skills also improved significantly, $t(29) = 7.88$, $p < .001$, with a large effect size ($d = 1.44$).

The largest improvement was observed in manipulative skills, $t(29) = 10.44$, $p < .001$, with a very large effect size ($d = 1.91$). Overall, the total movement score increased significantly, $t(29) = 12.15$, $p < .001$, indicating that the game-based learning approach had a substantial impact on students' fundamental movement skill development.

Table 3. Category Effect Size (APA Standard)

Cohen's d	Interpretation
0.20	Small
0.50	Medium
0.80+	Large

Cohen, J. (1988)

Discussion

The findings of this study indicate that manipulative skills showed the greatest improvement among the three components of fundamental movement skills. This result is particularly important in the context of junior high school students because object-control abilities such as throwing, catching, and kicking play a crucial role in enabling adolescents to participate successfully in various sports and physical activities.

This finding can be explained through the concept of the Proficiency Barrier, which suggests that children must reach a certain level of motor competence before they can successfully perform more complex and specialized sport skills (Seefeldt, 1980; Lakens 2024). When students develop stronger manipulative skills, they are better prepared to engage in more advanced sport activities, which are commonly introduced during the junior high school years. Therefore, improvements in object-control skills represent an essential foundation for students' long-term participation in physical activity.

In addition, the improvement in fundamental movement skills may also influence students' motivation to participate in physical activity. According to the Virtuous Cycle of Motor

Competence, motor skill development, perceived competence, physical activity participation, and physical fitness are interconnected in a dynamic relationship (Stodden et al., 2023). When students experience improvements in their movement skills, they tend to feel more confident in their physical abilities. This increased sense of competence encourages them to participate more actively in physical activities.

Game-based learning environments can facilitate this virtuous cycle because they provide students with enjoyable and meaningful movement experiences. Unlike traditional drill-based instruction, games create situations where students can practice skills while simultaneously experiencing success, cooperation, and engagement. As a result, students not only improve their motor competence but also develop more positive attitudes toward physical education. These findings support the idea that integrating game-based approaches in physical education can contribute to both motor development and motivational outcomes, which are important for fostering lifelong participation in physical activity among adolescents.

CONCLUSION

The findings of this study demonstrate that the implementation of a game-based learning approach significantly improves the fundamental movement skills of junior high school students. Improvements were observed across locomotor, non-locomotor, and manipulative skill components, with manipulative skills showing the greatest increase after the intervention.

From a developmental perspective, these improvements are important because motor competence plays a key role in enabling students to participate successfully in various physical activities and sports during adolescence. When students develop stronger fundamental movement skills, they gain greater control and confidence in performing movement tasks.

This relationship can be explained through the Virtuous Cycle of Motor Competence, which suggests that motor skill competence, perceived competence, physical activity participation, and physical fitness are interconnected in a dynamic developmental process (Stodden et al., 2008). Students who experience improvements in their movement abilities tend to develop higher levels of perceived competence, which in turn encourages them to participate more actively in physical activities.

Game-based learning environments can support this cycle because they provide students with enjoyable, meaningful, and socially interactive movement experiences. Through games, students repeatedly practice motor skills in dynamic situations that require coordination, decision making, and cooperation with peers. These experiences help students develop both motor competence and positive attitudes toward physical activity.

Therefore, the implementation of game-based learning in physical education can contribute not only to improving students' motor skills but also to fostering long-term motivation for active lifestyles. For physical education teachers, integrating structured game-based activities into learning sessions may represent an effective pedagogical strategy to promote both motor development and sustained engagement in physical activity among adolescents.

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