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The impact of game models and learning motivation on manipulative movement skills in elementary school students

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Abstract: This study examines the impact of two distinct game models and students' learning motivation on the acquisition of fundamental manipulative movement skills in primary school students. The study employed a 2×2 factorial experimental design at Gajah Mada Elementary School in Medan City, involving 40 students who were evenly divided into two groups according to game type (individual vs. group) and motivation level (high vs. low). The researchers used a two-way ANOVA at a 5% significance level to analyze the data obtained from skill testing. The Lilliefors test was used to assess normality in the data, while the F-test and Bartlett's test were employed to evaluate homogeneity of variance. The results showed that the game model had a significant effect on manipulative movement skills (Fcount = 5.87 > Ftable = 4.085), with group games performing better. Learning motivation also had a significant effect on skill acquisition (Fcount = 75.7 > Ftable = 4.085). There was also a substantial interaction between the game model and motivation (Fcount = 32.6 > Ftable = 4.085), indicating that the effectiveness of a game model relies on the student's motivation. These findings suggest that integrating suitable game models with targeted tactics to promote motivation could significantly enhance students' fundamental motor skills in physical education.

Keywords: *Elementary school, Games, Manipulative movement, Motivation.*

1. Introduction

Physical education (PE) is essential for children's physical, cognitive, and social-emotional development, particularly in elementary school, when they are learning motor skills and developing a lifelong habit of staying active [1-3]. It is essential to learn basic movement skills (FMS) in PE, such as throwing, catching, and kicking. These skills require the coordination of different muscle groups and are important for playing sports and staying active [4, 5]. FMS are typically categorized into locomotor, non-locomotor, and manipulative movements. Manipulative motions are more complicated and require more thought than locomotor and non-locomotor skills. They involve controlling objects and coordinating hands and/or feet [6, 7].

Although the curriculum places a strong emphasis on developing manipulative movement abilities, many Indonesian elementary school students still struggle with these skills. An initial examination at Gajah Mada Elementary School in Medan identified significant instructional obstacles, including insufficient student engagement, inefficient pedagogical approaches, limited student participation, and a lack of customised learning strategies. Teachers frequently provide equipment without organised direction, leading to ineffective and uninspired practice sessions. These findings align with previous studies that underscore the essential influence of student motivation and pedagogical style on effective PE instruction [8-10].

Motivation is widely acknowledged as a primary factor in the learning of motor skills, affecting

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both effort and perseverance in physical education exercises [8, 11, 12]. The teaching approach employed, especially those that incorporate play, can significantly influence educational outcomes. Game-based learning, particularly when tailored to align with students' interests and social behaviors, has demonstrated potential in improving engagement and movement performance [13-15]. Nonetheless, current research predominantly emphasizes overarching PE outcomes or singular game formats, neglecting the exploration of the interplay between learning motivation and various game models (i.e., individual versus group games) in the enhancement of manipulative movement skills.

Prior research has investigated the advantages of motivational methods and game-based learning in PE; however, there is a paucity of studies examining the synergistic impact of game model type (individual versus group) and student motivation levels on the acquisition of manipulative movement skills. Moreover, insufficient focus has been directed on context-specific modifications of game models informed by students' social and cultural behaviors beyond the educational setting. This research addresses this deficiency by creating game models based on students' usual play behavior and evaluating their varying effects according to motivation levels.

This study seeks to investigate the interaction effects of learning motivation and game model type (individual and group games) on the manipulative movement skills of elementary school students. By situating game selection within the framework of students' social play behaviors and assessing outcomes in a regulated environment, the research offers novel perspectives on adaptive PE instruction. The results are anticipated to enhance pedagogical approaches in schools with similar sociocultural traits and facilitate the creation of more inclusive, engaging, and effective PE programs.

2. Materials and Methods

This study used a quantitative approach through a 2x2 factorial experimental design. In this study, two independent variables influence the dependent variable. The independent variables are the game model and learning motivation, and the dependent variable is the ability to move manipulatively. The two independent variables of this study provide two possible main effects. Interaction occurs when one independent variable affects the level of another independent variable. The research design is presented in Table 1.

Table 1.
Research Design by 2x2 Factorial Level Design.

Learning Motivation (B)	Games Model (A)	
	Group (A_1)	Individual (A_2)
High (B_1)	A_1B_1	A_2B_1
Low (B_2)	A_1B_2	A_2B_2

2.1. Research Sample

The study samples were selected purposively to encompass a range of participants with high and low motivation levels. Forty students were obtained, namely class II-1 (20 students) and class II-2 (20 students). After being ranked and sorted from largest to smallest, the high and low motivation groups comprised 27% of the total groups [16]. In class II-1 (20 people), 27% of the upper group, or five people, have high motivation, and five people have low motivation. For class II-2 (20 people), 27% of the upper group consisted of eight people with low motivation and five people with high motivation. For class II-3 (20 people), there were 27% of the upper group, five people with low motivation, and five people with high motivation.

2.2. Measures

Data was collected using tests to determine the students' ability in manipulative movement learning. Manipulative movement abilities were assessed using Dale A. Ulrich's Test of Gross Motor Development-2 (TGMD-2). Previous researchers have tested this instrument. The results of the

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validity and reliability tests conducted on the TGMD-2 for elementary school students indicate that this test has high reliability and a relatively high degree of consistency [16]. The Test of Gross Motor Development (TGMD) provides a developmental framework for examining the performance of twelve basic motor skills in the movement patterns used. These skills are necessary for successful play in physical education and the playground, including locomotor skills (running, jumping, sliding, hopping, and skipping) and manipulative movement or object control skills (hitting and kicking a stationary ball, dribbling, catching, throwing, and rolling). Locomotor skills require smooth, coordinated movements, whereas object control skills focus more on a child's ability to play with and manipulate a ball. TGMD-2 is standardized for children aged 3 to 10 years 11 months; normative data show that by age 10, the majority of developing children are usually capable of achieving all of the performance criteria for a given skill [17, 18].

2.3. Data Analysis

The data analysis technique employed was a two-way analysis of variance (ANOVA) with a significance level of 5% for hypothesis testing. If the ANOVA test reveals an interaction, then the test is continued with the Tukey test. Meanwhile, the normality test employs the Lilliefors test, while the homogeneity test utilises the F test and the Bartlett test.

3. Results

According to the analysis results, as shown in Table 1, it was found that the basic manipulative movement skills of the students taught using the group play method yielded scores ranging from 49 to 82. The average score was 66.687, with a standard deviation of 6.311. Table 2 illustrates that 25% of students have scores below the average and do not meet the minimum learning completeness criteria. In contrast, the value of the manipulated motion test has met the minimum value provisions of 75% or 12 students. The learning outcomes of basic manipulative movement skills in groups of students who were taught individual playing method strategies showed that test scores ranged from 35 to 73, with an average score of 56.25 and a standard deviation of 13.310. The data also show that students with scores below the average minimum standard are relatively high at 44%, or seven students. Students who obtain learning outcomes that meet the minimum completeness criteria in sports subjects are 56% or nine students. It can be concluded that group play has a positive impact on increasing manipulative movement abilities compared to individual play.

Table 2.
Frequency Distribution of Group and Individual Games with Learning Motivation.

A_1B (Group Games and Learning Motivation)			A_2B (Individual Games and Learning Motivation)		
Class Interval	**Absolute Frequency**	**Relative Frequency**	**Class Interval**	**Absolute Frequency**	**Relative Frequency**
49-55	2	12.5	35-42	7	44%
56-62	1	6.25	43-50	0	0 %
63-69	1	6.25	51-57	1	6%
70-76	3	18.75	58-65	0	0 %
77-82	9	56.25	66-73	8	50%

Furthermore, Table 3 shows that students who are taught group games with high motivation have the lowest score of 62 and the highest score of 79. Meanwhile, the average score is 74, with a standard deviation of 8.39. Students who have grades according to the minimum standard score are six students, or 80%. This means that there are two students whose grades do not meet the minimum score criteria. Among the students who played individually with a low level of motivation, the overall score ranged from 35 to 80, with an average score of 47.50 and a standard deviation of 11.097. Students who achieve

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learning outcomes below the average are four students (50%), and students who achieve learning outcomes above the average are four students (50%).

Table 3.
Frequency Distribution of Group and Individual Games with High Learning Motivation.

A_1B. (Group Games and High Learning Motivation)			A_2B_1 (Individual Games and High Learning Motivation)		
Class Interval	**Absolute Frequency**	**Relative Frequency**	**Class Interval**	**Absolute Frequency**	**Relative Frequency**
44-52	-	-	35-43	-	-
53-61	-	-	44-52	1	12.5
62-70	4	50	53-61	3	37.5
71-79	4	50	62-70	4	50

The analysis results in Table 4 conclude that the results of the basic manipulative movement skills test in the group of students who have low motivation and are taught by the group play method as a whole have a score range of 54 to 73, with an average score of 62.75 and a standard deviation of 6.88. While students who obtain learning outcomes below the average are five students (62.5%), and students who obtain learning outcomes above the average are three students (37.5%). In the group of students who were taught using the individual play method with low motivation, the overall score ranged from 56 to 72, with an average score of 65 and a standard deviation of 4.536. Students who obtain learning outcomes below the average are one student (12.5%), those who obtain learning outcomes on average are two students (25%), and those who obtain learning outcomes above the average are four students (50%).

Table 4.
Frequency Distribution of Group and Individual Games with Low Learning Motivation.

A_1B_2 (Group Games and Low Learning Motivation)			A_2B_2 (Individual Games and Low Learning Motivation)		
Class Interval	**Absolute Frequency**	**Relative Frequency**	**Class Interval**	**Absolute Frequency**	**Relative Frequency**
54-58	2	25	56-60	2	25%
59-63	2	25	61-64	1	12.5%
64-68	1	12.5	65-68	1	12.5%
69-73	3	37.5	69-72	4	50%

While the results of the hypothesis test are;

1. F_{count} (R) > F_{table} (0.05) = 5.87 > 4.085, so Ho is rejected; there are significant differences between rows. There are differences in basic manipulative movement skills that have been taught by group and individual games.
2. F_{count} (C) > F_{table} (0.05) = 75.7 > 4.085, then Ho is rejected. There are significant differences between columns, indicating variations in basic manipulative movement skills and motivation to learn through group and individual games.
3. F_{count} (i) > F_{table} (0.05) = 32.6 > 4.085, then Ho is rejected. There is an interaction between column and row factors, indicating an interaction effect between the game model and learning motivation.

Thus, from the hypothesis testing results, this study confirms that there is a significant effect of the independent variable on the dependent variable. This is demonstrated by the game model and learning motivation, which interact with each other.

4. Discussion

The results of the data analysis revealed differences in the learning outcomes of basic manipulative movement skills taught through the group play method and the individual play method. In implementing the mastery of basic manipulative movement skills, the benefits are enormous for mastering other movements. The findings show that students also perform manipulative movements

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with a tendency to float. Therefore, students can perform manipulatives on one leg, specifically by hovering and touching the foot [18]. The results of the data analysis revealed that students who used the group play method had higher basic manipulative motor skills than those taught by the individual play method [19].

In addition, there is an interaction between learning methods and learning motivation on the learning outcomes of basic manipulative movement skills. The game method is an activity that can bring pleasure to those who participate in it. In learning, games are not always interpreted as they should be. However, they can be designed to help students understand learning, such as by providing opportunities for students to manipulate concrete objects related to the learning material. This finding also raises interactive games that have an impact on the process of communication and active interaction between students. The existence of interactive diversity, which students carry out during every movement made during game activities, can have a positive impact on their physical, emotional, and cognitive development [20]. In line with what has been stated [21], it is very appropriate to develop children's basic movement skills at school through play activities, as children in elementary schools tend to prefer play over serious study. These findings suggest that a learning process is evident in each student's game activity. Other research findings also conclude that games are an effective way for elementary school students to learn locomotor movement skills, thereby developing motor creativity [22].

However, these findings are also influenced by learning motivation. Especially after the COVID-19 pandemic, students have different levels of learning motivation. For students who are accustomed to studying at home and do not follow the teacher's instructions, this can lead to a lack of motivation for learning. At the same time, students who enjoy learning activities tend to have a high level of learning motivation. From the results of observations, it is also concluded that students play more often during online learning. This means that the findings of this study have relevance for understanding learning motivation in the aftermath of the COVID-19 pandemic. Moreover, elementary school students have a unique characteristic: they enjoy playing, so teachers can increase their motivation to learn through play activities. As hypothesized, students with high motivation are more suitable for group games, while those with low motivation are more suitable for individual play in basic manipulative movement learning activities.

Thus, the game model motivates students to learn more easily by drawing on their own experiences [23] as the games used by teachers are often derived from traditional games that students frequently play at home, which makes it easier for them to carry out basic manipulative movement activities. Some of the games used for group play are *mancik-mancik*, *pak tekong*, *kalang ambek*, *engklek*, and *lompat tangan*. Individual games, on the other hand, include *petok/tok lele* and *lumpek tali*. Therefore, student engagement in games has a clearly positive effect on learning [24]. The findings of this study indicate that group games foster student unity and cooperation, drawing on everyday life experiences at home. Even though students learn through individual games, they still benefit from the experience of completing basic manipulative movement activities. In the context of elementary school age, practice on learning and motor performance complements each other [25]. In particular, intrinsic motivation can lead to active participation in various activities, including physical activity and exercise practices during small-sided games and other pedagogical strategies [26].

Therefore, the results of this study also found the advantages and disadvantages of the game model. Group games have advantages, including (1) to awaken a group member's self-sensitivity towards other members in the group so that mutual respect, mutual openness, and mutual tolerance arise; (2) to create a sense of solidarity among all group members so that spontaneous participation arises to achieve common goals; (3) to motivate students to make the right moves; and (4) to improve learning outcomes that can be felt simultaneously, so that students can experience the impact of group games on improving basic motor skills. Besides the advantages, group games also have some disadvantages, including: (1) students entering a group they do not like, causing incompatibility, so that cohesiveness does not occur; (2) students depending on each other to complete assignments for other students; and (3) if one student

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makes a mistake, then all group members will also be punished. Individual games have the advantage of being oriented toward individual students. Students are given the freedom to make movements without assistance from friends or others. Based on this, individual games have advantages including: (1) students can improve their basic movement abilities by themselves and not from other help; (2) increasing student independence; (3) the child's physical condition is better because there are more opportunities to repeat activities; and (4) competition is tighter and more balanced because one player competes against another. Besides these advantages, individual games also have weaknesses, namely: (1) students lack enthusiasm for playing games; (2) the workload that each individual must bear is sometimes felt to be burdensome; and (3) the increase in individual game results on the level of basic motor ability is felt to be uneven depending on the individual himself.

5. Conclusion

The results of this study indicate that both individual and group game models substantially improve students' fundamental manipulative movement skills. Significantly, the efficiency of these models is influenced by students' levels of learning motivation. Motivated students perform better with group-based game models, probably because they are ready to learn in contexts where they can work together and connect with others. Conversely, less motivated students tend to perform better when involved in specific game-based activities, which may provide them with more personalized attention and reduce their performance anxiety. These results demonstrate how teachers' teaching methods and students' motivation can influence each other. This suggests that physical education teachers need to employ a range of methods to effectively reach all students.

There are two practical uses for these discoveries. First, PE teachers should consider using game models that illustrate how children interact socially and engage in play within their culture, making them more comfortable and interested. Second, teaching methods need to be adapted to fit each student's individual motivation profile, allowing everyone to have learning experiences tailored to their specific needs. This study also promotes the integration of technology-enhanced traditional games, utilizing students' familiarity with digital devices like smartphones to enhance the PE learning environment. The findings indicate that educational stakeholders, such as school administrators and curriculum creators, must facilitate teacher training in adaptive, student-centered instructional design within PE.

Although the results are promising, this study has several limitations, including its focus on data from only one elementary school in Medan and its small sample size. Consequently, generalization to broader or more varied educational settings should be undertaken with prudence. Subsequent research may expand the sample to include various schools with diverse sociocultural backgrounds, thereby enhancing the external validity of the results. Longitudinal studies are also recommended to investigate the lasting effects of various game models on the development of manipulation skills. Additionally, the integration of mixed-methods approaches, utilizing observational data, teacher interviews, and student self-reports, may yield more profound insights into the interplay between motivation and learning design across time.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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