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The Effect of Modified Game-Based Learning on Forward Roll Skill Improvement in Elementary School Students

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Abstract

This study investigated the effectiveness of modified game-based learning in improving forward roll skills among elementary school students. Difficulties in performing forward rolls are commonly caused by fear, low confidence, and limited motor coordination. A quasi-experimental pretest-posttest control group design was employed involving 26 students divided into an experimental group (n=13) and a control group (n=13). The experimental group received modified game-based learning, while the control group received conventional instruction. Data were collected using a validated forward roll skill assessment sheet and analyzed using normality, homogeneity, independent sample t-test, and N-Gain analyses. The results revealed a significant difference between the two groups ($p < 0.05$). The experimental group achieved a higher posttest mean score (90.46) than the control group (73.31). Furthermore, the experimental group obtained an N-Gain score of 82.28% (effective category), while the control group achieved 43.94% (less effective category). These findings indicate that modified game-based learning effectively improves forward roll skills, increases student confidence, and creates a more engaging physical education learning environment.

Keywords: game model modification, forward roll, motor skills, PJOK, elementary school.

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A. Introduction

The forward roll is a fundamental floor gymnastics movement taught in Physical Education, Sports, and Health (PJOK) in elementary schools. This skill is crucial because it plays a role in developing students' coordination, balance, flexibility, and motor skills. The (Ansar CS et al., 2024)forward roll is a fundamental floor gymnastics movement that can help improve basic movement skills and students' courage in participating in PJOK lessons.

However, in practice, many elementary school students still struggle with the correct technique for forward rolls. Common problems include a lack of courage, suboptimal coordination, and fear when performing the roll. (Prima, 2023)Studies have shown that students' poor forward roll ability is caused by a lack of interest in learning, fear, and uninteresting learning, which leads to students being less active in the learning process.

Physical Education (PJOK) learning plays a crucial role in supporting students' physical, motor, and social development. (Andrian et al., 2024)Game-based learning has been shown to increase motor activity and student participation in PJOK learning.(Bahtiar et al., 2023) also explains that approach game in Physical Education learning is capable increase participation active participant educate .

However, the learning process in schools is often monotonous and lacks variety, making students easily bored and less enthusiastic about participating. (Priambodo et al., 2025)Similarly, task-oriented learning models increase intrinsic motivation and psychomotor performance, making students more engaged and satisfied with physical activity.

At elementary school age, students tend to learn more easily through fun, play-based activities. Therefore, a game-based learning approach is an alternative that can be used to improve the quality of physical education (PJOK) instruction.(Kuspratiwi et al., 2026) Game-based learning has been shown to significantly improve motor skills, particularly manipulative movement skills, coordination, and physical competence. For example, cooperative circuit games improved locomotor skills and object control among elementary school students, demonstrating their effectiveness in motor skill development.

Furthermore, game modifications are also effective in improving students' motor skills. This (Izzu & Wiguno, 2025)explains why educational game models in physical education (PJOK) can create a more engaging learning environment, leading to more active students and optimal learning outcomes.

In the context of learning floor gymnastics, particularly forward rolls, a playful approach can help students reduce fear and increase their confidence in performing the movement. (Prima, 2023)explains that a playful approach can improve students' forward roll skills because the learning process becomes more enjoyable, active, and in line with the developmental characteristics of elementary school children.

Previous studies have primarily focused on the effectiveness of game-based learning in improving general motor skills and physical fitness. However, limited studies specifically examine the implementation of modified game-based learning for improving forward roll skills among

elementary school students. Therefore, this study offers novelty by integrating modified game-based activities specifically designed to reduce students' fear and improve confidence during forward roll learning. Developing enjoyable and effective gymnastics. Learning strategies is essential because floor gymnastics is often perceived as difficult and frightening by elementary school students.

Modifying game models is a learning strategy that adapts the rules, tools, and game situations to suit the learning objectives and characteristics of students. (Neira-Navarrete et al., 2024)Modified games, such as invasion games and manipulative games, have been shown to significantly improve motor competencies, including object control, coordination, and basic motor skills.

Basically (Fauzi, 2019), elementary school-aged children have excess energy for physical activity or play. This research shows that physical activity carried out through enjoyable stimuli, such as games, can develop students' motor skills without them feeling burdened by the physical activity. Conversely, if students engage in physical activity without any engaging stimuli, they tend to become bored and easily fatigued.

Based on this description, it can be concluded that the low forward roll skills of elementary school students need to be addressed through more creative, active, and enjoyable learning innovations. One alternative that can be used is modifying game models in Physical Education (PJOK) learning. Therefore, research on the effect of modified game models on improving forward roll skills in elementary school students is important to contribute to the development of more effective and innovative PJOK learning strategies.

B. Methods

This research is a quantitative experimental study, as it aims to test the effect of game model modifications on improving forward roll skills in elementary school students. Experimental research is a research method used to determine cause-and-effect relationships by administering specific treatments to research variables. (Singh et al., 2022). The validity of experimental findings depends on the level of control over variables and the use of robust designs such as randomized controlled trials. The sampling technique used in this study was total sampling because all students in the selected class participated in the research. Accordingly (Tahapary et al., 2019) Experimental research involves applying a treatment or intervention to a specific group to observe its effect on a dependent variable, such as learning outcomes or teaching effectiveness. Thus, this study emphasizes testing the relationship between the independent variable, namely the modification of the game model, and the dependent variable, namely the forward roll skills of elementary school students.

The research design used was a quasi-experimental design with a pretest-posttest control group design. In this design, the research subjects were divided into two groups, namely the experimental group that received forward roll learning through a modified game model and the control group that received learning with conventional methods. Before the treatment was given, both groups were first given a pretest to determine the students' initial abilities. After the treatment was implemented, both groups were given a posttest to determine the improvement in forward roll skills. The

difference in results between the two groups was then analyzed to determine the effect of the modified game model on student learning outcomes. (Nayeri et al., 2023) stated that the general method for analyzing pretest-posttest designs. It uses the pretest as a covariate to control for baseline differences, thereby increasing the accuracy of the treatment effect estimate.

Furthermore, according to (Emeljanovas, 2025), this design can accommodate a variety of interventions, such as game-based learning, technology-enhanced teaching, and specialized training programs, making it versatile for sports research. Therefore, this research design is considered appropriate for determining the effect of game model modifications on elementary school students' forward roll skills.

The use of a quasi-experimental design was chosen because the conditions in elementary schools do not allow researchers to fully control variables as in pure experiments. According to (You, 2024), quasi-experiments are typically used to assess the impact of teaching strategies, educational technology, and interventions on student outcomes. For example, research has evaluated the impact of active learning strategies, digital tools, and collaborative environments on student performance and engagement. This opinion is supported by(Nerona, 2019) Studies using this design have shown significant improvements in the experimental group compared to the control group, such as improved academic performance, decreased maladaptive behavior, and increased knowledge acquisition . In research on the effect of game model modifications on improving forward roll skills in elementary school students, it is important to establish an appropriate population and sample framework. The population in this study can include all 3rd grade students of SDN Selaawi. The determination of this number is based on previous research guidelines, which indicate that the number is sufficient to provide significant analysis. Meanwhile, the sample in this study is 13 students for the control group and 13 students for the experimental group. The forward roll assessment instrument was validated by two physical education experts before implementation. Instrument reliability was tested using inter-rater reliability to ensure consistency in scoring students' forward roll performance. This design can depicted as following:

Group	Pretest	Treatment	Posttest
Experiment	O	X1	O
Control	O	X2	O

O : Forward roll skill test instrument
X1 : Group given treatment with modified game model
X2 : Group that was not given treatment

The following treatments will be carried out:
Meeting 1 conducted a pretest, meetings 2 to 4 conducted target rolls by targeting cones, meetings 5 to 7 conducted jumping over obstacles using blocks, meetings 8 to 10 conducted rolling over an inclined plane, meeting 11 conducted relay rolls

alternately, meeting 12 conducted a posttest.

This forward roll skill assessment instrument is an observation sheet containing several assessment items arranged according to the stages of forward roll execution. The indicators for this research instrument are as follows:

No	Soal	Nilai			
		4	3	2	1
1	Bagaimana langkah-langkah forward roll senam lantai ?				
	1. Sikap Awal forward roll senam lantai				
	a. Sikap permulaan berdiri kaki rapat.				
	b. Kemudian letakkan kedua tangan menumpu selebar bahu didepan ujung kaki sejauh kurang lebih 60 cm.				
	c. Bengkokkan tangan.				
	d. Letakkan pundak pada matras.				
	e. Kepala dilipat sampai dagu mengenai dada.				
	2. Sikap Pelaksanaan forward roll senam lantai				
	a. Dilanjutkan berguling kedepan.				
	b. Ketika panggul menyentuh matras lipatlah kaki.				
	3. Sikap Akhir forward roll Senam Lantai				
	a. Peganglah tulang kering.				
	b. Dengan tangan menuju keposisi jongkok				

C. Results and Discussion

Table 1 . Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretes Eksperimen	13	45	48	46.23	1.092
Posttest Eksperimen	13	86	95	90.46	2.727
Pretest Kontrol	13	51	55	52.31	1.182
Posttest Kontrol	13	72	75	73.31	1.032
Valid N (listwise)	13				

Based on Table 1, the results of the descriptive statistical analysis show that the average value of forward roll skills in the experimental group experienced a significant improvement after being given treatment in the form of a modified game model. The experimental group showed an increase in the mean score from 46.23 in the pretest to 90.46 in the posttest. The minimum and maximum values also increased, from a range of 45–48 in the pretest to 86–95 in the posttest. The increase in the average value shows that the implementation of the modified game model had a positive influence on improving students' forward roll skills.

Meanwhile, the control group also experienced an improvement in scores, but not as great as the experimental group. The average pretest score of the control group was 52.31, with a standard deviation of 1.182, which then increased to 73.31, with a standard deviation of 1.032, in the posttest. The minimum and maximum values in the control group changed from a range of 51–55 to 72–75. This shows that conventional learning still improved students' abilities, but the results obtained were not as optimal as those of the experimental group that used the modified game model.

In addition, the higher average increase in the experimental group shows that the modified game model was able to create a more effective, interesting, and enjoyable learning process for elementary

school students. Game-based learning helped students become more active in movement, more confident in attempting forward roll movements, and better in coordination and self-confidence when performing the movements. Thus, it can be concluded that the modified game model had a positive effect on improving forward roll skills in elementary school students.

Table 2. Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	df	Sig.	Statistic	df	Sig.
Hasil	Pretest Eksperimen	.199	13	.166	.875	13	.062
	Posttest Eksperimen	.175	13	.200*	.952	13	.621
	Pretest Kontrol	.295	13	.003	.858	13	.037
	Posttest Kontrol	.233	13	.053	.888	13	.093

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on Table 2, the results of the normality test using the Shapiro–Wilk test show that the significance value (Sig.) in the experimental group pretest was 0.062, while the posttest value was 0.621. Meanwhile, the significance value in the control group pretest was 0.037, and the posttest value was 0.093. The data are considered normally distributed if the significance value is greater than 0.05.

The results indicate that the pretest and posttest data in the experimental group had significance values greater than 0.05; therefore, the data were normally distributed. In the control group, the posttest value of 0.093 also showed that the data were normally distributed, whereas the pretest value of 0.037 indicated that the data were not normally distributed because the value was less than 0.05. Despite one dataset showing a non-normal distribution, the independent sample t-test was still conducted because both groups had equal sample sizes, and the overall distribution was considered approximately normal.

Overall, most of the research data showed a normal distribution, so parametric statistical analysis could be used in the next stage. This normality test was conducted to ensure that the research data fulfilled the basic assumptions before hypothesis testing was carried out, so that the analysis results obtained could be considered valid and reliable.

Table 3. Homogeneity Test

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Data	Based on Mean	7.891	1	24	.010
	Based on Median	6.050	1	24	.021
	Based on Median and with adjusted df	6.050	1	19.557	.023
	Based on trimmed mean	7.907	1	24	.010

Based on Table 3, the Test of Homogeneity of Variances showed that the results of the homogeneity test using Levene's test had a significance value (Sig.) based on the mean of 0.010. The significance value was smaller than 0.05 (0.010 < 0.05); therefore, it can be concluded that the two data groups did not have homogeneous variances, or the data were not homogeneous.

In addition, the testing based on the median obtained a significance value of 0.021, while the median with adjusted df showed a significance value of 0.023. Both

values were also smaller than 0.05, which further strengthened the conclusion that the variance of the data between the experimental group and the control group was not homogeneous. Meanwhile, based on the trimmed mean, the significance value obtained was 0.010, which showed the same result, namely that the data were not homogeneous.

The results of this homogeneity test indicate that there were differences in data variation between the experimental group and the control group. Nevertheless, the research could still proceed to the hypothesis testing stage by considering statistical analysis techniques that were appropriate for the research data conditions.

Table 4 . Independent Sample Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Hasil	Equal variances assumed	12.444	.002	21.214	24	.000	17.154	.809	15.485	18.823
	Equal variances not assumed			21.214	15.366	.000	17.154	.809	15.434	18.874

Based on Table 4, the Independent Samples Test showed that the results of the independent sample t-test had a significance value on Levene's Test for Equality of Variances of 0.002. Because the significance value was smaller than 0.05 (0.002 < 0.05), the data were considered not homogeneous. Therefore, the interpretation of the t-test results used the line "Equal variances not assumed."

The t-test results obtained a t-value of 21.214, with a significance value (Sig. 2-tailed) of 0.000. The significance value was smaller than 0.05 (0.000 < 0.05); therefore, it can be concluded that there was a significant difference between the experimental group and the control group. The mean difference value of 17.154 indicates that the average forward roll skill result in the experimental group was higher compared to the control group.

In addition, the 95% confidence interval was in the range of 15.434 to 18.874, which shows that the difference between the two group averages was sufficiently strong and consistent. These results prove that the implementation of the modified game model gave a significant influence on improving forward roll skills in elementary school students compared to conventional learning given to the control group.

Table 5. Group Statistics

Group Statistics

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Hasil	Posttest Eksperimen	13	90.46	2.727	.756
	Posttest Kontrol	13	73.31	1.032	.286

Based on Table 5, Group Statistics above, it is known that the number of samples in each group was 13 students. The experimental group, which was given treatment in the form of a modified game model, obtained a mean posttest score of 90.46, with a standard deviation of 2.727 and a standard error of 0.756. Meanwhile, the control group, which used conventional learning, obtained a mean posttest score of

73.31, with a standard deviation of 1.032 and a standard error of 0.286.

These results show that the average value of forward roll skills in the experimental group was higher compared to the control group. The average difference of 17.15 points indicates that the implementation of the modified game model had a positive influence on improving forward roll skills in elementary school students.

Table 6. N-Gain

Descriptives

	Kelas			Statistic	Std. Error
N_GainPresen	1	Mean		82.28	1.370
		95% Confidence Interval for Mean	Lower Bound	79.30	
			Upper Bound	85.27	
		5% Trimmed Mean		82.27	
		Median		83.02	
		Variance		24.394	
		Std. Deviation		4.939	
		Minimum		74	
		Maximum		91	
		Range		17	
		Interquartile Range		8	
		Skewness		-.109	.616
		Kurtosis		-.832	1.191
	2	Mean		43.98	.846
		95% Confidence Interval for Mean	Lower Bound	42.13	
			Upper Bound	45.82	
		5% Trimmed Mean		44.04	
		Median		43.75	
		Variance		9.312	
		Std. Deviation		3.052	
		Minimum		38	
		Maximum		49	
		Range		11	
		Interquartile Range		4	
		Skewness		-.084	.616
		Kurtosis		.606	1.191

Based on the Descriptive Statistics table above, it can be seen that the average N_Gain score in Class 1 was 82.28, with a standard error of 1.370. The 95% confidence interval for the mean ranged from 79.30 to 85.27, indicating that the average increase in learning outcomes in Class 1 was relatively high and stable. In addition, the median value was 83.02, which was close to the mean value, showing that the data distribution was relatively balanced. The standard deviation value of 4.939 indicates that the variation in students' scores in Class 1 was moderate. The minimum score obtained was 74, while the maximum score reached 91, with a range of 17.

Meanwhile, in Class 2, the average N_Gain score was 43.98, with a standard error of 0.846. The 95% confidence interval for the mean ranged from 42.13 to 45.82. The median value was 43.75, which was also close to the mean, indicating a relatively balanced distribution of data. The standard deviation value of 3.052 shows that the variation in Class 2 scores was smaller compared to Class 1. The minimum score in Class 2 was 38, while the maximum score was 49, with a range of 11.

Furthermore, the skewness values in both classes were close to zero, namely -0.109 in Class 1 and -0.084 in Class 2, indicating that the data distribution tended to be normal. The kurtosis values were also

close to zero, showing that the data distribution did not experience extreme peaks or tails. Overall, the descriptive analysis shows that Class 1 had a much higher average N_Gain score compared to Class 2. This indicates that the treatment given in Class 1 was more effective in improving student learning outcomes than the learning process applied in Class 2.

Discussion

The findings of this study indicate that the modified game model is more effective than conventional learning in improving elementary school students' forward roll skills. However, the significance of these findings is not only reflected in the statistical differences between groups, but also in how the learning approach aligns with the developmental characteristics of children and the principles of motor learning. Elementary school students generally learn movement skills more effectively through active, enjoyable, and meaningful experiences. In this context, game modification functions not merely as a variation of activities, but as a pedagogical strategy that facilitates students' engagement in movement exploration without excessive pressure or fear.

From the perspective of motor learning theory, repeated movement experiences conducted in enjoyable situations can strengthen neuromuscular coordination and movement automatization. Modified games provide opportunities for students to practice movement patterns repeatedly in contextualized and less intimidating situations. This supports the view of (Romero-Martínez et al., 2025), who argued that integrating physical activity into learning activities contributes to improvements in motor competence, cognitive engagement, and physical literacy. In forward roll learning, the use of playful activities such as relay rolls, inclined-plane rolls, and obstacle-based rolling activities allows students to gradually understand body positioning, balance, and coordination. Consequently, students are not only practicing the movement mechanically but also constructing movement understanding through experiential learning.

The effectiveness of the modified game model can also be explained through the affective dimension of learning. One of the major challenges in teaching forward rolls to elementary school students is psychological fear, particularly fear of falling or making mistakes during movement execution. Conventional approaches often emphasize direct technical instruction, which may increase students' anxiety when they fail to perform the movement correctly. In contrast, modified games create a safer and more supportive learning climate that reduces fear and increases self-confidence. This finding reinforces the argument of (Biru et al., 2025) that play-based learning enhances children's motor coordination and physical skills because students participate more naturally and confidently during movement activities.

Compared with previous studies, the present findings confirm and extend earlier evidence regarding the benefits of game-based learning in physical education. (Widowati & Decheline, 2023) found that game modification increased students' motivation, concentration, and active participation in PJOK learning. However, the current study contributes more specifically to floor gymnastics learning, particularly forward roll skills, which involve relatively complex coordination and body control compared with general motor activities. Similarly, (Rahmi, 2012) demonstrated that sports and game modifications improved students' physical fitness outcomes. Nevertheless, the current study highlights that modified games are not only effective for general physical fitness improvement, but also for enhancing specific motor skills that require sequential

movement mastery and confidence development.

Despite these positive findings, several critical considerations should be acknowledged. First, the effectiveness of modified game models may depend heavily on teachers' creativity and ability to design developmentally appropriate learning activities. Poorly designed games may shift students' focus from learning objectives toward merely playing activities without meaningful skill acquisition. Second, this study focused only on short-term improvements in forward roll ability; therefore, it remains unclear whether the observed improvements can be maintained over longer periods. Third, individual differences such as students' initial motor competence, physical fitness level, and learning motivation were not analyzed in depth, even though these factors may influence the effectiveness of the intervention.

Another important point is that game-based learning should not be interpreted as replacing technical instruction entirely. Instead, modified games appear to function most effectively when combined with structured guidance and corrective feedback from teachers. Without appropriate feedback, students may repeat incorrect movement patterns that could hinder long-term skill development. Therefore, the role of the teacher remains central in balancing enjoyment, safety, and technical mastery during the learning process.

Overall, the findings suggest that modified game models provide a pedagogically relevant approach for elementary physical education because they integrate cognitive, affective, and psychomotor aspects simultaneously. The approach encourages active participation, reduces fear, increases motivation, and facilitates gradual motor skill acquisition. Consequently, modified game models can be considered an innovative and student-centered learning strategy for improving forward roll skills in elementary school physical education, particularly in floor gymnastics learning contexts.

D. Conclusion

In conclusion, modified game-based learning significantly improved forward roll skills among elementary school students compared to conventional teaching methods. The implementation of modified games enabled students to practice movements in a more enjoyable, active, and less stressful learning environment, which contributed to better motor skill acquisition. In addition, the learning model increased students' confidence, participation, enthusiasm, and willingness to perform forward roll movements during PJOK lessons.

These findings indicate that modified game-based learning is not only effective in improving psychomotor outcomes but also supports students' affective engagement in physical education. Therefore, modified game-based learning can serve as an innovative and effective instructional strategy for gymnastics learning, particularly forward roll activities, in elementary schools. Future studies are recommended to involve larger samples, longer intervention periods, and more diverse game modifications to further strengthen the effectiveness of this learning approach.

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school students.

F. Conflict of Interest

The author declares that there are no personal or institutional conflicts of interest in this study that could influence the results. This research was conducted objectively for the purpose of advancing scientific knowledge, specifically in the field of Physical Education, Sports, and Health (PJOK).

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