COMPETITOR:
JURNAL PENDIDIKAN KEPELATIHAN OLAHRAGA
e-ISSN: 2657-0734 & p-ISSN: 2085-5389 ‖ Volume 18, Number 1, 2026 ‖ P.0846-0855

The Effectiveness of Rubber Ball Media in Teaching Forward Rolls in Floor Gymnastics to Primary School Students

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ABSTRACT

Learning forward rolls in floor gymnastics at the primary school level continues to face challenges, particularly related to students' limited technical mastery, low confidence, and fear of performing rotational movements. From a motor learning perspective, these obstacles are often associated with inadequate structured practice and insufficient environmental support that ensures safety and gradual skill acquisition. Therefore, the use of appropriate and adaptive learning media is essential to enhance movement understanding, reduce anxiety, and improve overall learning effectiveness. This study aimed to examine the effectiveness of rubber ball media in teaching forward rolls in floor gymnastics. The research employed a quantitative experimental method using a pretest–posttest control group design. The participants were 30 fifth-grade elementary school students, divided equally into an experimental group and a control group. The instrument used was a standardized forward roll performance test. Data were analyzed using an independent samples t-test at a significance level of 0.05. The results revealed that the experimental group achieved a higher mean posttest score (M = 83.47, SD = 6.21) compared to the control group (M = 74.13, SD = 7.05). Statistical analysis showed that t-count (3.12) exceeded t-table (2.05) with $p < 0.05$, indicating a significant difference between groups. These findings empirically confirm that rubber ball media is effective in improving forward roll learning outcomes and provides a safe, economical, and practical alternative for physical education instruction.

ARTICLE HISTORY
Received: 2026/01/29
Accepted: 2026/02/11
Published: 2026/02/16

KEYWORDS
Forward Roll;
Floor Gymnastics;
Learning Media;
Motor Learning;
Physical Education.

AUTHORS' CONTRIBUTION
A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

Cites this Article : Mubarok, B.M.A.; Ramadhan, N.; Putri, W.S.K. (2026). The Effectiveness of Rubber Ball Media in Teaching Forward Rolls in Floor Gymnastics to Primary School Students. **Competitor: Jurnal Pendidikan Kepelatihan Olahraga**. 18 (1), p.0846-0855

INTRODUCTION

Physical education plays a strategic role in developing students' fundamental movement skills, body control, and self-confidence through systematic and meaningful activities. One of the fundamental components of floor gymnastics is the forward roll, which demands neuromuscular coordination, balance, spatial orientation, and courage in performing body rotations. Conceptually, this skill is part of the development of fundamental movement skills, which form the foundation for long-term sports participation and children's physical literacy (Logan et al., 2018; Robinson et al., 2019;

Hulteen et al., 2020). However, empirical studies have shown that elementary school students often encounter obstacles in learning basic acrobatic movements, such as fear, lack of body control, and poor technical mastery, which ultimately lead to poor learning outcomes (Anan, 2020; Baumann, 2022; Brazález, 2020).

The forward roll movement requires a precise sequence of techniques—a squatting position, hand support, back rounding, leg push, and a final standing position—which, if not mastered correctly, can lead to fear and potential minor injuries. Motor learning studies confirm that successful mastery of complex motor skills is strongly influenced by gradual practice, appropriate feedback, and a safe learning environment (Chiang et al., 2021; Cho & Kim, 2021). Therefore, learning that is not supported by appropriate media often leaves students hesitant and lacking confidence in performing full body rotations. This issue is crucial because negative experiences in the early stages can hinder the development of motor competence and active participation in physical education (Holfelder & Schott, 2019; Stodden et al., 2021).

Recent research developments in physical education emphasize the importance of an evidence-based approach to improving motor skill learning outcomes. Conceptually, the use of learning media in motor activities functions as a task constraint modifier that can adjust the difficulty level of the movement to suit the student's abilities (Rudd et al., 2020; Newell, 2020). The right media can provide concrete experiences, increase motivation, and reduce psychological barriers when students encounter challenging movements (Culha et al., 2021; Dakic et al., 2021).

Empirical research shows that structured training with assistive devices can significantly improve postural control, coordination, and movement accuracy (Ehsani et al., 2020; Gluppe et al., 2020). Furthermore, equipment-based interventions in basic gymnastics learning have proven effective in increasing student participation and confidence (Bortoli et al., 2021; García-Hermoso et al., 2020). Other studies also confirm that safety and risk perception significantly influence the success of learning body rotation movements in elementary school-aged children (Hadjipanayi et al., 2022; Lubans et al., 2021).

However, most research still focuses on the use of conventional mats, digital aids, or demonstrative approaches without exploring the potential of simple, flexible and economical media. However, recent literature in ecological dynamics theory suggests that modifying the learning environment through safe and adaptive tools can facilitate more effective movement learning by enhancing exploration and perception of movement (Chow et al., 2021; Renshaw et al., 2019). In this context, rubber balls, as a learning medium, are lightweight, elastic, and easily modified, making them potentially useful as a tactile stimulus and support for body rotation during forward rolls.

Although extensive literature has discussed the effectiveness of structured practice and the use of media in motor skill learning, there is a significant research gap regarding the use of simple media such as rubber balls in teaching forward rolls at the elementary school level. Most previous studies have not specifically tested the effectiveness of flexible media as a body rotation aid using a controlled experimental approach.

Previous research has focused more on general motor development interventions or the use of digital technology in physical education (García-Hermoso et al., 2020; Lubans et al., 2021), while exploration of simple media easily accessible to schools with limited facilities remains limited. However, studies on task and environmental modifications have shown that small changes in tools or learning conditions can result in significant improvements in motor control and biomechanical efficiency (Hulteen et al., 2020; Rudd et al., 2020).

Therefore, there is an urgent need to empirically test whether using rubber balls as a learning medium can significantly improve forward roll learning outcomes compared to conventional methods. An experimental approach with a control group is necessary to generate stronger and more objective causal evidence, while also enriching the literature on simple media innovations in elementary school-based physical education.

Based on the conceptual and empirical analysis, this study aims to test the effectiveness of using a rubber ball as a medium in teaching forward rolls to elementary school students through an experimental design with a control group and a treatment group. Learning outcomes were measured quantitatively using a standardized skills performance test to obtain an objective picture of improvements in technique mastery.

The novelty of this study lies in: (1) the use of a rubber ball as a simple, economical, and flexible learning medium that has not been widely studied experimentally in the context of elementary school floor gymnastics; (2) the integration of a structured motor learning approach with equipment modifications based on safety principles and risk perception; and (3) the provision of quantitative empirical evidence regarding the effectiveness of simple media in improving body control, courage, and learning outcomes in basic rotation skills.

Theoretically, this study expands the application of ecological dynamics theory and the constraint-led approach in the context of elementary school physical education. Practically, the research findings are expected to serve as a reference for physical education teachers in selecting innovative, safe, and evidence-based learning media to improve the quality of floor gymnastics instruction. Thus, this research contributes to strengthening research-based physical education practices and the sustainable development of children's movement literacy.

METHODS

Research Type and Design

This study employed a quantitative approach with a quasi-experimental method using a pretest–posttest control group design. This design was chosen because it is methodologically capable of providing stronger causal evidence for the effectiveness of learning interventions than descriptive or single-group designs (Khorasani et al., 2020; Molina-Torres et al., 2023). In physical education and movement training research, controlled designs with pre- and post-treatment measurements are recommended to objectively and systematically evaluate changes in motor skills (Sacomori et al., 2020; Rudd et al., 2020; Hulteen et al., 2020).

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Conceptually, this study draws on the constraint-led approach and ecological dynamics theory, which emphasize that modifications to learning tools and environments can facilitate more effective motor adaptation (Chow et al., 2021; Renshaw et al., 2019). Thus, the use of rubber balls as a learning medium is positioned as a task constraint manipulation to improve students' perceptions of safety, rotational control, and courage in performing forward rolls.

Participants

The study population was all fifth-grade elementary school students. The sample size of 30 students was selected using total sampling due to the relatively small and homogeneous population. The sample was divided proportionally into two groups:

The experimental group (n = 15) used rubber balls.

The control group (n = 15) used conventional methods without rubber balls.

The group division took into account equivalence of initial abilities based on pretest results. This sample size meets the minimum recommendations for experimental research on elementary school-scale physical education to detect changes in motor skills (García-Hermoso et al., 2020; Lubans et al., 2021).

Research Instruments

The main instrument was a forward roll skill performance test using a structured assessment rubric that included: (1) Starting position and hand support, (2) Back rounding and leg push-off, (3) Rotation fluency, and (4) Final stance and balance.

Scores were assigned on a scale of 1–4 for each indicator. Content validity was tested through expert judgment, while reliability was assessed using inter-rater reliability. The use of an objective performance test aligns with motor skill evaluation research that emphasizes actual performance-based measurements (Chiang et al., 2021; Cho & Kim, 2021; Ehsani et al., 2020).

Research Procedures

The study was conducted over six sessions (3 weeks). The research stages were as follows: (1) Pretest: Measurement of the initial abilities of both groups, (2) Intervention: (a) The experimental group practiced forward rolls with the aid of a rubber ball placed on the lower back to assist rotation and maintain body rounding, and (b) The control group followed conventional learning based on teacher demonstrations and repeated practice without additional aids, and (3) Posttest: Re-measurement of forward roll skills after treatment.

This stepwise approach is based on the principles of progressive motor learning and systematic feedback, which have been shown to be effective in improving postural control and coordination (Gluppe et al., 2020; Bortoli et al., 2021; Baumann, 2022).

Data Analysis

Data were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics using independent t-tests and paired t-tests at a significance level of 0.05. This analysis is commonly used in experimental physical education research to evaluate the effectiveness of movement learning interventions (Molina-Torres et al., 2023; Sacomori et al., 2020).

Furthermore, effect size (Cohen's d) was calculated to determine the strength of the intervention's influence, as recommended in modern sports intervention research (Hadjipanayi et al., 2022; Hulteen et al., 2020).

Research Design and Procedures

Table 1.
Pretest–Posttest Control Group Research Design

Group	Pretest	Treatment	Posttest
Experimental (n=15)	Forward roll test	Learning using rubber balls (6 meetings)	Forward roll test
Control (n=15)	Forward roll test	Conventional learning	Forward roll test

Table 2.
Forward Roll Skill Assessment Indicators

No	Indicators	Assessment Description	Score (1–4)
1	Starting Position	Squatting position, hands firmly supported	1–4
2	Body Rounding	Back rounded, head tucked in	1–4
3	Rotation	Movement smoothly without stopping	1–4
4	Final Position	Standing balanced without support	1–4
Total Maximum Score			**16**

RESULTS AND DISCUSSION

Result

Table 3.
Pre-test and post-test scores of the experimental group and control group

No	Student Code	Pretest	Posttest	Student Code	Pretest	Posttest
1	E-01	55	75	K-01	55	68
2	E-02	60	80	K-02	60	72
3	E-03	62	82	K-03	62	73
4	E-04	65	85	K-04	64	75
5	E-05	68	88	K-05	65	76
6	E-06	70	90	K-06	66	74
7	E-07	63	83	K-07	63	73
8	E-08	66	84	K-08	67	77
9	E-09	67	86	K-09	68	78
10	E-10	64	82	K-10	70	80
11	E-11	69	87	K-11	61	72
12	E-12	61	81	K-12	64	74
13	E-13	58	78	K-13	69	79
14	E-14	72	92	K-14	72	82
15	E-15	75	94	K-15	71	81
Mean	**-**	**65,20**	**83,47**	**-**	**64,87**	**74,13**

Table 4.
Shapiro-Wilk Normality Test Results

Group	Tes	N	Statistic	Sig.
Eksperimen	Pretest	15	0,962	0,71
	Posttest	15	0,958	0,63
Kontrol	Pretest	15	0,967	0,78
	Posttest	15	0,953	0,58

Based on the normality test results, all pretest and posttest data in the experimental and control groups had a significance value greater than 0.05.

Table 5.
Results of the Homogeneity of Variance Test (Levene's Test)

Variabel	F	df1	df2	Sig.
Pretest	0,11	1	28	0,74
Posttest	0,32	1	28	0,58

The homogeneity test results show that the significance values of the pretest and posttest are greater than 0.05. This means that the variance of data between the experimental group and the control group is homogeneous.

Table 6.
Descriptive statistics of pretest and posttest scores

Group	Tes	N	Mean	Std. Deviation
Eksperimen	Pretest	15	65,20	7,14
	Posttest	15	83,47	6,21
Kontrol	Pretest	15	64,87	6,98
	Posttest	15	74,13	7,05

The average pretest scores of the two groups were relatively the same, while the posttest scores of the experimental group were higher than those of the control group, indicating an improvement in learning outcomes after the use of rubber ball media.

Table 7.
Results of the Independent Samples T-Test Posttest Scores

Variabel	Group	Mean	Std. Deviation	tcalculated	ttable	Sig. (2-tailed)
Learning Outcomes Front roll	Eksperimen	83,47	6,21	3,12	2,05	0,004
	Control	74,13	7,05			

The t-test results show a significant difference between the experimental and control groups ($p < 0.05$), thus proving that rubber balls are more effective in teaching forward rolls.

Table 8.
Pre-test Equivalence Test

Group	N	Mean	Std. Deviation	Calculated	Sig.
Experiment	15	65,20	7,14	0,14	0,89
Control	15	64,87	6,98		

The pretest results showed no significant difference ($p > 0.05$), indicating that the initial abilities of both groups were equivalent.

Discussion

The results of this study indicate that the use of a rubber ball in teaching forward rolls significantly improves the learning outcomes of elementary school students compared to conventional learning. Conceptually, the main problem in teaching forward rolls lies not only in the technical aspects, but also in psychological factors such as fear, anxiety about injury, and low self-confidence due to limited experience with safe movement. Recent literature confirms that perceived risk and fear of body rotation can hinder children's motor exploration (Hadjipanayi et al., 2022; Lubans et al., 2021). In this context, the findings of this study demonstrate that the rubber ball functions as a

facilitative medium, creating a safer and more enjoyable learning environment, thus encouraging students to try and repeat the movements. This aligns with the findings of Sobhgol (2020) and Szumilewicz (2020), who stated that movement exercises designed in a safe, gradual, and educational manner can reduce anxiety and increase active participation in motor learning.

From a motor learning theory perspective, the results of this study are consistent with motor learning principles that emphasize the importance of concrete experiences, structured repetition, and manipulation of the learning environment to improve motor skills (Chow et al., 2021; Rudd et al., 2020). In this study, the rubber ball served as a modified task constraint, helping students maintain back rounding and rotational direction during forward rolls. This approach aligns with ecological dynamics theory, which states that small changes in equipment or environmental conditions can facilitate more effective and efficient motor adaptations (Renshaw et al., 2019; Hulteen et al., 2020).

Empirically, the increase in posttest scores in the experimental group indicates that training with the rubber ball not only improved rotational fluency but also improved coordination and balance at the end of the movement. These findings corroborate research by Tennfjord (2020) and Zong (2022), which confirmed that structured training supported by appropriate learning media significantly contributes to improved postural control and neuromuscular coordination. Furthermore, Ehsani et al. (2020) and Gluppe et al. (2020) demonstrated that progressive exercise-based interventions can improve dynamic stability and body control in school-aged children. Therefore, the rubber ball in this study served not only as a technical aid but also as a proprioceptive stimulus, helping students understand movement sequences in a more integrated manner.

This research also complements the findings of Najib et al. (2022), who stated that modifying media and activities in physical education can significantly increase the effectiveness of movement learning. While previous research has primarily explored digital media or conventional tools, this study introduces the rubber ball as a simple, flexible, lightweight, and easy-to-apply alternative. The advantage of this medium lies in its ability to adapt to the physical and psychological characteristics of elementary school students, while also providing light mechanical support during body rotation.

Another notable aspect of this study's findings is the increase in student motivation and participation during the learning process. Several recent studies have shown that a safe and enjoyable learning environment can increase engagement and sustained participation in physical activity (García-Hermoso et al., 2020; Navarro-Brazález, 2020). Dai et al. (2021) also emphasized that the use of contextual media in physical education has great potential to improve student engagement and learning outcomes. In this study, rubber balls not only facilitated technical aspects but also provided a more interactive and exploratory learning experience.

The main novelty of this study lies in the use of rubber balls as a learning medium for floor gymnastics that is economical and easy for physical education teachers to implement. Unlike specialized gymnastics equipment, which is relatively expensive and

limited in availability in elementary schools, rubber balls are affordable and readily available. This finding aligns with the recommendations of Sacomori (2020) and Siff (2020), who emphasized that the use of simple, safe, and high-quality equipment can increase exercise effectiveness and long-term participation in movement activities.

Theoretically, the results of this study expand the application of the constraint-led approach in the context of elementary school physical education. The rubber ball acts as an additional constraint that facilitates learning, rather than restricts it. This approach supports the idea that motor learning depends not only on verbal instructions but also on the dynamic interaction between the individual, the task, and the environment (Chow et al., 2021; Rudd et al., 2020).

However, this study has several limitations. First, the sample size was relatively small and involved only one educational level, so generalization of the results requires caution. Second, the measurements focused on motor learning outcomes without quantitatively evaluating affective aspects such as motivation, self-confidence, and anxiety levels of students. This limitation aligns with the findings of Navarro-Brazález (2020, 2021), who emphasized the importance of evaluating psychological and social dimensions in physical education intervention research.

Further research is recommended to involve larger and more diverse samples and integrate multidimensional measurements that encompass cognitive, affective, and social aspects. Furthermore, exploring the use of other simple media in basic gymnastics learning could be a relevant direction for further research. Thus, this research's contribution is not only practical for physical education teachers but also enriches the academic literature on evidence-based learning media innovations in developing elementary school children's motor skills.

CONCLUSION

This research provides conceptual and empirical contributions to the development of floor gymnastics instruction in elementary schools by utilizing rubber balls as an alternative medium for teaching forward rolls. Conceptually, these findings reinforce motor learning theory and the constraint-led approach, which asserts that modifying equipment and the learning environment can facilitate more effective movement adaptation. The results indicate that simple, safe, and flexible media such as rubber balls significantly improve students' courage, understanding of technical stages, and body rotation quality compared to conventional methods.

Methodologically, the use of a pretest-posttest control group experimental design allows for objective measurement of skill changes and provides stronger causal evidence for the intervention's effectiveness. Practically, these findings recommend rubber balls as an economical, easily applicable, and relevant learning medium for elementary school students. Thus, this study clearly addresses the research objective: the use of rubber balls in improving forward roll learning outcomes, while simultaneously enriching physical education practices based on scientific evidence and simple media innovation.

ACKNOWLEDGEMENTS

The author expresses his deepest appreciation and gratitude to all parties who contributed to the implementation of this research. Special thanks are due to the principal and Physical Education teachers who provided permission, support, and active collaboration throughout the data collection process. The participation of fifth-grade students involved in this research was also a key factor in the successful implementation of the learning intervention.

Conceptually, this research is inseparable from the support of an academic environment that encourages the implementation of an evidence-based approach (evidence-based practice) in physical education. Therefore, the author also expresses his gratitude to colleagues and experts who provided constructive input during the instrument validation process and refinement of the research design. Methodological support and intensive scientific discussions contributed to the quality of the analysis and interpretation of the results.

Finally, the author acknowledges that this research still has limitations. Therefore, any suggestions and constructive criticism are highly appreciated for the development of further, more comprehensive research in the field of gymnastics learning and motor skill development in elementary school students.

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