

Gamification in physical education: improving rhythmic gymnastics skills and student engagement through coaching games

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Abstract

Background and Study Aim Rhythmic gymnastics is a sport that combines athleticism, artistry, and musicality, offering numerous physical and cognitive benefits for children. However, traditional training methods often emphasize repetitive drills, which may reduce student engagement and hinder skill acquisition. This study aims to analyze the effects of Coaching Games (COG) on students' jumping skills and interest compared to traditional training methods.

Material and Methods The study employed a quasi-experimental pretest-posttest design. A total of 72 participants (mean age: 10.97 ± 0.80 years) were equally assigned to COG and CON groups. The training lasted for two months and included 18 sessions. The COG group practiced game-based activities, while the CON group followed traditional exercises. Student performance was assessed using multiple methods. Jumping ability was measured with the Stretched Jump instrument (validity: 0.995). Interest and engagement were evaluated using a validated 31-item Likert-scale questionnaire (Cronbach's α : 0.986).

Results Students in the COG group showed a significant increase in engagement ($\Delta=9.50\pm 7.45$, $p<0.001$, $d=1.022$). Their results were higher than those of the CON group ($\Delta=1.89\pm 7.44$, $p=0.186$). Both groups improved their jumping skills (COG: 6.33 ± 10.65 , $p=0.001$; CON: 4.83 ± 7.78 , $p=0.010$). However, the difference between them was not statistically significant ($p=0.689$, $d=0.161$).

Conclusions The COG model enhances student engagement in rhythmic gymnastics by reducing monotony. It provides a more enjoyable alternative to conventional training without compromising skill development.

Keywords: coaching games, conventional training, physical education, stretched jump, interest

Introduction

Physical education (PE) contributes to the development of physical fitness, motor skills, and overall well-being in children. One of its components is rhythmic gymnastics, which involves strength, flexibility, coordination, and musicality. Traditional training methods often focus on repetitive drills, which may lead to lower student engagement and slower skill acquisition. Examining alternative approaches can provide insights into more effective ways of teaching rhythmic gymnastics.

In this context, PE not only fosters physical health but also supports cognitive, social, and emotional development [1]. Among various physical education programs, rhythmic gymnastics combines creative expression with physical activity. It requires a high level of technical ability, coordination, and engagement. However, despite these characteristics,

teaching rhythmic gymnastics to students, particularly those in upper elementary school (ages 10–12), is challenging [2]. Conventional training methods often fail to maintain students' attention and interest, which can lead to lower engagement and slower skill development [3]. For this reason, researchers highlight the importance of creative approaches that can enhance both technical skills and student engagement [4].

Recent research has explored the use of game-based learning methods in physical education, particularly in increasing student involvement and motivation [5, 6]. One commonly applied approach is Coaching Games (COG), which incorporates gamification elements into training sessions [7]. Obstacle games, hopscotch, and agility ladder drills in the COG model create a more engaging learning environment and provide cognitively stimulating challenges that align with children's developmental needs [3, 8]. This approach supports students' sense of autonomy, competence, and relatedness, which are key factors in intrinsic motivation as described in Self-Determination Theory (SDT) [6].

Leaps are a key element in rhythmic gymnastics, contributing to both aesthetics and performance, particularly among primary school children. This sport integrates dance, acrobatic movements, and prop mastery to develop coordination and artistic expression [9, 10]. However, traditional teaching methods are sometimes associated with low student engagement due to their repetitive nature [11]. A game-based approach has been shown to enhance student motivation by creating an enjoyable learning environment, supporting motor skill development, and increasing self-confidence [5, 6]. A study conducted in Yogyakarta City reported low enthusiasm for rhythmic gymnastics among students, as well as limited participation in competitions. Public perception often regards the sport as technically complex, and there is little effort to promote it. Additionally, the study identified a lack of structured training models that incorporate games to improve gymnastics skills. As a result, rhythmic gymnasts have not fully developed their motivation and active participation, which may contribute to a decline in performance.

Although research on game-based learning in physical education is expanding, studies on the effects of the COG model in rhythmic gymnastics, particularly among upper elementary school children, remain limited. Most existing studies focus on general physical activities or sports rather than the specific requirements of rhythmic gymnastics, such as jumps, balance, and rhythmic movements [11, 12]. Additionally, while some studies have examined the impact of game-based methods on motivation, few have explored their effects on technical skill development in rhythmic gymnastics, particularly in leaps, which are fundamental to the sport [13, 14].

Recent findings on motor skill learning suggest that using diverse and mentally challenging training methods can help children acquire new skills more quickly [15, 16]. Comparing COG with conventional training (CON) provides empirical evidence of its effectiveness in enhancing student motivation and performance [17].

An analysis of previous studies has shown that researchers have primarily focused on addressing issues related to student engagement and motivation in rhythmic gymnastics. Many studies have explored game-based learning in physical education, but few have examined its impact on the technical aspects of rhythmic gymnastics, particularly in skill development. Despite numerous investigations, there is still a need for a more detailed examination of this issue and the search for more effective training approaches.

This study aims to analyze the effects of COG on students' jumping skills and interest compared to traditional training methods.

Materials and Methods

Participants

This study involved 72 students selected through purposive sampling. Inclusion criteria required participants to be 10–12 years old in 2024, have graduated from elementary school in Yogyakarta City, have a normal BMI, have no injuries in the past six months, and be willing to participate in 18 sessions over two months. The students were equally assigned to two groups: 36 students in the COG group, who received coaching games training, and 36 in the CON group, who underwent conventional training. Group assignment was randomized using a lottery method.

Ethical Standards

This study complied with applicable ethical standards, particularly regarding the involvement of children as participants. Before the study began, parents or guardians received a detailed explanation of its purpose, procedures, benefits, and potential risks. An informed consent form was provided, requiring a signature from parents or guardians as official approval for their child's participation. This document stated that participation was voluntary and that participants had the right to withdraw at any time without consequences. Additionally, special permission was required for the use of participant photos in scientific publications. Parents or guardians were given the option to approve or decline the use of their child's photos through a separate written consent form. Any published photos depicted educational research activities without revealing personal identities. All personal data were kept confidential and used solely for research purposes in accordance with good clinical practice (GCP) principles and applicable ethical regulations.

Research Design

This study employed a quantitative experimental approach using a one-group pretest-posttest design. The experiment compared a game-based coaching model (Coaching Games, COG) with a conventional training model (CON) to determine which method more effectively improves jump techniques and maintains engagement among children aged 10 to 12 in rhythmic gymnastics.

Data collection took place over two months and included 18 training sessions, each lasting approximately 45 minutes. Both the experimental (COG) and control (CON) groups participated in rhythmic gymnastics sessions. The experimental group followed a gamified training model, while the control group adhered to conventional training techniques (Table 1).

In the control group (CON), a rhythmic gymnastics training program was conducted three times a week for two months. Each session lasted

approximately 45 minutes and included warm-up, core training, and cool-down phases. The session began with a 10-minute warm-up, during which students performed static and dynamic stretching exercises targeting muscles involved in jumping, such as those in the legs, hips, and shoulders.

The core training phase followed and was divided into three sections, each lasting 10 minutes and focusing on conventional rhythmic gymnastics exercises. The first section (sessions 1–6) covered basic jumps, including jumping with both feet without equipment and variations in speed and height (Figure 1). The second section (sessions 7–12) emphasized graduated jump techniques, such as jumping over low obstacles (wooden boxes) and performing forward and sideways jumps using cones while ensuring soft landings. The third section (sessions 13–18) integrated multiple jumps with

rhythmic movements using equipment such as mats and agility ladders. These exercises were performed to music to create a more engaging training environment. Finally, the session concluded with a 5-minute cool-down, during which students performed stretching exercises and slow movements to reduce muscle tension.

The coaching games training program consisted of multiple sessions, each using a different game-based method. Each session began with 10 minutes of static and dynamic stretching to prepare the muscles and body. This was followed by the core training phase.

In sessions 1–6, obstacle games were used. Children jumped over five wooden boxes and then over three cones placed 30 cm apart (Figure 2). Each training session ended with a ready position after passing the cones. Sessions 7–12 incorporated

Table 1. Implementation of Exercises in Both Training Models

Training Model	Procedure
COG Training Model	Sessions began with a 10-minute dynamic warm-up.
	The core activities included obstacle games (sessions 1–6), hopscotch drills (sessions 7–12), and agility ladder exercises (sessions 13–18).
	Each session concluded with a 5-minute cool-down.
CON Training Model	Followed a traditional format: 10-minute warm-up, 30-minute structured skill drills, and 5-minute cool-down.
	Training phases progressed from basic jumps (sessions 1–6) to graduated jumps over obstacles (sessions 7–12) and rhythmic movement integration (sessions 13–18).

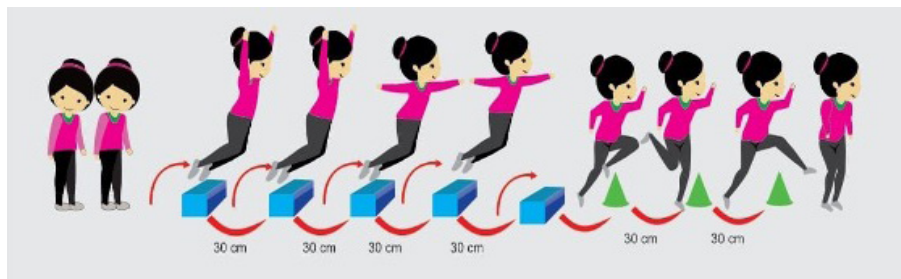


Figure 1. Basic jump exercise [14]

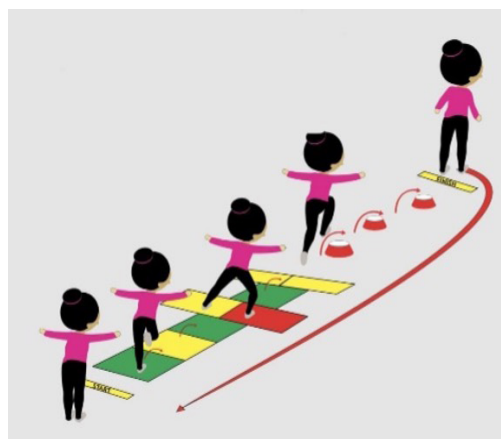


Figure 2. Obstacle game [14]

hopscotch games using a designated mat (Figure 3). Students played hopscotch with their arms outstretched, then jumped over three cones arranged 30 cm apart, finishing in an upright position. Sessions 13–18 introduced the agility ladder method (Figure 4). In these sessions, students stepped on the ladder with alternating foot positions, jumped on one leg, performed alternating sideways jumps, and jumped in and out of the agility ladder.

Each core training session lasted 30 minutes, with a three-minute break between sets. The program concluded with a five-minute cool-down to aid recovery. The equipment used included wooden boxes, cones, hopscotch mats, and agility ladders.

In these sessions, students stepped on the ladder with alternating foot positions, jumped on one leg, performed alternating sideways jumps, and jumped in and out of the agility ladder. Each core training session lasted 30 minutes, with a three-minute break between sets. The program concluded with a five-minute cool-down to support recovery. The equipment used included wooden boxes, cones, hopscotch mats, and agility ladders.

After completing the training sessions, data were collected from both groups. Two research instruments were used: the Stretched Jump test, which had a validity score of 0.995, and a closed-ended questionnaire based on a study by Armande [18]. The Stretched Jump test was selected to assess students' technical ability due to its high validity and relevance to rhythmic gymnastics. It evaluated technical proficiency based on form, execution, and landing. While alternative jump tests exist, this measure was considered the most suitable for the study.

The test consisted of three main components: the starting position, execution, and final position (Figure 5). Each component included specific indicators as assessment criteria. In the starting position, proper body posture was emphasized. For example, both legs had to be straight, arms positioned downward with fingers together, the body upright with a forward gaze, and the abdominal

muscles engaged to maintain stability. During execution, participants were required to begin with bent legs. While in the air, the toes had to be pointed, and the gaze directed forward. Additionally, both hands were raised for balance, and the knees were bent upon landing to absorb impact.

In the final position, students were assessed based on whether their gaze remained straight ahead, their knees were bent upon landing, their hands were raised, and their feet were together, returning to the starting position. This skill assessment used a rating scale to reflect the level of movement accuracy. A score of 85–100 was given if the dominant movements were correct with less than 10% errors. A score of 61–85 indicated correct execution with minor errors (less than 25%). If the performance contained multiple incorrect movements with errors below 50%, the score ranged from 30–60. The lowest score of 1–30 was assigned if only one indicator was met and errors exceeded 50%. This instrument served as a comprehensive guide for evaluating participants' technical execution of the Stretched Jump in a structured manner.

After collecting data on technical ability, the study used a closed-ended questionnaire to assess students' interest (Table 2). The questionnaire consisted of 31 items rated on a four-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree). Its validity was tested using the product-moment correlation formula, and its reliability was assessed with Cronbach's alpha, yielding a value of 0.986. This result indicates that the questionnaire was both valid and reliable. Eight main indicators were measured: fighting spirit (6 items), discipline (4 items), independence (3 items), personality (4 items), honesty (3 items), sportsmanship (3 items), self-confidence (4 items), and expectations of rewards (4 items).

Some questions were constructed using the reverse-scoring method to minimize response bias, such as questions 18 and 24 [18]. This approach accounted for potential biases in participants' answers. The questionnaire aimed to assess students'

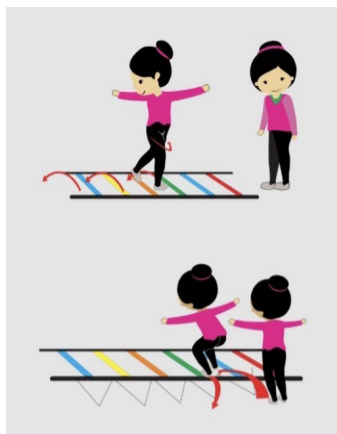


Figure 3. Hopscotch game [14]

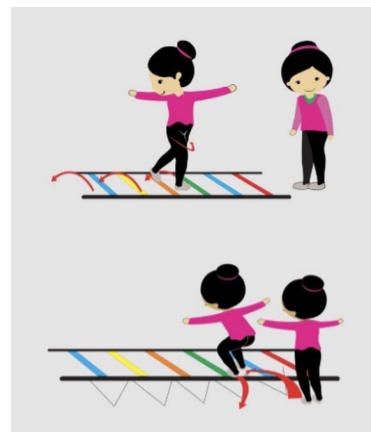


Figure 4. Agility ladder drill game [14]

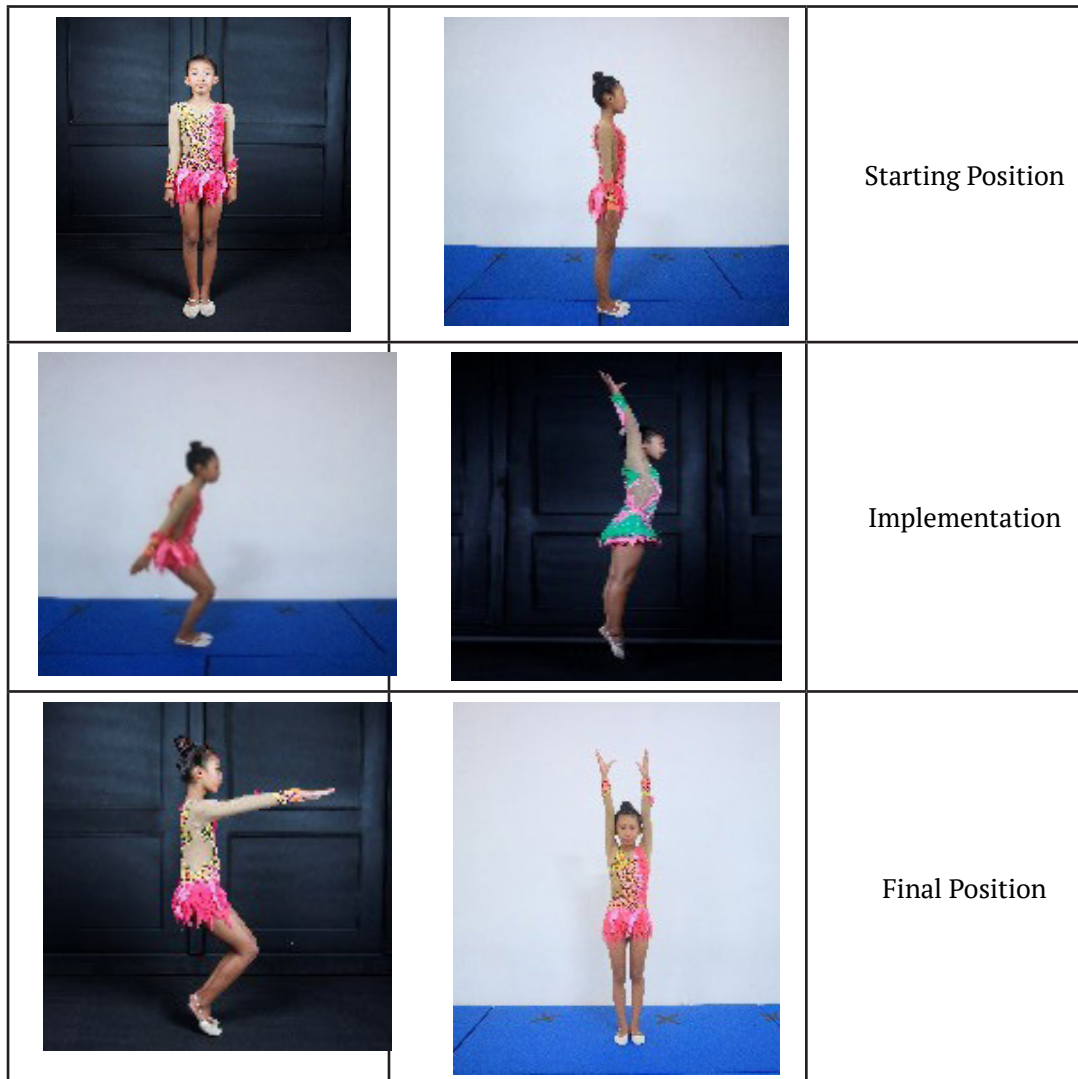


Figure 5. Stretched Jump skill assessment (personal documentation)

interest in rhythmic gymnastics by considering both internal factors, such as motivation, enthusiasm, and self-confidence, and external factors, such as support from friends, family, and school. Participants completed the questionnaire under the supervision of a gymnastics instructor, with assistance from a physical education teacher. The survey was administered in a classroom setting with a maximum of 15 participants per session to ensure a quiet and comfortable environment while minimizing distractions.

Statistical Analysis

The analysis documented the mean, standard deviation, minimum, and maximum values for each variable. Paired t-tests were used for normally distributed data to assess within-group differences, while the Wilcoxon signed-rank test was applied for non-parametric data. The significance threshold was set at $p < 0.05$. The Mann-Whitney U test was performed to evaluate the efficacy of the COG and CON training models. Effect sizes were calculated using Cohen's d to assess the practical significance

of differences between groups. An effect size greater than 0.8 was considered substantial, values between 0.5 and 0.8 were classified as moderate, and values below 0.5 were regarded as small. Data analysis was conducted using Microsoft Excel and SPSS version 23 software.

Results

The study included 72 students (63.9% male, 36.1% female) with a mean age of 10.97 ± 0.80 years. The average anthropometric characteristics were as follows: height, 136.21 ± 4.49 cm; weight, 36.69 ± 2.99 kg; and BMI, 1.79 ± 1.54 kg/m². Table 3 presents detailed characteristics of students in both groups.

Table 3 also presents the results of the Stretched Jump test and the questionnaire on students' interest and engagement. In the CON group, the mean Stretched Jump score increased significantly from 68.11 ± 6.96 to 72.94 ± 6.47 ($\Delta = 4.83 \pm 7.78$, $p = 0.010$). Although interest in this group also increased from 88.22 ± 5.13 to 90.11 ± 4.53 ($\Delta = 1.89 \pm 7.44$, $p = 0.186$), the change was not statistically significant.

Table 2. Table of specifications for the study’s questionnaire

No	Items	Indicators
1	I feel enthusiastic every time I join rhythmic gymnastics training.	
2	I consistently arrive punctually for all rhythmic gymnastics’ activities.	
3	I can do rhythmic gymnastics movements without help from friends or teachers.	
4	I am pleased when I succeed in doing rhythmic gymnastics movements correctly.	
5	I correct movement errors after getting feedback from the teacher.	
6	Praise from the teacher increases my motivation to participate in rhythmic gymnastics.	
7	In my opinion, rhythmic gymnastics is essential for maintaining physical fitness.	
8	I practice rhythmic gymnastics movements at home outside of school hours.	
9	I am confident when performing rhythmic gymnastics movements in front of others.	
10	I am motivated if there is a prize for those good at rhythmic gymnastics.	
11	Rhythmic gymnastics movements are easy for me to learn and practice.	
12	I follow the movement instructions carefully during practice.	
13	The facilities and infrastructure at school are adequate for rhythmic gymnastics activities.	
14	Friends’ support makes me more enthusiastic about participating in rhythmic gymnastics.	
15	The rhythmic gymnastics training program at school is well organized.	
16	My parents support my participation in rhythmic gymnastics activities.	
17	The principal pays special attention to rhythmic gymnastics activities.	
18	I feel bored when participating in rhythmic gymnastics.*	
19	I engage in rhythmic gymnastics voluntarily, not under duress.	
20	Rhythmic gymnastics movements make my body feel healthier and fitter.	
21	I would be embarrassed if I could not follow rhythmic gymnastics movements well.	
22	I memorize the sequence of rhythmic gymnastics movements outside of practice hours.	
23	My friends’ enthusiasm influences my enthusiasm for rhythmic gymnastics.	
24	I prefer other activities to rhythmic gymnastics.*	
25	The accompanying music for rhythmic gymnastics makes the exercise more enjoyable.	
26	The rhythmic gymnastics cool-down movements help reduce my fatigue.	
27	I was proud when I successfully completed the entire rhythmic gymnastics series.	
28	In my opinion, rhythmic gymnastics is a useful activity.	
29	The rhythmic gymnastics warm-up movements effectively prepare the body for exercise.	
30	I want rhythmic gymnastics to become a routine activity at school.	
31	I would recommend rhythmic gymnastics to my friends or juniors.	

Table 3. Description of subjects’ characteristics

Group	Variable		Mean±SD	Min	Max	One-Sample Kolmogorove-Smirnov test	Paired test
CON	Stretched Jump	Pre	68.11±6.96	55	82	0.124 [#]	0.010*
		Post	72.94±6.47	58	85	0.004	
		Δpre-post	4.83±7.78	-13	18		
	Interest	Pre	88.22±5.13	81	96	0.012	0.186
		Post	90.11±4.53	82	98	0.173 [#]	
		Δpre-post	1.89±7.44	-10	16		
COG	Stretched Jump	Pre	69.89±8.25	53	81	0.200 [#]	0.001 ^{†*}
		Post	76.22±5.50	67	87	0.200 [#]	
		Δpre-post	6.33±10.65	-12	31		
	Interest	Pre	87.61±5.06	79	85	0.200 [#]	0.000 ^{†*}
		Post	97.11±6.62	96	111	0.107 [#]	
		Δpre-post	9.50±7.45	-4	24		

Note. Δ is the difference; # - normally distributed with $p > 0.05$; * - significantly different with $p < 0.05$; † - Using the paired t-test; without (†) using the Wilcoxon test.†

Table 4. The influence of the Coaching Games training method on jumps technique and students' interest

Variable	Group (Mean±SD)		P (sig.)	Effect size (d_{Cohen})
	CON	COG		
Stretched Jump	4.83±7.78	6.33±10.65	0.689	0.161
Interest	1.89±7.44	9.50±7.45	0.000*	1.022

* - significant difference at $p < 0.05$

In the COG group, a significant increase was observed in the Stretched Jump score, rising from 69.89 ± 8.25 to 76.22 ± 5.50 ($\Delta = 6.33 \pm 10.65$, $p = 0.001$). Similarly, interest showed a significant improvement from 87.61 ± 5.06 to 97.11 ± 6.62 ($\Delta = 9.50 \pm 7.45$, $p < 0.001$).

Since not all data were normally distributed, a Mann-Whitney U test was conducted to compare differences between groups. The results are presented in Table 4.

Table 4 shows that the Coaching Games (COG) training method was more effective in increasing students' interest in rhythmic gymnastics than the conventional training method (CON). The average increase in interest in the COG group was 9.50 ± 7.45 , which was substantially higher than in the CON group, where the increase was only 1.89 ± 7.44 . Statistical tests confirmed a significant difference between the two groups ($p < 0.001$) with an effect size of 1.022, indicating a large effect. These findings demonstrate that the Coaching Games method effectively enhances students' interest in rhythmic gymnastics.

For jump technique, measured using the Stretched Jump test, the COG group showed a greater improvement than the CON group, with an average increase of 6.33 ± 10.65 compared to 4.83 ± 7.78 . However, despite this difference, statistical tests did not indicate a significant difference between the two groups ($p = 0.689$) with an effect size of 0.161, which is considered small. These results suggest that while the Coaching Games method yields better outcomes, it does not lead to a statistically significant improvement in jump techniques compared to the conventional method.

Discussion

This study demonstrates that the Coaching Games (COG) model had a significant effect size ($d = 1.022$) in increasing interest in rhythmic gymnastics among upper elementary school students compared to the conventional (CON) method. This finding aligns with previous research, including Self-Determination Theory, which suggests that game-based learning environments foster intrinsic motivation by promoting autonomy, competence, and relatedness [6]. Game-based methodologies can enhance student engagement and motivation in sports by introducing engaging variations and challenges tailored to their developmental stage [19].

One of the factors contributing to the effectiveness of COG is its structured yet dynamic nature. Integrating obstacle courses, hopscotch, and agility ladder drills in COG appears to have enhanced student participation by making training sessions more engaging and enjoyable. These strategies align with research suggesting that game-based interventions increase student engagement and involvement in physical education (PE) [3]. Additionally, the use of music and varied challenges in COG may have stimulated emotions and fostered social connections, both of which are essential for sustaining interest [11].

Beyond engagement, emotional arousal plays a key role in maintaining attention. In COG, the combination of music and dynamic visuals, such as colored mats and cones, strengthens students' connection with the activities. The rhythmic cues provided by music synchronize movement and improve mood, thereby reducing perceived effort and increasing commitment to physical exercise [20]. This aligns with the study results, where 84% of COG participants stated that "music made training more enjoyable" (Q25), directly correlating with higher post-test interest levels.

Furthermore, COG employs a reward-based approach, such as verbal praise for completing workouts or peer recognition for skill mastery. This method integrates external motivators while fostering intrinsic satisfaction. Maintaining student motivation requires a balance between extrinsic and intrinsic incentives. External rewards, such as badges and leaderboards, initially encourage participation, while intrinsic enjoyment ensures long-term commitment [5]. In this study, reverse-scored questions (e.g., Q18: "I feel bored during rhythmic gymnastics") further highlight COG's effectiveness in reducing monotony, a common issue in traditional PE methods.

COG incorporates a variety of games across sessions, including obstacle games, hopscotch, and ladder drills. These activities help sustain student interest and prevent habituation caused by repetitive tasks, which can lead to disengagement [21]. Neurocognitive studies suggest that such activity variation introduces novel stimuli, activating dopamine pathways and enhancing memory recall and motivation [22]. Agility ladder drills, for example, not only refine coordination but also provide cognitive challenges by integrating physical and mental tasks—an approach that

increases student engagement [23, 24, 25].

While the increase in student interest in rhythmic gymnastics highlights the role of educational innovation in PE [26], different training methods serve distinct purposes. Conventional training methods remain effective for skill development, although they may not sustain student engagement over time. In contrast, the interactive, reward-based COG method fosters intrinsic satisfaction through peer recognition and clear goals, though it still incorporates extrinsic motivators [6, 27]. The finding that gamification enhances both immediate engagement and long-term commitment to physical activity aligns with this dual motivational framework [5].

However, several factors must be considered when implementing the Coaching Games approach, including the need for diverse training tools and the availability of coaches qualified to design game-based exercises aligned with training objectives [28]. To achieve optimal results in improving rhythmic gymnastics skills, future research should focus on long-term observations and explore the integration of the Coaching Games method with more intensive technical training.

Besides interest and skill development, this study also compared the Jumping Technique variable between the COG and CON groups. While both groups showed significant improvements after training, the COG group demonstrated slightly better jumping technique gains ($\Delta = 6.33$ vs. 4.83 for CON). However, the difference was not statistically significant. The effectiveness of the COG method is likely influenced by the use of training aids, such as agility ladders and cones, which enhance students' coordination and balance. Zhang et al. [16] demonstrated that incorporating training aids accelerates motor learning and improves children's physical performance.

This suggests that both approaches effectively teach basic jump skills, possibly due to their shared emphasis on skill development. The study's short duration (eight weeks) may explain the lack of significance, as motor skill learning often requires more time to produce measurable changes [1]. Additionally, while the Stretched Jump test is a relevant assessment tool, it may lack the sensitivity to capture subtle technical improvements. Jump technique involves a biomechanical component that necessitates structured and intensive training, regardless of the training method used. Morrow et al. [29] similarly emphasized the importance of consistent technique-based training in developing specific motor skills in children. Future research could employ biomechanical analysis methods, such as motion capture or force plates, to detect more nuanced differences in jump mechanics [30].

Although the Coaching Games method enhances motivation and engagement, the technical aspects

of jumping in rhythmic gymnastics still require more structured, technique-based training. Game-based learning models are generally more effective in improving psychological factors such as motivation and engagement but may be less effective in developing technical skills over a short period [11]. Motor skill development, particularly in jumping techniques that involve complex biomechanical components, requires a longer training duration to produce significant improvements [29]. This study lasted only eight weeks with 18 training sessions, which may have been insufficient to observe substantial changes in the biomechanical aspects of jumping [11].

Individual differences in basic motor skills, influenced by prior experience, physical condition, and motor coordination, also play a role in training outcomes. Participants with advanced jumping skills at the start of the study may have experienced a ceiling effect, where performance improvements were minimal despite additional training interventions [12]. While coaching games introduce variety and increase student engagement, not all participants adapt immediately to different training methods. Some children may require more time to develop neuromuscular responses to game-based training compared to traditional approaches [31].

Although the Stretched Jump test has high validity (0.995), it may lack sensitivity in detecting gradual improvements in jumping technique. A more detailed biomechanical analysis, such as motion capture or force plate assessments, may be necessary to identify subtle changes in performance that standard measurement tools might overlook [16].

Limitations of the study

While this study provides valuable insights, several limitations should be acknowledged. The sample was drawn exclusively from elementary schools in Yogyakarta, Indonesia, which limits the generalizability of the findings to broader populations. Additionally, the eight-week intervention period may have been too short to capture long-term changes in jump technique or sustained interest.

Self-reported interest measures were susceptible to social desirability bias, and a longer follow-up period would help determine whether the observed improvements persist over time. Although the Likert-scale questionnaire demonstrated high reliability, self-reported data remain inherently vulnerable to response biases. The Stretched Jump evaluation assessed overall technical performance but may not have been sensitive enough to detect subtle biomechanical improvements.

Uncontrolled external factors, such as parental support or participation in extracurricular physical activities, were not accounted for,

potentially influencing the outcomes. Variability in instrumentation and implementation could have affected the intervention's impact, particularly on skill-based measures like jumping technique. Lastly, the study primarily relied on quantitative methods, leaving qualitative insights unexplored, and the practical significance of the effect sizes remains uncertain.

Conclusions

The Coaching Games (COG) model significantly enhances upper elementary students' interest in rhythmic gymnastics compared to conventional training (CON). The COG approach, which incorporates obstacle courses, hopscotch, agility ladder drills, and music, aligns with Self-Determination Theory by reducing monotony and increasing emotional engagement. However, the difference in jump performance between the COG and CON groups was not statistically significant,

suggesting that short-term interventions may be insufficient to address the biomechanical complexity of jumps. These findings indicate that game-based methodologies in physical education can enhance student motivation and promote long-term participation in rhythmic gymnastics.

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Conflict of Interest

The authors report that there are no competing interests to declare.

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