



## Rhythm games: exploring locomotor skills, physical fitness, and gender interaction among elementary students

*Juegos rítmicos: exploración de las habilidades locomotoras, la aptitud física y la interacción de género en estudiantes de primaria*

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### Abstract

**Introduction:** Locomotor skills are the foundation of children's physical development, contributing to physical fitness. Music-based rhythm games in physical education have the potential to increase student motivation and movement quality.

**Objective:** This study aims to analyze the relationship between locomotor skills and physical fitness and to test the effectiveness of rhythm games, considering gender interactions in 7-8-year-old elementary school students.

**Methodology:** This study used a mixed design (cross-sectional and quasi-experimental) on 120 students aged 7-8 years from two schools. Locomotor skills were measured using TGMD-3 and cardiovascular fitness through aerobic endurance tests. Rhythm game interventions were conducted for six weeks (three times per week). Data analysis used regression and ANOVA.

**Results:** The results showed a very strong positive correlation between locomotor skills and physical fitness ( $R = 0.989$ ;  $p < 0.05$ ). However, because the value was close to perfect, reanalysis was recommended to avoid possible calculation errors. Rhythm games had a significant effect on improving locomotor skills and physical fitness, and there was a significant interaction with gender.

**Conclusion:** It was concluded that rhythm games effectively improve the locomotor skills and physical fitness of 7-8-year-old students and support equal gender participation in physical education.

### Keywords

Music-based physical activities; basic movement skills; physical fitness; gender differences; elementary education.

### Resumen

**Introducción** Las habilidades locomotoras son la base del desarrollo físico de los niños y contribuyen a su aptitud física. Los juegos rítmicos basados en la música en la educación física tienen el potencial de aumentar la motivación y la calidad del movimiento de los estudiantes.

**Objetivo:** El objetivo de este estudio es analizar la relación entre las habilidades locomotoras y la aptitud física, y evaluar la eficacia de los juegos rítmicos, teniendo en cuenta las interacciones de género en estudiantes de primaria de 7 a 8 años.

**Metodología:** Este estudio utilizó un diseño mixto (transversal y cuasi-experimental) en 120 alumnos de 7-8 años de dos escuelas. Las habilidades locomotoras se midieron utilizando TGMD-3 y la aptitud cardiovascular mediante pruebas de resistencia aeróbica. Las intervenciones con juegos rítmicos se llevaron a cabo durante seis semanas (tres veces por semana). El análisis de los datos se realizó mediante regresión y ANOVA.

**Resultados:** Los resultados mostraron una correlación positiva muy fuerte entre las habilidades locomotoras y la aptitud física ( $R = 0,989$ ;  $p < 0,05$ ). Sin embargo, dado que el valor era casi perfecto, se recomendó realizar un nuevo análisis para evitar posibles errores de cálculo. Los juegos rítmicos tuvieron un efecto significativo en la mejora de las habilidades locomotoras y la aptitud física, y se observó una interacción significativa con el género.

**Conclusión:** Se concluyó que los juegos rítmicos mejoran eficazmente las habilidades locomotoras y la aptitud física de los alumnos de 7 a 8 años y favorecen la participación equitativa de ambos sexos en la educación física.

### Palabras clave

Actividades físicas basadas en la música; habilidades básicas de movimiento; aptitud física; diferencias de género; educación primaria.

## Introduction

The development of fundamental movement skills (FMS) during elementary school is an important foundation for lifelong participation in physical activity. Mastery of skills such as running, jumping, and throwing contributes to children's involvement in physical activity and is associated with cardiorespiratory and musculoskeletal health (Stodden et al., 2014; Gu et al., 2017; King-Dowling et al., 2020). Conversely, low motor skills are associated with an increased risk of weight gain and long-term health consequences (Burns & Fu, 2018). These findings indicate a bidirectional relationship between motor competence and physical fitness: good movement skills enable more intense participation in physical activities, while adequate physical fitness supports the quality and efficiency of movement. However, in physical education practice, these two constructs are still often positioned separately, both in curriculum planning and empirical research.

Conceptually, FMS encompasses locomotor, non-locomotor, and manipulative skills (Ulrich, 2000), and is an important indicator of overall child development (Bremer & Cairney, 2018). Fundamental motor skills learning for children needs to be experienced in a fun environment (Bardid et al., 2016). A positive learning atmosphere will help to promote children's interest in performing and repeating those activities. Having an ability to perform fundamental movement skills do not merely form components of motor development; rather it is the essential separator for children, childhood, adolescence and later becoming adults to involve in various physical activities (Baharudin, 2016; Wainwright et al., 2018; Zulfikar et al., 2021). Locomotor skills are fundamental motor skills that consist of practiced patterns of movements such as running, jumping, and hopping. These skills don't just help make working out day in and day out a little less tedious or more tolerable, they also play a big role in being healthier and fitter. Studies have reported that (Bakhtiar et al., 2019; Lee et al., 2020; Oktarifaldi et al., 2024), give children can improve their physical fitness through engaging in high levels of PA when they are able to perform basic movement skills legit.

The locomotor skills in primary school children have been widely studied focusing on pedagogical practices based on physical activity. Although the significance of locomotor skills has been acknowledged, yet few limitations still exist in available literature. Research in the area of locomotion still mainly concentrates on structural and technical forms of training because these are frequently believed to be boring from a child's perspective. There is scant investigation on the use of even more context designed and interactive game-based approaches (Bardid et al., 2017). Previous research on associations between motor skills and physical fitness often dichotomize these two concepts without studying how they reciprocally influence each other. Moreover, determinants of locomotor skill development like age, gender and social environment along with the effect of specific physical education interventions are not well explored. The gender dimension is also an important factor in physical education. Several findings indicate differences in physical fitness levels between male and female students (Maulana et al., 2024). However, there has not been much research that integrally analyzes how locomotor skills, physical fitness, and gender interact within the same analytical framework, especially in the context of pedagogical interventions. Thus, there is still a need to examine whether the relationship between locomotor skills and physical fitness is consistent across both genders, and whether certain learning approaches can minimize this gap.

One approach that has the potential to bridge motor, fitness, and motivational aspects is rhythm-based games. In this study, rhythm games are operationally defined as structured game activities that integrate locomotor movement patterns with external rhythms (music or beats), so that students perform movements following a specific tempo and rhythmic pattern. Rhythm is among these elements for enhancing the acquisition of motor skills. Rhythmic cueing assists children in controlling the speed of movements, coordinating different body parts and generating more organized movements (Kassing et al., 2021). Rhythm is fundamental to help children in their motor coordination, time orientation and movement regularity, and quality of movement (Amado et al., 2016; Kassing & Jay-Kirschenbaum, 2021). Prior research indicate (Utami et al., 2025) that rhythm-based teaching does not only enhances the quality of movements, rhythm interaction also influence the focused attention and emotional reactions of children (Kourkoutas et al., 2021; Moore, 2012). Students were found to be more engaged and motivated if rhythm and music were integrated into their learning (Moore, 2012; Rigon et al., 2024). Although the literature shows the positive impact of music and rhythm on motivation and participation, empirical



evidence regarding their simultaneous influence on locomotor skills and physical fitness in elementary school students is still limited.

Based on this conceptual framework, this study was designed to integrate three main axes—locomotor skills, physical fitness, and gender interaction—into one study design. Specifically, this study has three objectives: (1) to analyze the correlational relationship between locomotor skills and physical fitness in elementary school students; (2) to identify gender differences in both variables; and (3) to test the effectiveness of rhythm game interventions in improving locomotor skills and physical fitness compared to conventional physical education learning. Thus, this study combines correlational and quasi-experimental approaches, while explicitly testing gender as an analytical variable.

The contribution of this study lies in the conceptual and empirical integration of motor competence and physical fitness within the context of rhythm-based pedagogy. Rather than examining each variable separately, this study places them within a systemic framework to understand how rhythm game interventions can strengthen the relationship between locomotor skills and physical fitness and potentially create a more inclusive learning environment for both male and female students. This approach is expected to provide a theoretical and practical basis for the development of more effective, contextual, and gender-responsive physical education models at the elementary school level.

## Method

This study used a quantitative approach with a methodological framework that was consistent with the research objectives. A cross-sectional design was used in the initial stage to explore the correlation between physical fitness and locomotor abilities of students at a specific point in time, while a quasi-experimental design was applied in the second stage to test the effectiveness of rhythm games intervention on improving Functional Movement Skills (FMS) and physical fitness. The research sample consisted of 120 students aged 7–8 years from two elementary schools designated as research locations. In the cross-sectional stage, stratified random sampling was used based on age and gender (male and female) to ensure balanced representation. In the quasi-experimental stage, each school was designated as an experimental group and a control group, with 30 students per group selected purposively based on low to intermediate locomotor skill levels. To minimize external variables, the study controlled for the equivalence of the PJOK curriculum, learning duration, socioeconomic background of the school, and uniform test timing. Ethically, this study obtained approval from the school and parents/guardians of students, guaranteed data confidentiality, and ensured voluntary participation.

Students' locomotor abilities were measured using the Test of Gross Motor Development-3 (TGMD-3), which assesses running, galloping, hopping (one foot), long jumping, skipping, and sliding skills (Rey et al., 2020; Ulrich, 2013; 2017). This instrument has been validated and is reliable for measuring the gross motor development of elementary school-aged children. Each skill was recorded and assessed based on performance criteria, then coded according to the FMS proficiency level. Cardiovascular fitness was measured using the 2.4 km Cooper Test to assess students' aerobic endurance and general physical condition. All measurement procedures were carried out by researchers and assistants who had received training to maintain assessment consistency (inter-rater reliability) and were conducted in relatively similar environmental conditions for all participants.

The rhythm game intervention was carried out for six weeks with a frequency of three times per week. The program was designed by integrating basic locomotor movements and moderate-tempo music accompaniment (100–120 bpm) to stimulate coordination, rhythm, and active involvement of students. The experimental group received rhythm game-based learning, while the control group followed conventional PJOK learning. Pretest and posttest measurements were conducted to assess changes in locomotor skills and physical fitness. Data were analyzed using descriptive statistics (mean, standard deviation, minimum, and maximum values) to describe the students' ability profiles. Regression tests were used to examine the relationship between fitness and locomotor abilities, while analysis of variance (ANOVA) was used to determine differences in improvement between groups and interactions based on gender. With this procedure, the research design was not only relevant and consistent with the quantitative approach, but also allowed for replication of the research through a systematic description of the intervention, instruments, and statistical analysis.



## Results

The study was conducted over a six-week period, following the basic movement curriculum for first and second grade elementary school students. The first week included an initial orientation, explaining the learning objectives and a summary of the learning content, and an initial test consisting of locomotor ability and physical fitness. Both the experimental and control groups received similar guidance on basic movement concepts. The experiment was conducted from the second to the fifth week. Students in the experimental group utilized learning materials based on rhythm games, while the control group used learning materials from regular games. In the final week, students from both groups took a final exam that included tests of locomotor ability and physical fitness.

### *The relationship between locomotor skills and physical fitness*

Table 1. Descriptive Statistics TGMD-3 and Physical Fitness

Variables	Mean	Std. Deviation	Variance	Minimum	Maximum
TGMD-3	6.19	2.70	7.28	1.00	12.00
Physical Fitness	24.08	1.95	3.79	20.40	27.60

The TGMD-3 score results had an average value of 6.19 with a standard deviation of 2.70 and a variance of 7.28. The minimum value recorded was 1.00 and the maximum was 12.00, resulting in a score range of 11 points. The score distribution showed a relatively wide spread compared to the average value, as reflected in the standard deviation which was close to half of the mean. Meanwhile, the physical fitness score has an average of 24.08 with a standard deviation of 1.95 and a variance of 3.79. The minimum value recorded is 20.40 and the maximum is 27.60, with a range of 7.20 points. Compared to TGMD-3, the spread of physical fitness data is smaller, as seen from the lower standard deviation and narrower score range.

Table 2. Tests of Normality and Homogeneity of Variance

Variables	Tests of Normality (Kolmogorov-Smirnov)		Homogeneity of Variance (Levene)	
	Statistic	Sig.	Statistic	Sig.
TGMD-3	0.079	0.064	0.452	0.503
Physical Fitness	0.080	0.056		

The Kolmogorov-Smirnov normality test results show a significance value of 0.064 for TGMD-3 and 0.056 for physical fitness ( $p > 0.05$ ). These values indicate that there is no significant difference between the data distribution and the normal distribution at the 5% level. Meanwhile, the Levene's test for homogeneity of variance for TGMD-3 produced a statistical value of 0.452 with  $p = 0.503$  ( $>0.05$ ), indicating that the data variance is not significantly different.

Table 3. Tests Regression Locomotor Skills and Physical Fitness

Model	R	R Square	Sig. (2-tailed)	F	Sig.	Unstandardized Coefficients B
Correlation	0.989 <sup>**</sup>	0.978	0.000			
Regression (Constant)				5152.445	0.000 <sup>b</sup>	-26.823
Kebugaran						1.371

\*\* Correlation is significant at the 0.01 level (2-tailed)

a. Dependent Variable: TGMD-3

b. Presictors: (Constant), Physical Fitness

Simple linear regression analysis was performed with TGMD-3 as the dependent variable and physical fitness as the predictor variable. The results of the analysis showed a Pearson correlation coefficient of  $R = 0.989$  with a significance value of  $p = 0.000$  ( $<0.05$ ). The coefficient of determination ( $R^2$ ) of 0.978 indicated that 97.8% of the variation in TGMD-3 scores was statistically related to the variation in physical fitness scores in this model. The F value in the regression ANOVA table was 5152.445 with  $p =$

0.000. The unstandardized regression coefficient (B) was 1.371 with a constant of  $-26.823$ . The regression equation obtained was:

$$\text{TGMD-3} = -26.823 + 1.371 \times \text{Physical Fitness}$$

### ***Effectiveness of Rhythm Games and Gender Interaction***

Based on the results of a pretest conducted before the experiment, 30 students from each school with locomotor scores ranging from 0 to 6 points were divided into two groups and given treatment. The final data obtained were then analyzed using ANOVA to compare students' locomotor skills and physical fitness by gender. The data used were normally distributed and had homogeneous variance (Table 4). The Kolmogorov-Smirnov significance value (Sig.) for all groups was above 0.05, approaching the limits of normality. A Levene's Test significance value  $>0.05$  indicates that the variances of both groups (treatment and control) can be considered homogeneous or balanced.

Table 4. Tests of Normality and Homogeneity of Variance

Variables		Tests of Normality (Kolmogorov-Smirnov <sup>a</sup> )		Homogeneity of Variance (Levene)	
		Statistic	Sig.	Statistic	Sig.
TGMD-3	Perlakuan	0.155	0.062	1.565	0.216
	Kontrol	0.150	0.081		
Physical Fitness	Perlakuan	0.118	0.200*	1.537	0.65
	Kontrol	0.146	0.103		

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

a. Lilliefors Significance Correction

Table 5 displays the outcomes of the analysis of variance (ANOVA), which is a test for between-subjects effects of the dependent variable in the TGMD-3 test. The test results indicate that overall, the dependent variable was significant ( $F = 16.704$ ,  $p < 0.05$ ) with a contribution of 47.2% ( $R^2 = 0.472$ ) to the variability of the dependent variable. This means that the factors of gender, group (treatment vs. control), and the gender  $\times$  group interaction together have a significant influence on students' locomotor skills. The gender factor has an effect that is close to significant ( $p = 0.064$ ). The fact that the Treatment Group (TGK) component is statistically significant ( $p < 0.05$ ) suggests that the control group and the group that received rhythm games vary significantly. Additionally, there is a significant interaction ( $p < 0.05$ ) between gender and treatment group. Therefore, primary school children's locomotor abilities may be improved by rhythm game-based learning, however the efficacy of this approach differs across male and female students.

In Table 6, we can see how different genders, treatments, and interactions affect locomotor abilities. Based on the data, males had a higher average TGMD-3 ( $3.533 \pm 0.212$ ) than females ( $2.967 \pm 0.212$ ). Although this difference was not statistically significant, male students showed a slight advantage in locomotor skills in general. The experimental group taught rhythm games-based physical education had a higher TGMD-3 score ( $4.067 \pm 0.212$ ) than the control group ( $2.433 \pm 0.212$ ). Based on the interaction of gender and treatment, the average scores of male and female students showed a pattern that female students obtained a greater increase from the rhythm games intervention than male students. Although in general males had slightly higher locomotor skills, females showed the most significant progress after receiving rhythm-based learning.

Table 5. Tests of Between-Subjects Effects Dependent Variable Tes TGMD-3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	67.650 <sup>a</sup>	3	22.550	16.704	0.000
Intercept	633.750	1	633.750	469.444	0.000
Gender	4.817	1	4.817	3.568	0.064
Kelompok	40.017	1	40.017	29.642	0.000
Gender * Kelompok	22.817	1	22.817	16.901	0.000
Error	75.600	56	1.350		
Total	777.000	60			
Corrected Total	143.250	59			

a. R Squared = 0.472 (Adjusted R Squared = 0.444)



Table 6. Estimated Marginal Means Dependent Variable TGMD-3

Variable	Mean	Std. Error
Gender		
Male	3.533	0.212
Female	2.967	0.212
Treatment		
Experiment	4.067	0.212
Control	2.433	0.212
Gender * Treatment		
Male Experiment	3.733	0.300
Male Control	3.333	0.300
Female Experiment	4.400	0.300
Female Control	1.533	0.300

The results of the ANOVA test, tests of between-subjects effects on the dependent variable physical fitness can be seen in Table 7, that the gender factor, treatment, and the interaction between the two all have a significance value of less than 0.05 ( $p < 0.05$ ). The test results show overall significance ( $F = 12.502$ ,  $p < 0.05$ ) with a contribution of 40.1% ( $R^2 = 0.401$ ) to the variability of the dependent variable. This means that the combination of gender, treatment (rhythm games), Furthermore, substantial variations in students' levels of physical fitness may be accounted for by the interplay of these two elements. Male and female students' levels of physical fitness vary significantly, as shown by the gender factor's significant impact ( $p = 0.05$ ). Male students have a higher level of physical fitness on average than female students. The treatment group has a significant effect on fitness test results ( $p < 0.05$ ), indicating that rhythm games-based learning significantly improves physical fitness compared to conventional learning methods. Gender and treatment group also significantly interacted on physical fitness ( $p=0.009$ ). This finding indicates that treatment and sex had a joint effect on physical fitness outcomes.

Table 7. Tests of Between-Subjects Effects Dependent Variable Physical Fitness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	169,857 <sup>a</sup>	3	56,619	12,502	0,000
Intercept	869,443	1	869,443	191,975	0,000
Gender	50,784	1	50,784	11,213	0,001
Kelompok	85,921	1	85,921	18,972	0,000
Gender * Kelompok	33,153	1	33,153	7,320	0,009
Error	253,620	56	4,529		
Total	1292,920	60			
Corrected Total	423,477	59			

a. R Squared = 0,401 (Adjusted R Squared = 0,369)

Table 8. Estimated Marginal Means Dependent Variable TGMD-3

Variable	Mean	Std. Error
Gender		
Male	4.727	0.389
Female	2.887	0.389
Treatment		
Experiment	5.003	0.389
Control	2.610	0.389
Gender * Treatment		
Male Experiment	5.180	0.549
Male Control	4.273	0.549
Female Experiment	4.827	0.549
Female Control	0.947	0.549

The mean physical fitness values according to sex, treatment and their combined effect are provided in Table 8. The p-value was less than 0.05 for treatment (experimental or control) of the factor on physical fitness. This suggests that fitness level was statistically significantly different for treatment and control students. Employing rhythm games was proven to significantly enhance physical activity levels among students, compared to traditional educational practices. Likewise, everything was about the fitness as well ( $p = 0.001$ ) where boys has more fitness in comparison with girls of students. The effect of the intervention differed by student sex and found a significant interaction between sex and treatment ( $p = 0.009$ ). The fitness scores were higher among the students who received treatment (mean = 5.003) than those who did not receive the treatment (mean = 2.610). Male dyads in the experimental condition exhibited the highest fitness score ( $M = 5.180$ ), whereas males in the control group also demonstrated higher levels of fitness than females did ( $M = 4.273$ ). Fitness It was showed that women in the experimental group get a real increase in fitness ( $M = 4.827$ ), and, with between-group differences not observed among control group participants who had the lowest score on this variable ( $M = 0.947$ ). This shows

that despite the fact that men have higher fitness, there was a greater intervention effect on women's fitness. Therefore, the learning of physical education that was based on a rhythm game improved the fitness of male and female students.

## Discussion

This study aims to explore the relationship between locomotor skills, physical fitness, and gender interaction in the context of rhythm game interventions in elementary school students. The results show a very high positive relationship between locomotor skills (TGMD-3) and physical fitness ( $R = 0.989$ ;  $p < 0.001$ ), as well as a significant effect of rhythm game treatment on improving locomotor skills and physical fitness. However, the correlation strength of 97.8% variance explained is a statistically unusual finding in educational research and needs to be interpreted with caution. This value potentially reflects model overfitting, multicollinearity between variables, limited sample size, or possible construct similarity between the instruments used. Therefore, rather than being interpreted as a deterministic relationship, these results are more appropriately positioned as an indication of a very strong relationship that still requires replication with a more rigorous experimental design and a larger sample to ensure external validity and model stability.

These findings are consistent with (Barnett et al., 2013; Wulf et al. 2001; Barnett et al., 2011; Gao et al., 2019), which confirm the significant contribution of motor skills to long-term fitness and health development. From the perspective of the developmental motor skills competency model (Stodden et al. 2008; Luz et al., 2016), the relationship between FMS and fitness is reciprocal and dynamic. The practical implication is that physical education programs in elementary schools should not separate fitness training from the development of basic motor skills. Investing in FMS from an early age, as emphasized by (D. R. Lubans et al., 2010), has the potential to have a lasting impact on health and sports participation into adulthood. Therefore, the PJOK curriculum needs to prioritize FMS development as a strategic priority in building students' physical literacy.

Furthermore, these findings reinforce that the development of rhythmic game-based locomotor skills also has an impact on cognitive and affective aspects. Lakes & Hoyt (2004) van der Fels et al. (2015) show that rhythmic motor activities can improve executive functions such as attention and self-regulation. This enriches the interpretation that rhythmic games not only improve physical performance but also support general learning readiness. Pedagogically, the implications are in line with Logan et al. (2018), Cairney et al. (2019) and Robinson et al. (2015), who emphasize the importance of lifelong physical literacy. Physical education needs to be designed as a meaningful and enjoyable learning experience, not just routine physical exercise. With this approach, students not only become fitter, but also more confident, motivated, and able to manage their emotions in movement activities.

The effectiveness of rhythm games in improving locomotor skills shows that the integration of music and structured tempo helps students regulate coordination and movement control more systematically. These results are consistent with Sriwahyuniati et al. (2023), Dewi et al. (2025) and Utami et al. (2025), who highlight the role of rhythm in increasing motivation, social interaction, and movement quality. (Estevan et al., 2021; N. E. Logan et al., 2021), also emphasize the advantages of a game-based approach over formal training. The practical implication is that PE teachers can integrate rhythm elements simply through clapping, moderate-tempo music, or simple percussion instruments without requiring expensive facilities. This approach is adaptive for large classes and can be a solution to space and time constraints (Dewi et al., 2025). However, this study does not claim the absolute superiority of rhythm games over all pedagogical approaches, but rather demonstrates their effectiveness in the context of the design and population studied.

Gender analysis shows a significant interaction between gender and treatment, with girls showing greater improvement in locomotor skills. These findings are in line with SW Logan et al. (2018) and Robinson et al. (2017), which show variations in intervention responses based on gender. Collaborative and expressive rhythm games appear to create a more inclusive learning space, thereby increasing female student participation. An important implication is that PE learning design needs to consider a gender-sensitive approach, reducing the dominance of competitive activities that tend to favor certain students.



Rhythm-based strategies can be an alternative to create learning experiences that are equitable, enjoyable, and empowering for all students.

In terms of physical fitness, rhythm games have also been shown to improve endurance and coordination through repetitive and structured movements, in line with D. Lubans et al. (2016; 2022) and the principles of early childhood sports according to Paiman (2009). Although some studies, such as Maulana et al. (2024) report a dominance of fitness among male students, the results of this study supported by Sucipto et al. (2023) and Utami et al. (2025) show that a rhythm-based approach can moderate this gap. Implicitly, rhythm games can be used as an innovative model in the development of an inclusive, character-based PJOK curriculum that is relevant to children's developmental needs. The integration of rhythm in learning allows physical education to function as a vehicle for integrated physical, social, emotional, and cognitive development, while strengthening the goals of physical literacy and lifelong active participation.

Overall, this study contributes theoretically and practically to the development of rhythm-based physical education in elementary schools. Theoretically, this study expands the developmental motor competency model by placing rhythm as a pedagogical variable that has the potential to strengthen the relationship between locomotor skills and physical fitness within Margaret (Whitehead, 2010) physical literacy framework. The implications of this study confirm that physical education teachers can design learning that integrates rhythmic elements to develop motor skills and fitness simultaneously and create a more gender-inclusive learning environment. However, the limitations of the quasi-experimental design, sample size, potential statistical bias in very high correlation values, and uncontrolled confounding variables require proportional interpretation. Further research is recommended using a randomized experimental design, a larger sample, multicollinearity analysis, and longitudinal measurements to assess the sustainability of the effects. Thus, rhythm games can be viewed as a promising pedagogical approach, but further empirical validation is needed before they can be recommended as a universal learning model.

## Conclusions

This study concludes that there is a very strong relationship between locomotor skills and the physical fitness of elementary school students, so that the development of basic motor skills should be seen as the main foundation in integrated physical education. Rhythm game interventions have been proven to be effective in improving locomotor skills and physical fitness, as well as contributing to the creation of a more gender-inclusive learning environment, with more consistent improvements in female students. These findings confirm that rhythm games are an innovative pedagogical strategy relevant to strengthening physical literacy, equal participation, and enjoyable learning; therefore, their systematic application in the PJOK curriculum is recommended, along with further research to test their long-term impact and application in a broader context.

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## References

- Amado, D., Del Villar, F., Sánchez-Miguel, P. A., Leo, F. M., & García-Calvo, T. (2016). Analysis Of The Impact Of Creative Technique On The Motivation Of Physical Education Students In Dance Content: Gender Differences. *The Journal Of Creative Behavior*, 50(1), 64–79. <https://doi.org/10.1002/jocb.69>
- Baharudin, L. (2016). Hubungan Antara Aktivitas Olahraga Dengan Kemampuan Gerak Dasar Siswa (Studi Pada Siswa Kelas Vi, V Dan Vi Sd Negeri 7 Sidokumpul Gresik). *Jurnal Pendidikan Olahraga Dan Kesehatan*, 4(1). <https://ejournal.unesa.ac.id/index.php/jurnal-pendidikan-jasmani/article/view/18788>
- Bakhtiar, S., Johor, Z., Oktarifaldi, O., & Putri, L. P. (2019). Implementation Of Learning And Fundamental Motor Skill Measurement Of Early Childhood Motor Skill For PAUD Teachers In Padang Panjang City. In *Jurnal Humanities Pengabdian Kepada Masyarakat* (Vol. 1, Issue 1, Pp. 36–47). Universitas Negeri Padang (UNP). <https://doi.org/10.24036/jha.0101.2019.04>
- Bardid, F., Huyben, F., Lenoir, M., Seghers, J., De Martelaer, K., Goodway, J. D., & Deconinck, F. J. A. (2016). Assessing Fundamental Motor Skills In Belgian Children Aged 3-8 Years Highlights Differences To US Reference Sample. *Acta Paediatrica, International Journal Of Paediatrics*, 105(6), E281–E290. <https://doi.org/10.1111/Apa.13380>
- Bardid, F., Lenoir, M., Huyben, F., De Martelaer, K., Seghers, J., Goodway, J. D., & Deconinck, F. J. A. (2017). The Effectiveness Of A Community-Based Fundamental Motor Skill Intervention In Children Aged 3–8 Years: Results Of The “Multimove For Kids” Project. *Journal Of Science And Medicine In Sport*, 20(2), 184–189. <https://doi.org/10.1016/j.jsams.2016.07.005>
- Barnett, L. M., Hardy, L. L., Lubans, D. R., Cliff, D. P., Okely, A. D., Hills, A. P., Morgan, P. J., & (ACAORN), P. A. And S. B. S. Of The A. C. And A. O. R. N. (2013). Australian Children Lack The Basic Movement Skills To Be Active And Healthy. *Health Promotion Journal Of Australia*, 24(2), 82–84. <https://doi.org/10.1071/HE12920>
- Barnett, L. M., Morgan, P. J., Van Beurden, E., Ball, K., & Lubans, D. R. (2011). A Reverse Pathway? Actual And Perceived Skill Proficiency And Physical Activity. *Medicine And Science In Sports And Exercise*, 43(5), 898–904. [10.1249/MSS.0b013e3181fdadd](https://doi.org/10.1249/MSS.0b013e3181fdadd)
- Barnett, L. M., Stodden, D., Cohen, K. E., Smith, J. J., Lubans, D. R., Lenoir, M., Iivonen, S., Miller, A. D., Laukkanen, A., Dudley, D., Lander, N. J., Brown, H., & Morgan, P. J. (2016). Fundamental Movement Skills: An Important Focus. *Journal Of Teaching In Physical Education*, 35(3), 219–225. <https://doi.org/10.1123/jtpe.2014-0209>
- Bremer, E., & Cairney, J. (2018). Fundamental Movement Skills And Health-Related Outcomes: A Narrative Review Of Longitudinal And Intervention Studies Targeting Typically Developing Children. In *American Journal Of Lifestyle Medicine* (Vol. 12, Issue 2, Pp. 148–159). SAGE Publications. <https://doi.org/10.1177/1559827616640196>
- Brian, A., Bardid, F., Barnett, L. M., Deconinck, F. J. A., Lenoir, M., & Goodway, J. D. (2018). Actual And Perceived Motor Competence Levels Of Belgian And United States Preschool Children. *Journal Of Motor Learning And Development*, 6(S2), S320–S336. <https://doi.org/10.1123/jmld.2016-0071>
- Brian, A., Pennell, A., Taunton, S., Starrett, A., Howard-Shaughnessy, C., Goodway, J. D., Wadsworth, D., Rudisill, M., & Stodden, D. (2019). Erratum: Correction To: Motor Competence Levels And Developmental Delay In Early Childhood: A Multicenter Cross-Sectional Study Conducted In The USA (Sports Medicine (Auckland, N.Z.) (2019) 49 10 (1609-1618)). *Sports Medicine (Auckland, N.Z.)*, 49(10), 1619–1620. <https://doi.org/10.1007/S40279-019-01156-Z>
- Burns, R. D., & Fu, Y. (2018). Testing The Motor Competence And Health-Related Variable Conceptual Model: A Path Analysis. *Journal Of Functional Morphology And Kinesiology*, 3(4), 61. <https://doi.org/10.3390/jfkm3040061>



- Cairney, J., Dudley, D., Kwan, M., Bulten, R., & Kriellaars, D. (2019). Physical Literacy, Physical Activity And Health: Toward An Evidence-Informed Conceptual Model. *Sports Medicine*, 49(3), 371–383. <https://doi.org/10.1007/S40279-019-01063-3>
- Dewi, P. C. P., Asmawi, M., Laksana, A. A. N. P., & Dewi, K. A. K. (2025). Exploring The Effects Of Movement-Based Learning On Elementary School Students'academic Achievement: A Systematic Review. *Proceedings Of The International Conference On Social Science, Environment And Technology Development*, 76–90. <https://eproceeding.undwi.ac.id/index.php/icssetd/article/view/500>
- Estevan, I., Bardid, F., Utesch, T., Menescardi, C., Barnett, L. M., & Castillo, I. (2021). Examining Early Adolescents' Motivation For Physical Education: Associations With Actual And Perceived Motor Competence. *Physical Education And Sport Pedagogy*, 26(4), 359–374. <https://doi.org/10.1080/17408989.2020.1806995>
- Gao, Z., Zeng, N., Pope, Z. C., Wang, R., & Yu, F. (2019). Effects Of Exergaming On Motor Skill Competence, Perceived Competence, And Physical Activity In Preschool Children. *Journal Of Sport And Health Science*, 8(2), 106–113. <https://doi.org/10.1016/j.jshs.2018.12.001>
- Gu, X., Thomas, K. T., & Chen, Y. L. (2017). The Role Of Perceived And Actual Motor Competency On Children's Physical Activity And Cardiorespiratory Fitness During Middle Childhood. *Journal Of Teaching In Physical Education*, 36(4), 388–397. <https://doi.org/10.1123/jtpe.2016-0192>
- Kassing, G., & Jay-Kirschenbaum, D. (2021). Dance Teaching Methods And Curriculum Design. In *Dance Teaching Methods And Curriculum Design*. Human Kinetics Publishers. <https://doi.org/10.5040/9781718237957>
- Kassing, G., Jay-Kirschenbaum, D., & Jay, D. M. (2021). *Dance Teaching Methods And Curriculum Design: Comprehensive K-12 Dance Education*. Human Kinetics Publishers.
- King-Dowling, S., Proudfoot, N. A., Cairney, J., & Timmons, B. W. (2020). Motor Competence, Physical Activity, And Fitness Across Early Childhood. *Medicine And Science In Sports And Exercise*, 52(11), 2342–2348. <https://doi.org/10.1249/MSS.0000000000002388>
- Kourkoutas, E., Tragoulia, E., Georgiadi, M., Papatzani, I., & Lakiotaki, K. (2021). Preliminary Findings From The Implementetion Of A Rhythm Based Inclusive Program For Students With Special Educational Needs. *IEEE Global Engineering Education Conference, EDUCON, 2021-April*, 1195–1201. <https://doi.org/10.1109/EDUCON46332.2021.9454064>
- Lakes, K. D., & Hoyt, W. T. (2004). Promoting Self-Regulation Through School-Based Martial Arts Training. *Journal Of Applied Developmental Psychology*, 25(3), 283–302. <https://doi.org/10.1016/j.appdev.2004.04.002>
- Lee, J., Zhang, T., Chu, T. L., Gu, X., & Zhu, P. (2020). Effects Of A Fundamental Motor Skill-Based Afterschool Program On Children's Physical And Cognitive Health Outcomes. *International Journal Of Environmental Research And Public Health*, 17(3), 733. <https://doi.org/10.3390/ijerph17030733>
- Logan, N. E., Raine, L. B., Drollette, E. S., Castelli, D. M., Khan, N. A., Kramer, A. F., & Hillman, C. H. (2021). The Differential Relationship Of An Afterschool Physical Activity Intervention On Brain Function And Cognition In Children With Obesity And Their Normal Weight Peers. *Pediatric Obesity*, 16(2), E12708. <https://doi.org/10.1111/ljpo.12708>
- Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2012). Getting The Fundamentals Of Movement: A Meta-Analysis Of The Effectiveness Of Motor Skill Interventions In Children. In *Child: Care, Health And Development* (Vol. 38, Issue 3, Pp. 305–315). <https://doi.org/10.1111/j.1365-2214.2011.01307.X>
- Logan, S. W., Ross, S. M., Chee, K., Stodden, D. F., & Robinson, L. E. (2018). Fundamental Motor Skills: A Systematic Review Of Terminology. *Journal Of Sports Sciences*, 36(7), 781–796. <https://doi.org/10.1080/02640414.2017.1340660>
- Lubans, D. R., Leahy, A. A., Mavilidi, M. F., & Valkenborghs, S. R. (2022). Physical Activity, Fitness, And Executive Functions In Youth: Effects, Moderators, And Mechanisms. In *Current Topics In Behavioral Neurosciences* (Vol. 53, Pp. 103–130). Springer. [https://doi.org/10.1007/7854\\_2021\\_271](https://doi.org/10.1007/7854_2021_271)
- Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental Movement Skills In Children And Adolescents: Review Of Associated Health Benefits. In *Sports Medicine* (Vol. 40, Issue 12, Pp. 1019–1035). Springer Science And Business Media LLC. <https://doi.org/10.2165/11536850-000000000-00000>



- Lubans, D., Richards, J., Hillman, C., Faulkner, G., Beauchamp, M., Nilsson, M., Kelly, P., Smith, J., Raine, L., & Biddle, S. (2016). Physical Activity For Cognitive And Mental Health In Youth: A Systematic Review Of Mechanisms. *Pediatrics*, *138*(3), E20161642. <https://doi.org/10.1542/Peds.2016-1642>
- Luz, C., Rodrigues, L. P., Almeida, G., & Cordovil, R. (2016). Development And Validation Of A Model Of Motor Competence In Children And Adolescents. *Journal Of Science And Medicine In Sport*, *19*(7), 568–572. <https://doi.org/10.1016/j.jsams.2015.07.005>
- Maulana, R. A., Friskawati, G. F., & Vicki, A. K. (2024). Gender Dan Kebugaran Jasmani Siswa: Analisis Perbedaan Hasil Tes Kebugaran Siswa Indonesia (TKSI) Fase D. *Jurnal Olahraga Pendidikan Indonesia (JOPI)*, *4*(1), 39–49. <http://jopi.kemendikpora.go.id/index.php/jopi>
- Moore, A. (2012). *Teaching And Learning: Pedagogy, Curriculum And Culture*. Routledge.
- Oktarifaldi, O., Marta, I. A., Nugroho, A. W., Hardi, V. J., & Utomo, S. (2024). Keterampilan Gerak Dasar Kelompok Usia 7 Sampai 9 Tahun Siswa Sekolah Dasar. *Jendela Olahraga*, *9*(1), 10–23. <https://doi.org/10.26877/jo.v9i1.17646>
- Paiman. (2009). Olahraga Dan Kebugaran Jasmani Pada Anak Usia Dini. *Cakrawala Pendidikan*, *XXVIII*(3), 270–281.
- Rey, E., Carballo-Fazanes, A., Varela-Casal, C., & Abelairas-Gómez, C. (2020). Reliability Of The Test Of Gross Motor Development: A Systematic Review. *Plos ONE*, *15*(7 July), E0236070. <https://doi.org/10.1371/journal.pone.0236070>
- Rigon, M., Invernizzi, P. L., Signorini, G., Trecroci, A., Scurati, R., Formenti, D., Colella, D., Bosio, A., & Cherubini, D. (2024). The “Thinking System” In A New School Concept: A Rhythmic Teaching Approach In Physical Education To Develop Creativity. *Plos ONE*, *19*(4 April), E0301858. <https://doi.org/10.1371/journal.pone.0301858>
- Robinson, L. E., Okely, A. D., Webster, E. K., & Ulrich, D. A. (2017). Does Intervening In Childcare Settings Impact Fundamental Movement Skills Development? In *Medicine And Science In Sports And Exercise* (Vol. 49, Issue 1, P. 218). Ovid Technologies (Wolters Kluwer Health). <https://doi.org/10.1249/MSS.0000000000001092>
- Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor Competence And Its Effect On Positive Developmental Trajectories Of Health. *Sports Medicine*, *45*(9), 1273–1284. <https://doi.org/10.1007/S40279-015-0351-6>
- Sriwahyuniati, C. F., Hidayatullah, M. F., Purnama, S. K., Siswantoyo, & Tomoliyus. (2023). Game-Based Rhythmic Gymnastics Exercise Models To Develop Gross Motor Skills For Primary School Students. *Cakrawala Pendidikan*, *42*(1), 100–109. <https://doi.org/10.21831/Cp.V42i1.46027>
- Stodden, D. F., Gao, Z., Goodway, J. D., & Langendorfer, S. J. (2014). Dynamic Relationships Between Motor Skill Competence And Health-Related Fitness In Youth. *Pediatric Exercise Science*, *26*(3), 231–241. <https://doi.org/10.1123/Pes.2013-0027>
- Stodden, D. F., Langendorfer, S. J., Goodway, J. D., Robertson, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A Developmental Perspective On The Role Of Motor Skill Competence In Physical Activity: An Emergent Relationship. *Quest*, *60*(2), 290–306. <https://doi.org/10.1080/00336297.2008.10483582>
- Sucipto, Hidayat, Y., Hambali, B., Gumilar, A., & Nur, L. (2023). Exploring The Influence Of Gender And Tactical Learning Approaches On Students' Enjoyment Levels In Physical Education. *Cakrawala Pendidikan*, *42*(3), 719–732. <https://doi.org/10.21831/Cp.V42i3.54218>
- Ulrich, D. A. (2013). The Test Of Gross Motor Development-3 (TGMD-3): Administration, Scoring, And International Norms. *Spor Bilimleri Dergisi*, *24*(2), 27–33.
- Ulrich, D. A. (2017). Introduction To The Special Section: Evaluation Of The Psychometric Properties Of The TGMD-3. *Journal Of Motor Learning And Development*, *5*(1), 1–4. <https://doi.org/10.1123/jmld.2017-0020>
- Utami, N. S., Nurkamto, J., Hidayatullah, M. F., & Yulianto, H. (2025). Sociocultural-Based Games Enhancing Manipulative Movement Skills In Indonesian Kindergartens. *Cakrawala Pendidikan*, *44*(3), 626–635. <https://doi.org/10.21831/Cp.V38i3.25324>
- Van Der Fels, I. M. J., Te Wierike, S. C. M., Hartman, E., Elferink-Gemser, M. T., Smith, J., & Visscher, C. (2015). The Relationship Between Motor Skills And Cognitive Skills In 4-16 Year Old Typically Developing Children: A Systematic Review. *Journal Of Science And Medicine In Sport*, *18*(6), 697–703. <https://doi.org/10.1016/j.jsams.2014.09.007>



- Wainwright, N., Goodway, J., Whitehead, M., Williams, A., & Kirk, D. (2018). Laying The Foundations For Physical Literacy In Wales: The Contribution Of The Foundation Phase To The Development Of Physical Literacy. *Physical Education And Sport Pedagogy*, 23(4), 431-444. <https://doi.org/10.1080/17408989.2018.1455819>
- Whitehead, M. (2010). Physical Literacy: Throughout The Lifecourse. In *Physical Literacy: Throughout The Lifecourse*. Routledge. <https://doi.org/10.4324/9780203881903>
- Wulf, G., Mcnevin, N., & Shea, C. H. (2001). The Automaticity Of Complex Motor Skill Learning As A Function Of Attentional Focus. In *The Quarterly Journal Of Experimental Psychology A* (Vol. 54, Issue 4, Pp. 1143-1154). SAGE Publications. <https://doi.org/10.1080/02724980143000118>
- Zulfikar, M., Hasyim, A. H., Ikadarny, I., & Anwar, N. I. A. (2021). Penguasaan Keterampilan Gerak Dasar Siswa Sekolah Dasar. *Jurnal Sport Science*, 11(1), 27. <https://doi.org/10.17977/Um057v11i1p27-34>

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