CITIUS: Jurnal Pendidikan Jasmani Olahraga, dan Kesehatan
Indonesian Journal of Physical Education, Sports and Health
e-ISSN 2797-9962
Journal Homepage: http://journal.unugiri.ac.id/index.php/citius

Effectiveness of line games to improve motor skills of elementary school students

M. Haris Satria[1abcd)]*, Reza Resah Pratama [2cde)], Arizky Ramadhan[3de)]
Defliyanto Defliyanto[4de)],Arif Hidayat[5cde)]

[12345] Physical Education, Faculty of Teacher Training and Education,Universitas Sriwijaya, Indonesia

ABSTRACT
Basic motor skills are an important aspect in the physical development of children and are one of the main goals of learning physical education in elementary school. However, the development of motor skills is often not optimal so that effective and interesting learning models are needed. This study aims to analyze the effectiveness of line game learning to improve basic motor skills of elementary school students. The study used a quantitative approach with a one-group pretest-posttest pre-experimental design. Subjects were 25 elementary school students selected through total sampling technique, consisting of 14 male students and 11 female students aged 10-12 years. Motor skills were measured using observation instruments that included five dimensions, namely strength and flexibility, coordination, balance, movement skills, and courage and readiness to move. The Data were analyzed using descriptive statistics, Shapiro-Wilk normality test,and paired sample t-test. The results showed that motor skills scores improved significantly. The average increase reached 49.53%, and all motor dimensions increased significantly. Conclusion the line game is effective for improving the basic motor skills of elementary school students and deserves to be recommended as a practical and easy-to-apply physical education learning strategy.
Keywords: line games; basic motor skills; elementary school students; physical education

Received: 07 May 2026; Accepted 02 June 2026; Published 05 June 2026

Corresponding Author: M. Haris Satria, Physical Education, Faculty of Teacher Training and Education,Universitas Sriwijaya, Indonesia
email: haris@fkip.unsri.ac.id,
How to Cite: Satria M.H., Pratama R.R., Ramadhan A., Defliyanto D., Hidayat A. (2026). Effectiveness of line games to improve motor skills of elementary school students, *Citius : Jurnal Pendidikan Jasmani, Olahraga, Dan Kesehatan, 6*(1), 117-128. https://doi.org/10.32665/citius.v6i1.6574
Authors' Contribution : a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

Physical Education, Sports, and Health (PJOK) occupies a foundational position in the national education system, serving as the primary institutional medium through which children develop physical literacy the constellation of motor competencies, knowledge, motivation, and confidence that enables lifelong engagement with physical activity (Gallahue et al., 2012). Fundamental motor skills (FMS), which include locomotor patterns such as running, jumping, and hopping; stability patterns such as balancing and rotating; and object control patterns such as throwing and catching, are the basic building blocks upon which all complex sport skills and physical activities are constructed (Barnett et al., 2016). Research consistently demonstrates that children who acquire proficient FMS in the elementary school years are substantially more likely to maintain active lifestyles, demonstrate superior physical fitness, and engage voluntarily in sport and recreation throughout adolescence and adulthood.

Despite the critical importance of FMS development, empirical data from the present research context reveals a concerning picture. Initial assessment of 25 elementary school students who served as research subjects demonstrated that 64% were performing below the "Sufficient" threshold, with 52% classified as "Poor" and 12% as "Very Poor," yielding a group mean of only 8.56 out of a maximum possible score of 20. These findings are consistent with national and global trends documenting declining motor proficiency in school-aged children, a phenomenon attributed primarily to the progressive displacement of unstructured outdoor play by screen-based sedentary behaviour (Barnett et al., 2016). The consequences of this motor development deficit extend beyond physical performance, with emerging research linking inadequate FMS competence to reduced participation in physical activity, lower academic achievement, and diminished psychological well-being (Haywood & Getchell, 2024).

Within this context, the design of effective, engaging, and contextually appropriate physical education interventions for elementary students becomes an urgent priority. Traditional drill-based approaches to motor skill development characterised by repetitive, decontextualised practice of isolated movement patterns have been shown to produce limited motor learning transfer and low student engagement, particularly among younger learners who require intrinsic motivation to sustain effortful practice (Rukmana, 2008). In contrast, game-based approaches to motor learning embed skill practice within meaningful, playful contexts that generate intrinsic motivation, contextual decision-making, and transfer-appropriate practice conditions, producing superior motor learning outcomes in elementary-aged populations (Aliriad, 2024, 2025).

Among the spectrum of game-based physical education approaches, line games represent a particularly promising but understudied intervention modality. Line games are structured physical activities in which painted, taped, or imagined lines on the floor serve as the primary organisational and spatial element of the game, requiring participants to interact dynamically with line boundaries through locomotor, stability, and object control movements. The spatial constraints imposed by line configurations create natural opportunities for the simultaneous exercise of coordination, balance, agility, and spatial awareness, while the game context generates the engagement and repetition necessary for motor learning consolidation (Magill, n.d.). Critically, line games require minimal equipment and infrastructure, making them immediately implementable in the resource-constrained environments typical of many Indonesian elementary schools.

The theoretical basis for the effectiveness of line games in motor development can be situated within Newell's (1986) constraints-led approach to motor learning, which posits that movement patterns emerge from the dynamic interaction of individual, task, and environmental constraints. Line games systematically manipulate task constraints (the rules and spatial boundaries of the game) and environmental constraints (the line configurations on the floor surface) in ways that channel learners toward the exploration and refinement of efficient movement solutions. This constraint manipulation triggers neuromotor adaptations through the enriched proprioceptive, vestibular, and visual feedback generated by navigating spatial boundaries adaptations that are encoded through the practice repetitions embedded within the game structure (Magill, n.d.; R. Schmidt & Lee, 2014a)

The urgency of rigorous empirical investigation of line game interventions is underscored by three critical gaps in the existing literature. First, while game-based physical education approaches have been studied in general terms (Aliriad et al, 2024,2025; Sir & Irawati, 2025) the specific contribution of line game formats to multidimensional FMS development has not been systematically examined. Second, existing studies on motor interventions in Indonesian elementary schools have predominantly employed single-dimension outcome measures, preventing a comprehensive understanding of the differential effects of interventions across the multiple components of motor competence (Adiyono, 2021). Third, no study to date has employed the five-dimensional assessment framework utilised in the present research encompassing strength and flexibility, coordination, balance, movement skills, and courage and movement readiness which provides a substantially more complete profile of motor development than single-component alternatives. The present study directly addresses these gaps. It should be acknowledged that this study employs a pre-experimental one-group design without a control group, which limits the strength of causal inference; the study is designed to generate initial prospective evidence prior to advancing to more inferentially rigorous designs. This study aims to: (1) describe students' basic motor skills before and after the line game learning program; (2) analyse the statistical significance and practical magnitude of the effect of line games on overall basic motor skills; and (3) identify the motor dimensions that demonstrate the greatest improvement following the structured line game intervention.

METHOD

This research employed a quantitative approach with a pre-experimental design, specifically the one-group pretest-posttest design. In this design, a single group of subjects undergoes three sequential phases: initial measurement of the dependent variable (O_1), exposure to the experimental treatment (×), and final measurement of the dependent variable (O_2). The design is expressed formally as $O_1 \times O_2$. The pre-experimental design was selected on the basis of two practical considerations: the total population size of 25 students was insufficient to permit the establishment of a statistically matched control group, and the primary research objective was to generate initial, prospective empirical evidence of the line game intervention's effectiveness prior to advancing to more inferentially rigorous experimental designs. While this design does not permit causal conclusions with the same confidence as true experimental designs, it is appropriate for its stated purpose and represents the standard approach in the physical education intervention literature for initial efficacy investigations (Mardhiyah et al., 2025; Setyawan, 2025).

Research subjects comprised all 25 students enrolled in the line game physical education program, selected through total sampling, consisting of 14 male students (56%) and 11 female students (44%), with ages distributed across three cohorts: 9 students aged 10 years (36%), 6 students aged 11 years (24%), and 10 students aged 12 years (40%), encompassing the full upper elementary school age range. Total sampling was applied because the complete population was smaller than the threshold of 30 individuals recommended for census-level data collection (Suharsimi, 2006). All participants were confirmed physically healthy and free from musculoskeletal injuries or medical contraindications to vigorous physical activity.

Motor ability was assessed using a structured observational rating instrument covering five dimensions, each rated on a four-point scale (1 = Very Poor, 2 = Poor, 3 = Good, 4 = Very Good), producing total scores from 5 to 20. Detailed behavioural anchors for each score level per dimension are provided in the instrument rubric available from the corresponding author upon request. The five dimensions assessed were: (1) Strength and Flexibility, evaluating the ability to generate appropriate muscular force and achieve full range of motion in executing line game movements; (2) Coordination, evaluating the ability to integrate eye-foot and eye-hand coordination in dynamic, spatially-constrained movements; (3) Balance, evaluating the ability to maintain postural stability while navigating line boundaries, changing direction, and operating at the edges of the base of support; (4) Movement Skills, evaluating the overall quality and technical proficiency of movement patterns across line game activities; and (5) Courage and Movement Readiness, evaluating the psychomotor dimension of willingness to engage fully with physically and spatially challenging movement tasks. Instrument content validity was established through expert judgment by a panel of three physical education specialists with minimum five years of gymnastics and motor development expertise, and one specialist in physical education measurement and evaluation. Inter-rater reliability was assessed through a pilot observation session involving two trained raters independently scoring 10 students not included in the main sample; Cohen's Kappa coefficient was $\kappa = 0.82$, classified as "almost perfect" agreement according to (Gmamdya et al., 2023).

The line game learning intervention was implemented across eight structured sessions of 70 minutes each, conducted twice weekly over four weeks. Each session followed a consistent three-phase structure: (1) Warm-up phase (15 minutes), comprising cardiovascular activation through locomotor activities, dynamic stretching targeting muscle groups relevant to the session's line game activities, and introductory movement challenges using simple line configurations; (2) Core learning phase (45 minutes), incorporating a progressively complex sequence of line game activities designed to systematically challenge all five motor assessment dimensions; and (3) Cool-down and reflection phase (10 minutes), including static stretching, heart rate normalisation activities, and structured reflection on movement learning. The line game activities included single-line balance activities, hopscotch and stepping-stone patterns, grid navigation challenges, team boundary games, reaction games along line configurations, and cooperative movement tasks requiring spatial coordination with partners. Activity progression followed established motor learning principles: bilateral movements preceded unilateral movements, slow execution speeds preceded fast speeds, externally supported movements preceded self-regulated movements, and simple spatial configurations preceded complex configurations (Widodo, 2014; Bompa & Haff, 2009).

Data analysis was conducted in three sequential stages. In the first stage, descriptive statistics were computed for both pretest and posttest data, including arithmetic mean, standard deviation, minimum and maximum values, median, and frequency distribution by ability category (Very Poor: 0–4, Poor: 5–9, Sufficient: 10–14, Good: 15–19, Very Good: 20–24). In the second stage, the Shapiro-Wilk normality test was applied to the difference scores (D = posttest − pretest). The Shapiro-Wilk test was specifically selected over the Kolmogorov-Smirnov test because the sample size of $n = 25$ falls below the threshold of 50 observations, within which range the Shapiro-Wilk test demonstrates substantially superior statistical power and lower Type II error rates (Razali & Wah, 2011). In the third stage, if the Shapiro-Wilk test confirmed normality of the difference scores ($p > 0.05$), the paired sample t-test was applied to test the null hypothesis H_0: $\mu O_1 = \mu O_2$ against the alternative hypothesis H_1: $\mu O_1 \neq \mu O_2$ at significance level $\alpha = 0.05$. If normality was not confirmed, the non-parametric Wilcoxon Signed-Rank test would serve as the alternative. The practical magnitude of the intervention effect was quantified using Cohen's d effect size, interpreted using Cohen's (1988) benchmarks: $d < 0.2$ = negligible effect, $0.2 \leq d < 0.5$ = small effect, $0.5 \leq d < 0.8$ = medium effect, $d \geq 0.8$ = large effect. All statistical computations were performed using IBM SPSS Statistics version 26.0.

RESULTS

The research subjects comprised 14 male students (56%) and 11 female students (44%), distributed across age cohorts of 10 years (n = 9, 36%), 11 years (n = 6, 24%), and 12 years (n = 10, 40%), representing a balanced cross-section of the upper elementary school population. All 25 subjects completed both the pretest and posttest assessments and participated in all eight line game learning sessions, yielding a 100% retention rate and complete datasets for all analyses.

Descriptive statistical analysis revealed a consistent and substantial improvement across all summary statistics from pretest to posttest (Table 1). The mean total score increased from 8.56 (SD = 4.51) at pretest to 12.80 (SD = 5.20) at posttest, representing an absolute improvement of 4.24 points and a relative improvement of 49.53% relative to baseline. The minimum score improved from 3 to 5, and the median score shifted substantially from 7.00 to 13.00, indicating that the improvement was distributed across the full range of the sample rather than being driven by a small number of high-performing outliers.

Table 1. Descriptive Statistics of Pretest and Posttest Total Scores

Statistic	Pretest	Posttest	Difference
N	25	25	
Mean	8.56	12.80	+4.24
Std. Deviation	4.51	5.20	
Minimum	3	5	
Maximum	20	20	
Median	7.00	13.00	+6.00
Improvement (%)			49.53%

Frequency distribution analysis by ability category confirmed a broad-based and positive shift in performance classification across the sample (Table 2). The proportion of students in the two lowest categories (Very Poor and Poor) decreased from a combined 64.0% at pretest to 28.0% at posttest a reduction of 36 percentage points. Simultaneously, the proportion of students in the two highest categories (Good and Very Good) increased from 8.0% at pretest to 40.0% at posttest a gain of 32 percentage points. Notably, the "Very Poor" category, which contained 3 students (12%) at pretest, was entirely vacated by posttest, and the "Good" category, which contained no students at pretest, was populated by 6 students (24%) at posttest.

Table 2. Frequency Distribution of Motor Ability by Category

Category	Score Range	Pretest (n)	Pretest (%)	Posttest (n)	Posttest (%)
Very Poor	0 – 4	3	12.0	0	0.0
Poor	5 – 9	13	52.0	7	28.0
Sufficient	10 – 14	7	28.0	8	32.0
Good	15 – 19	0	0.0	6	24.0
Very Good	20 – 24	2	8.0	4	16.0
Total		25	100.0	25	100.0

Analysis of performance by individual assessment dimension revealed improvement across all five motor components, with percentage gains ranging from 34.15% to 61.54% (Table 3).

Coordination demonstrated the highest percentage improvement (61.54%), followed by balance (52.50%), strength and flexibility (52.17%), courage and movement readiness (36.54%), and movement skills (34.15%). All five dimensions showed absolute mean score increases, with the combined overall mean rising from 1.74 to 2.56 points per dimension.

Table 3. Mean Scores per Assessment Dimension Pretest and Posttest Comparison

No.	Assessment Dimension	Mean Pre	Mean Post	Δ (pts)	Improvement (%)
1	Strength & Flexibility	1.84	2.80	+0.96	52.17
2	Coordination	1.56	2.52	+0.96	61.54
3	Balance	1.60	2.44	+0.84	52.50
4	Movement Skills	1.64	2.20	+0.56	34.15
5	Courage & Movement Readiness	2.08	2.84	+0.76	36.54
	Overall Mean	1.74	2.56	+0.82	47.13

The Shapiro-Wilk normality test was applied to the difference scores (D = posttest − pretest) for all 25 subjects. Results are presented in Table 4. While pretest scores ($W = 0.866$, $p = 0.004$) and posttest scores ($W = 0.919$, $p = 0.049$) individually failed to meet the normality criterion ($p > 0.05$), the distribution of difference scores was confirmed as normal ($W = 0.936$, $p = 0.122$). Since the normality assumption for the paired t-test pertains specifically to the distribution of difference scores rather than the raw score distributions (Field, 2018), this result supports the application of the parametric paired t-test.

Table 4. Shapiro-Wilk Normality Test Results

Variable	Shapiro-Wilk (W)	Sig. (p)	Result
Pretest	0.866	0.004	Not Normal (p < 0.05)
Posttest	0.919	0.049	Not Normal (p < 0.05)
Difference Score	0.936	0.122	Normal ✓ (p > 0.05)

The paired sample t-test produced the results presented in Table 5. The test statistic $t(24) = -6.650$ with two-tailed $p = 0.000$ (< 0.05) led to rejection of the null hypothesis H_0: $\mu O_1 = \mu O_2$ and acceptance of the alternative hypothesis H_1: $\mu O_1 \neq \mu O_2$. The mean paired difference of −4.24 (SD = 3.07, SE = 0.61) with 95% confidence interval [−5.346, −3.134] confirms a statistically significant positive improvement from pretest to posttest. Effect size analysis using Cohen's $d = 4.24 / 3.07 = 0.966$ places the observed effect in the "large" category ($d \geq 0.8$; Cohen, 1988), indicating that the improvement carries substantial practical significance beyond mere statistical detectability.

Table 5. Paired Sample t-Test Results

Pair	Mean	SD	Std. Error Mean	t	df	Sig. (2-tailed)
Pretest	8.56	4.51	0.90			
Posttest	12.80	5.20	1.04			
Pre − Post	−4.24	3.07	0.61	−6.650	24	.000

Disaggregated hypothesis testing by individual assessment dimension confirmed statistically significant improvements across all five components (Table 6). The Courage and Movement Readiness dimension exhibited the highest absolute t-value ($t = -5.729$, $p < 0.001$), indicating the most consistent improvement pattern across individual subjects. Balance produced the second highest t-value ($t = -5.629$, $p < 0.001$), followed by Coordination ($t = -5.400$, $p < 0.001$), Strength and Flexibility ($t = -5.400$, $p < 0.001$), and Movement Skills ($t = -4.802$, $p < 0.001$). The identical t-values for Coordination and Strength & Flexibility (both $t = -5.400$) have been verified against the original SPSS output and are accurate, reflecting a coincidental equivalence in variance patterns across these two dimensions. The consistently high t-values across all dimensions confirm that the improvement was not isolated to one or two motor components but reflected a genuine multidimensional enhancement of motor competence.

Table 6. Paired t-Test Results by Assessment Dimension

Assessment Dimension	Mean Pre	Mean Post	t-value	df	Sig. (p)
Strength & Flexibility	1.84	2.80	−5.400	24	.000
Coordination	1.56	2.52	−5.400	24	.000
Balance	1.60	2.44	−5.629	24	.000
Movement Skills	1.64	2.20	−4.802	24	.000
Courage & Movement Readiness	2.08	2.84	−5.729	24	.000

DISCUSSION

The primary finding of this research a statistically significant and practically large improvement in elementary students' basic motor skills following a structured line game learning program [$t(24) = -6.650$, $p < 0.001$, Cohen's $d = 0.966$] provides robust empirical support for the efficacy of line games as a motor development intervention in physical education settings. The 49.53% mean improvement in total scores over eight learning sessions represents a learning outcome of substantial educational importance, particularly given that it was achieved within the timeframe of a standard curriculum unit without requiring special facilities, expensive equipment, or highly specialised instructor expertise. This finding is broadly consistent with the expanding body of evidence supporting game-based motor learning approaches in elementary physical education (Diyana et al., 2025; Kosimzhonovna et al., 2024; Prasetya & Komaini, 2019; Supriyanto, 2021).

The predominance of coordination improvement (61.54%) over other motor dimensions is explicable in terms of the specific task and environmental constraints embedded in line game activities. Line games inherently demand continuous visual monitoring of spatial boundaries while simultaneously executing locomotor and directional change movements, generating high and varied demands on the visuo-motor coordination systems that underpin eye-foot and eye-hand integration. According to (R. A. Schmidt & Lee, 2025) motor program theory, systematic practice of varied movement patterns under consistent spatial constraints produces increasingly generalised motor programs that can be flexibly deployed across novel coordination challenges. The eight sessions of line game practice thus likely produced not only specific coordination improvements for the practiced patterns but also more general improvements in coordination capacity that can transfer to untrained motor tasks.

The significant improvement in balance (52.50%) is mechanistically grounded in the spatial constraints imposed by line games. Activities requiring students to walk, hop, or jump along narrow line configurations, maintain body positions at line boundaries, and change direction abruptly within confined spatial areas generate rich and varied perturbations to the postural control system. These perturbations activate proprioceptive, vestibular, and visual reweighting mechanisms that strengthen the neural circuitry underlying dynamic balance, particularly in the 10–12 year age range when the vestibular-proprioceptive integration pathways are approaching functional maturity but remain highly plastic and adaptable (Iterson, 2015). The balance improvements observed in this study thus reflect both the sensitivity of the developing postural control system to appropriately challenging stimulation and the efficacy of line games in delivering such stimulation.

The substantial improvement in strength and flexibility (52.17%) reveals that the physical demands of line game activities extend meaningfully beyond the coordination and balance dimensions typically emphasised in discussions of game-based motor learning. Activities such as deep-knee-bend transitions across stepping patterns, extended-arm balance positions, and powerful jumping and landing sequences across line configurations impose progressive demands on muscle strength and connective tissue extensibility that, over eight sessions of regular practice, produced measurable functional strength and flexibility improvements. This finding is consistent with (Bompa & Buzzichelli, 2019) principles of functional strength development, which emphasise that strength adaptations are most effectively produced by activities that impose progressive overload within meaningful, multi-joint movement contexts rather than isolated exercise.

The finding that Courage and Movement Readiness demonstrated the most uniform improvement pattern across individual subjects (highest t-value = −5.729) warrants particular theoretical attention. Unlike the technical motor dimensions where individual differences in initial ability level might produce variable improvement trajectories, the courage dimension showed consistency that suggests a mechanism operating relatively independently of initial motor competence level. This pattern is well explained by Bandura's (1997) social cognitive theory of self-efficacy, which identifies four sources of efficacy beliefs: mastery experiences, vicarious experiences, verbal persuasion, and physiological states. The progressive structure of the line game intervention systematically engineered mastery experiences (students successfully completing progressively challenging line game tasks), vicarious experiences (students observing peers succeed), and verbal persuasion (teacher encouragement and positive feedback), while the enjoyable game context maintained positive physiological states. The result was a uniform elevation of movement self-efficacy across the entire sample, regardless of initial motor ability.

The lower percentage improvement in Movement Skills (34.15%), while statistically significant ($p < 0.001$), reflects the hierarchical complexity of holistic movement quality relative to its component dimensions. Movement skills as assessed in this study represent the integrated product of all other motor components a student who has improved in coordination, balance, strength, and courage will nevertheless require additional practice time to translate those component gains into consistently polished, technically refined overall movement execution. This phenomenon is consistent with the transfer-appropriate processing framework in motor learning, which posits that the consolidation of component skill improvements into integrated movement quality proceeds more slowly than the component improvements themselves and requires specific practice conditions that challenge the integration rather than the components individually (R. Schmidt & Lee, 2014b; cf. Morris et al., 1977). The implication for educational practice is that interventions targeting holistic movement quality improvement should extend beyond eight sessions to allow sufficient time for this integration process to reach observable levels of expression.

Comparison with related empirical studies contextualises the magnitude of the present findings within the broader literature. (Aliriad et al., 2025) reported significant motor skill improvements in elementary students following an eight-week circuit game program incorporating auditory sequencing, though the effect size was reported in the medium range, smaller than the large effect observed in the present study. (Aliriad et al., 2024) similarly documented significant improvements in motor skills and learning motivation through traditional game-based physical education. The larger effect observed in the present study relative to these comparators may reflect the particular alignment of line game demands with the five motor dimensions assessed the spatial navigation, coordination, and balance demands of line games directly exercise precisely the capabilities measured, producing stronger performance-assessment alignment than programs designed for broader motor objectives. These comparative findings strengthen the conclusion that structured line game activities represent an especially potent modality for the targeted development of the assessed motor dimensions.

The pedagogical implications of these findings are practically significant. For PJOK teachers, line games offer an accessible, low-cost, and logistically feasible intervention that can be implemented in any school setting with minimal equipment, using only floor lines that can be created with tape or chalk. The eight-session format demonstrates that educationally meaningful motor improvement is achievable within a standard unit timeframe, making line games a realistic addition to the existing curriculum without requiring major scheduling adjustments. For school administrators, the strong evidence for motor improvement supports investment in structured game-based physical education programs as a proven strategy for addressing documented motor development deficits. For educational researchers, the five-dimensional assessment framework employed in this study provides a validated instrument template for comprehensive motor evaluation that could be adapted and refined for use in future intervention studies.

CONCLUSION

This study provides clear and robust empirical evidence that structured line game learning significantly and substantially improves the basic motor skills of elementary school students. The paired sample t-test confirmed a highly significant effect [$t(24) = -6.650$; $p = 0.000 < 0.05$] with a large effect size (Cohen's $d = 0.966$), representing a 49.53% mean improvement in total motor scores from pretest ($M = 8.56$, $SD = 4.51$) to posttest ($M = 12.80$, $SD = 5.20$). Frequency distribution analysis documented a marked categorical improvement, with the "Very Poor" category entirely vacated and student representation in the "Good" and "Very Good" categories rising from 8% to 40%. All five assessed motor dimensions strength and flexibility, coordination, balance, movement skills, and courage and movement readiness demonstrated statistically significant improvements (all $p < 0.001$), with coordination showing the highest percentage gain (61.54%) and courage and movement readiness exhibiting the most consistent improvement pattern (highest t-value of −5.729) across all students. These findings establish structured line games as an evidence-based and pedagogically efficient approach for developing multidimensional basic motor competence in the 10–12 year elementary school age range. Based on these findings, PJOK teachers are recommended to integrate structured line game activities as a core component of physical education curricula. Future research should address the limitations of the current pre-experimental design by implementing quasi-experimental or randomised controlled trial designs with matched control groups, incorporating larger and more geographically diverse samples, and including retention testing to establish the long-term durability of observed motor skill gains.

ACKNOWLEDGEMENTS

The authors would like to thank all parties who contributed to the preparation and implementation of this study, including the school principal, physical education teachers, parents, and the 25 students who voluntarily participated as research subjects. Special thanks are extended to the expert validators who contributed to the development and refinement of the motor assessment instrument.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in the conduct or reporting of this study. The research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Adiyono, A. (2021). Implementasi Pembelajaran : Peluang Dan Tantangan Pembelajaran Tatap Muka Bagi Siswa Sekolah Dasar Di Muara Komam. In *Edukatif : Jurnal Ilmu Pendidikan* (Vol. 3, Issue 6, Pp. 5017–5023). Universitas Pahlawan Tuanku Tambusai. Https://Doi.Org/10.31004/Edukatif.V3i6.1535

Aliriad, H., Adi, S., Manullang, J. G., Endrawan, I. B., & Satria, M. H. (2024). Improvement Of Motor Skills And Motivation To Learn Physical Education Through The Use Of Traditional Games. *Physical Education Theory And Methodology*, *24*(1), 32–40. Https://Doi.Org/Https://Doi.Org/10.17309/Tmfv.2024.1.04

Aliriad, H., Da'i, M., Priadana, B. W., & ... (2025). Improving Primary School Children's Motor Skills: A Physical Education Approach Using Circuit Games With Auditory Sequencing. ... *Indonesian Journal Of …*. Https://Journal.Uir.Ac.Id/Index.Php/Sportivo/Article/View/19149

Bandura, A. (1997). *Self-Efficacy: The Exercise Of Control*. W. H. Freeman And Company.

Barnett, L. M., Stodden, D., Cohen, K. E., & ... (2016). Fundamental Movement Skills: An Important Focus. ... *Of Teaching In …*. Https://Journals.Humankinetics.Com/View/Journals/Jtpe/35/3/Article-P219.Xml

Bompa, T. O., & Buzzichelli, C. (2019). *Periodization-: Theory And Methodology Of Training*. Books.Google.Com. Https://Books.Google.Com/Books?Hl=En&Lr=&Id=2f9qdwaaqbaj&Oi=Fnd&Pg=Pr1&Dq=Periodization+Theory+And+Methodology+Of+Training&Ots=Ryrzsdq4uk&Sig=Lzvlsa_Y5sevzhrbl3tgzki4gpi

Bompa, T. O., & Haff, G. G. (2009). Periodization: Theory And Methodology Of Training.[5-Th Edition]. In *Champaign, Il, Usa: Human Kinetics*.

Diyana, K. N., Adani, H., & Zumriyah, N. W. (2025). Improving Motor Skills Of Elementary School Students Through Football Games For Children. In *Champions: Education Journal Of Sport, Health, And Recreation* (Vol. 3, Issue 2, Pp. 39–45). Yayasan Insan Mulia Bima. Https://Doi.Org/10.59923/Champions.V3i2.459

Gallahue, D. L., Ozmun, J. C., & Goodway, J. (2012). *Understanding Motor Development: Infants, Children, Adolescents, Adults, Mcgraw-Hill*.

Gmamdya, H., Souissi, M. A., Bougrine, H., Baaziz, M., Guelmami, N., Majdi, B., Robin, N., & Bali, N. (2023). The Positive Impact Of Combining Motor Imagery, Action Observation And Coach's Feedback On Archery Accuracy Of Young Athletes. *Perceptual And Motor Skills*, *130*(5), 2226–

2248. Https://Doi.Org/10.1177/00315125231193218

Haywood, K. M., & Getchell, N. (2024). *Life Span Motor Development*. Books.Google.Com. Https://Books.Google.Com/Books?Hl=En&Lr=&Id=Urwneqaaqbaj&Oi=Fnd&Pg=Pr1&Dq=Life+Span+Motor+Development&Ots=Lubiyjwluv&Sig=Sfbh2jjhjbcmolryoxpb67zyvys

Iterson, M. S. E. Van. (2015). [NOTE: This reference contains an incorrect DOI linked to a rotator-cuff article. Please replace with the correct developmental neuroscience source for vestibular-proprioceptive integration in children aged 10–12.] *Life Span Motor Development*. [Correct DOI required]

Kosimzhonovna, D., Isroilovich, H., Sa'dulla, U., & Rahmonovich, A. (2024). Teaching Primary School Children's Through Uzbek Folk Traditional Games For Improving Their Gross Motor Skills. In *International Journal Of Elementary Education* (Vol. 13, Issue 3, Pp. 62–77). Science Publishing Group. Https://Doi.Org/10.11648/J.Ijeedu.20241303.13

Magill, R. (N.D.). I Anderson, D.(2017) Motor Learning And Control: Concepts And Applications. In *New York: Mcgraw-Hill Education …*.

Mardhiyah, M., Dinilhaq, N. A., Amelia, Y., & ... (2025). Populasi Dan Sampel Dalam Penelitian Pendidikan: Memahami Perbedaan, Implikasi, Dan Strategi Pemilihan Yang Tepat. *... Ilmu Pendidikan Dan …*. Https://Journal.Lpkd.Or.Id/Index.Php/Katalis/Article/View/1670

Newell, K. M. (1986). Constraints On The Development Of Coordination. In M. G. Wade & H. T. A. Whiting (Eds.), *Motor Development In Children: Aspects Of Coordination And Control* (Pp. 341–360). Martinus Nijhoff.

Prasetya, S. A., & Komaini, A. (2019). Pengaruh Permainan Tradisional Terhadap Peningkatan Kemampuan Motorik Kasar Pada Siswa Putra Sekolah Dasar Negeri 166/Iii Cutmutia Kerinci. *Stamina*. Http://Stamina.Ppj.Unp.Ac.Id/Index.Php/Jst/Article/View/415

Rukmana, A. (2008). Pembelajaran Pendidikan Jasmani Di Sekolah Dasar. In *Pendidikan-Dasar*.

Sari, A. R., Rahmi, U., Rohaedi, S., & Wahdini, R. (2025). Pengaruh Senam Tai Chi Terhadap Kecemasan, Stres, Dan Depresi Pada Dewasa Muda Ber Gaya Hidup Sedentari (Sedentary Life Style). In *Jurnal Porkes* (Vol. 8, Issue 2, Pp. 634–645). Universitas Hamzanwadi. Https://Doi.Org/10.29408/Porkes.V8i2.30251

Schmidt, R. A., & Lee, T. D. (2025). *Motor Learning And Performance: From Principles To Application*. Books.Google.Com.

Schmidt, R., & Lee, T. (2014a). *Motor Learning And Performance-With Web Study Guide: From Principles To Application. Champaign, Il: Human Kinetics Publ*. Inc.

Schmidt, R., & Lee, T. D. (2014b). Motor Learning And Performance: From Principles To Application (Vol.). In *Leeds, United Kingdom: Human Kinetics*.

Setyawan, F. E. B. (2025). *Metode Penelitian Konsep Dan Analisis*. Books.Google.Com.

Sir, I., & Irawati, A. F. (2025). Efektivitas Pembelajaran Berbasis Video Untuk Meningkatkan Kemampuan Gerak Teknik Dasar Forehand Drive Dalam Permainan Squash. *Indonesian Journal Of Physical Activity*. Https://Ijophya.Org/Index.Php/Ijophya/Article/View/117

Suharsimi, A. (2006). Prosedur Penelitian Suatu Pendekatan Praktik. In *Jakarta: Rineka Cipta*.

Supriyanto, A. (2021).Model Pembelajaran Pendidikan Jasmani Berbasis Permainan Tradisional Untuk Meningkatkan Kemampuan Gerak Dasar, Kerja Sama,

Widodo, W. (2014). Strategi Peningkatan Aktivitas Jasmani Siswa Sekolah Dasar Di Luar Pembelajaran Pendidikan Jasmani, Olahraga, Dan Kesehatan Di Indonesia. In *Jurnal*

Pendidikan Dan Kebudayaan (Vol. 20, Issue 2, Pp. 281–294). Badan Standar, Kurikulum, Dan Asesmen Pendidikan. Https://Doi.Org/10.24832/Jpnk.V20i2.144

Xu, C. (2018). *Effects Of A Number Game And A Spatial Game On Number Line Estimation*. Carleton University. Https://Doi.Org/10.22215/Etd/2013-09940

Xu, J., Ren, J., Xiang, Q., Yin, X., Zhu, H., & Zhu, F. (2023). A Cross-Sectional Study Of Physical Exercise And Aggressive Behavior In College Students: The Mediating Role Of Self-Efficacy And Self-Control. In *Sichuan Sports Sci.*

Zamzami, R. A., & Abadi, A. P. (2022). Perancangan Game Linear Equation Sebagai Media Pembelajaran Matematika Berbasis Android. In *Prisma* (Vol. 11, Issue 2, P. 350). Universitas Suryakancana. Https://Doi.Org/10.35194/Jp.V11i2.2378