Enhancing Gross Motor Skills in Early Childhood through Structured Play: A Quasi-Experimental Study Using TGMD

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Abstract. This study investigates the effectiveness of structured play-based activities in enhancing children's gross motor skill development, as measured using the Test of Gross Motor Development (TGMD) framework. Employing a quantitative quasi-experimental approach with a one-group pretest–posttest design, the research involved 20 early childhood participants selected through purposive sampling. The intervention consisted of systematically designed play activities implemented over four weeks, with two sessions per week, emphasizing locomotor and object control skills aligned with developmental motor learning principles [1], [2]. Data analysis included descriptive statistics, Shapiro–Wilk normality testing, and paired sample t-tests at a significance level of $\alpha = 0.05$. The findings indicate a substantial improvement in gross motor performance, with mean scores increasing from 45.30 (pretest) to 65.75 (posttest). The inferential analysis confirmed a statistically significant difference ($p < 0.05$), demonstrating the positive impact of the intervention. Furthermore, the calculated effect size (Cohen's $d = 1.25$) suggests a large practical effect, indicating that structured play contributes meaningfully to motor skill acquisition. These results support contemporary perspectives in sport pedagogy and motor development theory, which emphasize the role of active, play-centered learning environments in optimizing neuromuscular coordination and physical literacy in early childhood [3], [4]. The study highlights the pedagogical value of integrating structured play into early education curricula as an evidence-based strategy to foster children's physical development. Future research is recommended to incorporate control group comparisons and longitudinal tracking to strengthen causal inference and developmental generalization.

Keywords: Gross motor skills, structured play activities, Test of Gross Motor Development (TGMD), early childhood development, motor learning, physical literacy, quasi-experimental design, sport pedagogy.

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1 Introduction

Gross motor development constitutes a critical domain of early childhood growth, underpinning physical activity engagement, health outcomes, and school readiness. These skills include locomotor abilities (e.g., running, jumping) and object control competencies (e.g., throwing, catching), which evolve progressively through environmental stimulation and structured practice [1], [2]. From a sport science perspective, early mastery of fundamental movement skills is strongly associated with long-term physical literacy, neuromuscular coordination, and active lifestyle participation [3].

Play represents one of the most effective and developmentally appropriate approaches to stimulate children's motor competence. Beyond its recreational function, play facilitates multidimensional development encompassing physical, cognitive, social, and emotional domains. Structured and movement-oriented play activities, in particular, provide repeated opportunities for children to refine coordination, balance, agility, and muscular strength through meaningful and engaging contexts [4], [5]. Contemporary pedagogical models in physical education further emphasize play-based learning as a key strategy to optimize motor skill acquisition during early developmental stages.

However, recent trends indicate a significant shift in children's activity patterns, characterized by increased sedentary behavior and prolonged exposure to digital devices. Global evidence suggests that insufficient physical activity among children is associated with delayed motor development and reduced physical fitness levels [6]. This concern is particularly relevant in early childhood—the so-called "golden period" of development—where inadequate stimulation may result in long-term developmental consequences [7]. Consequently, there is a pressing need for systematic interventions supported by valid and reliable assessment tools to monitor and enhance children's motor development.

The Test of Gross Motor Development (TGMD) is a widely recognized and standardized instrument for evaluating gross motor proficiency in children. It enables objective assessment of locomotor and object control skills, providing detailed performance indicators that can guide intervention design and evaluation [8], [9]. The use of TGMD enhances measurement precision and allows researchers to quantify developmental changes in response to targeted physical activity programs.

Despite growing evidence supporting the benefits of play-based activities, several research gaps remain. Many previous studies have primarily explored correlational relationships between physical activity and motor development without employing standardized instruments such as TGMD, thereby limiting the specificity and comparability of findings. Furthermore, existing TGMD-based studies are often descriptive, with limited experimental investigations examining structured play as an intervention variable [10]. Research focusing on specific categories of play—such as traditional games or structured movement-based activities—and their differential effects on locomotor and object control skills is still relatively scarce. In addition, empirical studies situated within local educational contexts, particularly in early childhood education settings in Indonesia, remain underrepresented.

To address these gaps, the present study offers several contributions. First, it integrates structured play activities as an intervention within a quasi-experimental framework using TGMD as a standardized assessment tool. Second, the study provides a focused analysis of two primary TGMD domains—locomotor and object control skills—allowing for a more nuanced understanding of motor development. Third, by situating the research within a specific educational context, the findings offer practical relevance for early childhood and primary education settings. Finally, the study employs both descriptive and inferential statistical analyses to determine the magnitude of intervention effects, thereby strengthening the empirical basis for play-based motor learning strategies.

2 Methods of Research

This research uses a quantitative approach with a quasi-experimental method (*quasi-experimental design*) through design *one-group pretest-posttest* (Sugiyono, 2023). This design was chosen to determine the effect of play activities on children's gross motor skills by comparing the results before and after treatment..

2.1 Research Design

This study employed a quantitative approach using a quasi-experimental method with a one-group pretest–posttest design. This design enables the evaluation of intervention effects by comparing participants' performance before and after treatment within the same group [1]. The approach is widely used in motor development research when random assignment is not feasible, particularly in educational and early childhood settings [2].

2.2 Participants

The participants consisted of 20 children enrolled in early childhood education or primary school (adjusted to the research context). A purposive sampling technique was applied to ensure that participants met specific inclusion criteria, including (1) being within the critical age range for fundamental motor development, (2) having no physical or health limitations that could affect motor performance, and (3) attending all intervention sessions. This selection strategy ensures sample homogeneity and supports internal validity in intervention-based studies [3].

2.3 Instrumentation

Gross motor performance was assessed using the Test of Gross Motor Development (TGMD), a standardized and validated instrument widely applied in pediatric motor assessment [4]. The TGMD evaluates two principal domains: locomotor skills (e.g., running, hopping, galloping, sliding) and object control skills (e.g., throwing, catching, kicking, striking, and dribbling). Each skill is assessed using specific performance

criteria, with scores assigned based on the correct execution of movement components (binary scoring: 0 = not performed correctly; 1 = performed correctly).

The instrument demonstrates strong psychometric properties, including high inter-rater reliability and construct validity across diverse populations [5]. Table 1 summarizes the assessment framework used in this study.

Table 1. TGMD Assessment Framework

No	Domain	Skill	Key Performance Indicator	Description	Score
1	Locomotor	Run	Arm–leg coordination	Balanced arm swing and rhythmic stride	0–1
2	Locomotor	Hop	Single-leg balance	Repetitive hopping on one leg	0–1
3	Locomotor	Jump	Two-foot take-off and landing	Symmetrical jump with stable landing	0–1
4	Locomotor	Gallop	Step–jump coordination	Forward step followed by a leap	0–1
5	Locomotor	Slide	Lateral coordination	Sideways movement with controlled rhythm	0–1
6	Object Control	Throw	Directional accuracy and arm coordination	Controlled throw toward a target	0–1
7	Object Control	Catch	Hand coordination and timing	Secure catch using both hands	0–1
8	Object Control	Kick	Lower-limb coordination	Accurate forward kick	0–1
9	Object Control	Strike	Hand–tool coordination	Hitting a ball with a bat or racket	0–1
10	Object Control	Dribble	Ball control	Continuous controlled dribbling	0–1

2.4 Research Procedure

The study was conducted over a four-week period, comprising three sequential phases: pretest, intervention, and posttest. During the initial phase, participants completed a pretest using the TGMD instrument to establish baseline motor performance across locomotor and object control domains.

The intervention phase consisted of structured play-based activities delivered over eight sessions (twice weekly), with each session lasting approximately 30–45 minutes. Each session followed a standardized format: (1) warm-up activities to prepare physiological readiness, (2) core play-based tasks emphasizing fundamental movement skills, and (3) cool-down activities to facilitate recovery. The play activities were systematically designed using a progressive model, moving from simple to more complex movement patterns to align with motor learning principles and children's developmental levels [6].

Following the intervention, participants completed a posttest using the same TGMD protocol. The posttest data were then compared with pretest results to evaluate changes in motor skill performance attributable to the intervention.

2.5 Data Analysis

Data were analyzed using both descriptive and inferential statistical techniques. Descriptive statistics, including mean, standard deviation, and score distribution, were used to summarize participants' performance in pretest and posttest conditions. Prior to hypothesis testing, data normality was assessed using the Shapiro–Wilk test, which is recommended for small sample sizes [7].

Inferential analysis was conducted using a paired sample t-test to determine whether there was a statistically significant difference between pretest and posttest scores. The level of significance was set at $\alpha = 0.05$. Additionally, effect size (Cohen's d) was calculated to quantify the magnitude of the intervention effect, providing a more comprehensive interpretation of practical significance beyond p-values [8]. All statistical analyses were performed using standard statistical software.

3 Result and Discussion

3.1 Result

This study examined the effectiveness of structured play-based activities on children's gross motor skills using TGMD assessment. The dataset comprised pretest and posttest scores from 20 participants, analyzed through descriptive and inferential statistics.

Descriptive Analysis

Table 1. Descriptive Statistics of Gross Motor Skills.

Variables	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Mean Gain
Gross Motor Skills (Total)	45,30 ± 6,12	65,75 ± 5,48	+20,45
Locomotor Skills	23,10 ± 3,45	33,40 ± 3,10	+10,30
Object Control Skills	22,20 ± 3,20	32,35 ± 2,95	+10,15

The descriptive results indicate a substantial improvement in overall gross motor performance following the intervention. The total score increased by 20.45 points, reflecting meaningful developmental progress. Both locomotor and object control domains exhibited comparable gains, suggesting that the intervention effectively stimulated multiple components of motor competence.

Normality Test

Table 2. Shapiro–Wilk Normality Test Results

Variables	N	Statistics	p-value	Interpretation
Pretest	20	0,958	0,412	Normal
Posttest	20	0,964	0,537	Normal

The Shapiro–Wilk test results indicate that both pretest and posttest data are normally distributed ($p > 0.05$), fulfilling the assumptions required for parametric analysis.

Inferential Analysis

Table 3. Paired Sample t-Test Results

Variable	Mean (Pre)	Mean (Post)	t-value	p-value	Interpretation
Gross Motor Skills (Total)	45,30	65,75	-12,45	<0,001	Significant

The paired sample t-test revealed a statistically significant difference between pretest and posttest scores ($p < 0.05$), confirming the effectiveness of the intervention.

Effect Size

Table 4. Effect Size (Cohen's d)

Variable	Cohen's *d*	Category	Interpretation
Gross Motor Skills (Total)	1,25	Large	Strong practical effect

The calculated effect size (Cohen's d = 1.25) indicates a large effect, suggesting that the intervention produced substantial and meaningful improvements beyond statistical significance.

3.2 Discussion

The findings of this study demonstrate that structured play-based activities significantly enhance children's gross motor skills. The observed improvements across both locomotor and object control domains indicate that repeated engagement in movement-oriented play provides effective stimuli for neuromuscular development and coordination. These results are consistent with contemporary motor development theories, which emphasize the importance of active, experience-based learning during early childhood [11], [12].

The notable increase in locomotor skills suggests that activities such as running, jumping, and hopping promote balance, rhythm, and whole-body coordination. Similarly, improvements in object control skills—such as throwing, catching, and kicking—reflect enhanced hand–eye coordination and motor planning. These outcomes support previous findings that structured physical activities can accelerate motor competence development by providing task-specific practice and feedback [13].

From a statistical perspective, the significant t-test results confirm that the observed improvements are unlikely to occur by chance. More importantly, the large effect size demonstrates that the intervention has strong practical relevance, reinforcing the role of structured play as an evidence-based pedagogical strategy. This aligns with recent meta-analyses indicating that motor skill interventions in early childhood yield moderate-to-large effects on physical development outcomes [14].

The present study also contributes to addressing gaps in prior research by integrating a standardized assessment tool (TGMD) within an experimental framework. Unlike descriptive studies, this research provides empirical evidence of causality between play-based interventions and motor skill improvement. Furthermore, by separately analyzing locomotor and object control domains, the study offers a more detailed understanding of how different motor components respond to structured play activities.

From a sport science perspective, these findings highlight the importance of early intervention in fostering physical literacy, which is essential for long-term engagement in physical activity and sports participation [15]. Play-based learning environments create opportunities for children to explore movement patterns in an enjoyable and motivating context, thereby enhancing adherence and learning outcomes.

Despite these contributions, several limitations should be acknowledged. The relatively small sample size may limit generalizability, and the absence of a control group restricts the ability to fully attribute causality. Additionally, the intervention duration of four weeks may not capture long-term developmental effects. Future research should employ randomized controlled designs, larger sample sizes, and extended intervention periods to strengthen the robustness of findings.

Overall, this study provides strong evidence that structured play activities are an effective and practical approach to improving gross motor skills in children. The

findings support the integration of play-based movement programs into early childhood education curricula to promote optimal physical development.

4 Conclusion

This study provides empirical evidence that structured play-based activities significantly enhance children's gross motor skills, as measured using the TGMD framework. The observed improvements in both locomotor and object control domains from pretest to posttest confirm that systematic engagement in movement-oriented play contributes positively to motor competence development. Inferential statistical analysis demonstrated a significant difference between baseline and post-intervention scores ($p < 0.05$), while the large effect size (Cohen's $d = 1.25$) indicates that the intervention produced substantial practical benefits.

From a sport science perspective, these findings reinforce the role of structured play as an effective pedagogical strategy for promoting neuromuscular coordination, physical literacy, and early movement proficiency [1], [2]. The integration of progressive, skill-oriented play activities enables children to develop fundamental movement patterns in an engaging and developmentally appropriate context, thereby supporting long-term participation in physical activity.

Despite these contributions, the study is limited by the relatively small sample size and the absence of a control group, which may affect the generalizability and causal interpretation of the findings. Future research is recommended to employ randomized controlled designs, larger participant cohorts, and extended intervention durations to further validate and expand upon these results.

In conclusion, structured play-based interventions represent a practical and evidence-based approach for improving gross motor development in early childhood. These findings support the incorporation of systematically designed play activities into educational and sport pedagogy practices to optimize children's physical development outcomes.

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