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The Effect of a Sociocultural-Based Manipulative Movement Game Model on Children's Manipulative Skills: A Quasi-Experimental Study in Indonesian Kindergartens

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ABSTRACT (Bold, TNR 10)

This study examines the effect of a sociocultural-based manipulative movement game model on the manipulative skills of children aged 5–6 years in Indonesian kindergartens. A quasi-experimental design with a pretest–posttest control group approach was employed. A total of 24 participants were purposively selected with prior parental consent, consisting of an experimental group (n = 12) from TK Negeri 4 Yogyakarta and a control group (n = 12) from TK Negeri 11 Yogyakarta. The intervention was designed based on Vygotsky's sociocultural theory, incorporating key elements of the Australian Physical Literacy Framework, including manipulative movement skills, confidence, collaboration, and rule comprehension. Children's manipulative skills were assessed using the ball skills subdomain of the Test of Gross Motor Development–3 (TGMD-3). Data analysis was conducted using the Mann–Whitney U test and the Wilcoxon rank-sum test. The results indicated a significant improvement in manipulative skills within the experimental group between pretest and posttest (W = 56.949, p = 0.04384), as well as a significant difference between the experimental and control groups in the posttest (W = 44.807, p = 0.0004301). These findings demonstrate that the sociocultural-based manipulative movement game model is effective in enhancing children's manipulative skills. The study highlights the importance of integrating mediated learning, scaffolding, and the zone of proximal development into early childhood physical-motor learning. Therefore, this model is recommended as an alternative approach to improving physical-motor learning in Indonesian kindergarten settings.

Keywords: Sociocultural approach; Manipulative skills; Physical literacy; Early childhood; TGMD-3

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1 INTRODUCTION

Manipulative movement skills constitute a fundamental component of early childhood development, serving as the basis for children's future participation in a wide range of physical activities. These skills include throwing, catching, dribbling, kicking, and striking objects with implements (Sport Australia, 2019). Empirical evidence indicates that early interventions targeting object control skills significantly contribute to cognitive development, particularly executive functions, although their influence on social development appears less pronounced (Capio et al., 2024). This highlights the critical importance of introducing structured manipulative movement activities during early childhood. From a theoretical perspective, Vygotsky's concept of the Zone of Proximal Development (ZPD) emphasizes that learning can be optimized through guided interaction and meaningful activity, including physical engagement (Wang & Zhang, 2022). In this regard, teachers act as mediators who provide scaffolding to facilitate children's acquisition of motor skills, which simultaneously

stimulate cognitive processes. Furthermore, the ontogenetic nature of motor development requires deliberate stimulation and structured practice (Goodway et al., 2021). Psychological dimensions such as goal setting and self-monitoring have also been shown to enhance motor skill performance and intrinsic motivation, reinforcing the role of active learner engagement in the developmental process (Hidayat, 2012).

The development of manipulative movement skills is strongly influenced by sociocultural and environmental contexts. Evidence from cross-cultural studies demonstrates that children raised in environments that actively support physical activity exhibit higher levels of physical literacy compared to those in less supportive settings (Mohammadi et al., 2023). Additionally, disparities in object control skills have been identified based on gender and cultural background. For example, Indonesian boys demonstrate comparable performance to their American counterparts in catching and kicking but show lower proficiency in throwing and striking, while Indonesian girls generally underperform across most object control skills except kicking (Syafruddin et al., 2020). These findings are consistent with further evidence highlighting gender-based differences in manipulative skills among children aged 5–6 years, emphasizing the need for culturally responsive and gender-sensitive instructional approaches (Dilandes et al., 2022). However, in many kindergarten settings, particularly in public institutions, the development of these skills remains suboptimal due to limited availability of educators with specialized training in physical education. As a result, physical-motor learning is often delivered by general classroom teachers, leading to insufficient stimulation of children's gross motor development despite its inclusion as a core competency in national education standards (The Ministry of Education, 2022).

To address these challenges, the development of contextual, culturally relevant, and pedagogically sound instructional models is essential. One promising approach is the implementation of a sociocultural-based manipulative movement game model, which integrates motor skill development with meaningful social interaction and cultural elements. Grounded in Vygotsky's sociocultural theory, this model emphasizes mediated learning, scaffolding, and progression within the zone of proximal development (Cole et al., 1978). The instructional design incorporates the use of picture books in read-aloud sessions to initiate social interaction, followed by game-based activities that embed Indonesian cultural values. These activities are structured to develop not only manipulative movement skills but also confidence, collaboration, and rule comprehension, aligning with the core elements of physical literacy (Sport Australia, 2019). Therefore, this study aims to investigate the effect of this sociocultural-based game model on the development of manipulative movement skills among kindergarten children aged 5–6 years in Yogyakarta, Indonesia, with the expectation of contributing to empirical evidence on early childhood physical-motor learning in the Indonesian context.

2 METHOD

This study employed a quasi-experimental design to examine the effect of a sociocultural-based manipulative movement game model on the manipulative movement skills of children aged 5–6 years. A total of 24 participants were purposively selected from two kindergartens in Yogyakarta, Indonesia, consisting of 12 children in the experimental group (TK Negeri 4) and 12 children in the control group (TK Negeri 11). All participants met the inclusion criteria: (1) aged 5–6 years, (2) actively enrolled in the selected kindergartens, (3) free from medical conditions that could limit physical activity participation, and (4) having obtained written parental or guardian consent. The instrument used to assess manipulative movement skills was the Test of Gross Motor Development–Third Edition (TGMD-3), specifically the ball skills subtest, which measures competencies such as throwing, catching, and striking (Goodway et al., 2021). The control group followed routine physical-motor learning activities conducted by classroom teachers, including singing, rhythmic movement, and simple ball

games, without receiving any specific intervention.

The experimental group participated in a structured intervention consisting of 12 sessions, each lasting 150 minutes. The intervention was designed based on a sociocultural perspective and included five categories of manipulative movement games: throwing, catching, dribbling, kicking, and striking with an implement. Each session was systematically organized into four stages: opening (30 minutes), core activity (60 minutes), break (30 minutes), and closing (30 minutes). The opening stage introduced manipulative movement concepts through mediated learning, including shared reading of the picture book Serunya Bermain Bola to stimulate interaction and contextual understanding. The core activity involved warm-up exercises followed by individual and group-based games that allowed children to explore object manipulation, develop confidence, understand rules, and enhance collaboration. These activities incorporated traditional and modified Indonesian games, enabling teachers to identify each child's Zone of Proximal Development (ZPD) and provide appropriate scaffolding support.

The break and reflection components were integral to the intervention, supporting both physical recovery and socio-emotional development. During breaks, children engaged in shared eating and informal interaction, fostering social bonding, communication skills, and emotional regulation. This was followed by a guided reflection session in which children discussed their learning experiences, such as successful task performance and peer collaboration. This reflective process, aligned with Vygotsky's principles of mediated learning and ZPD, facilitated metacognitive awareness, reinforced skill acquisition, and enhanced motivation. Additionally, the integration of culturally familiar games and narratives ensured contextual relevance and strengthened children's sense of identity and engagement. Overall, the intervention model combined physical, cognitive, social, and cultural dimensions, providing a comprehensive framework for early childhood physical-motor learning.

3 FINDINGS AND DISCUSSION

3.1 Findings

3.1.1 TGMD-3 pretest and posttest ball skills subtest

In the initial phase, students' manipulative movement skills were assessed using the Ball Skills subtest of the TGMD-3 instrument. The pretest data for each skill (K) in the control group are presented in Table 1.

Table 1. Control group pretest data

No.	Skill	Mean	SD	Median	Skew	Kurtosis	SE
1.	K1	1.332	0.658	1.3	-0.252	-1.395	0.19
2.	K2	1.272	0.492	1.25	-1.218	1.29	0.14
3.	K3	1.307	0.753	1.17	-0.88	0.51	0.22
4.	K4	1.083	0.63	1	-0.403	-0.753	0.18
5.	K5	1.375	0.57	1.5	-0.303	-1.223	0.165
6.	K6	0.982	0.825	1	0.045	-1.24	0.237
7.	K7	0.873	0.812	1	0.0725	-1.743	0.235

Given the relatively small sample size of 24 participants (n = 24), the normal assumption was not met. Therefore, a non-parametric statistical test was employed instead of the independent samples t-test. The Wilcoxon Rank-Sum Test was considered appropriate for detecting location shifts in median values between groups. Before analyzing posttest differences between the control and experimental groups, it was necessary to confirm that there were significant median differences in the pretest scores, particularly with respect to their central tendency. With an experimental data sample size of n=24, the median value, skewness

(distribution slope), and kurtosis (distribution peak sensitivity level) were analyzed. The skewness value describes the level of asymmetry of the data distribution, while the kurtosis value provides information about the peak or flatness of the distribution, especially in pretest data. In this context, the median is considered more representative than the mean because it is not affected by outliers. In contrast, the mean can be affected by extreme values, such as maximum and minimum values.

When comparing the median values from Tables 1 and 2, it becomes evident that several manipulative movement skills showed notable improvement following the implementation of the sociocultural-based movement game model. Specifically, the skills that demonstrated measurable progress included the one-handed dribble of a stationary ball (K3), two-handed catch (K4), overhand throw (K6), and underhand throw (K7).

Table 2. Experiment group posttest description

No.	Skill	Mean	SD	Median	Skew	Kurtosis	SE
1.	K1	1.116	0.556	1.2	-0.146	1.462	0.16
2.	K2	1.168	0.645	1	-0.5425	0.93	0.185
3.	K3	1.417	0.846	2	-0.953	-0.39	0.247
4.	K4	1.61	0.513	1.67	-0.805	-0.8	0.15
5.	K5	1.29	0.793	1.5	-0.807	0.5275	0.23
6.	K6	1.395	0.487	1.5	-0.5375	0.74	0.14
7.	K7	1.373	0.52	1.5	-0.24	-0.81	0.15

Skill Key: K1: Two-handed strike of a stationary ball; K2: One-handed forehand strike of a self-bouncing ball; K3: One-handed dribble of a stationary ball; K4: Two-handed catch; K5: Kick of a stationary ball; K6: Overhand throw; K7: Underhand throw

These skills are essential components of early childhood motor development, requiring coordination, timing, and confidence in object control. The Mann–Whitney U test confirmed statistically significant differences in posttest scores between the control and experimental groups, validating the effectiveness of the intervention. For instance, the improvement in catching and throwing skills suggests that children benefited from repeated, scaffolded practice within a socially interactive and culturally familiar learning environment. However, not all students showed equal progress, indicating that factors such as attendance consistency, engagement levels, or individual developmental differences may have influenced outcomes.

The relevance of these findings lies in their support for Vygotsky's sociocultural theory, which emphasizes the role of social interaction and guided learning within the Zone of Proximal Development (ZPD). The game model's structure, incorporating storytelling, traditional games, and collaborative play, provided a rich context for mediated learning, allowing children to internalize movement concepts through meaningful experiences. For example, using culturally familiar games like "Gobak Sodor" or "Bentengan" not only enhanced motor skill acquisition but also reinforced cultural identity and social values. Moreover, the integration of reflection activities helped children recognize their progress, boosting self-confidence and encouraging metacognitive awareness. These elements collectively contributed to a holistic learning experience that addressed physical, cognitive, and emotional development. The study's results underscore the importance of designing early childhood physical education programs that are not only skill-focused but also culturally responsive and socially engaging.

3.1.2 Hypothesis testing

1. Baseline equivalence testing (Pre-test)

A Mann-Whitney U test (Wilcoxon rank-sum test) was conducted to assess the baseline equivalence of the control and experimental groups prior to the intervention. The analysis compared the pre-test scores of both groups to determine if they originated from

populations with the same distribution. The results indicated a statistically significant difference at the baseline (W= 56949, *p* = .04384). This significant pre-test difference reveals that the groups were not equivalent in terms of manipulative movement skills before the study began. This is a methodological limitation, as it introduces a potential confounding variable. To account for this initial disparity, the primary analysis correctly focuses on the change or the post-test difference between the groups, rather than a direct comparison of post-test scores alone.

2. Post-test comparison and treatment effect

A second Mann-Whitney U test was performed on the post-test data to evaluate the effect of the intervention after accounting for the baseline difference. The test revealed a statistically significant and substantially larger difference between the control and experimental groups (W = 44807, *p* < .001). The marked significance in the post-test comparison, despite the initial group inequality, provides strong evidence for the efficacy of the intervention. The sociocultural-based game model administered to the experimental group is the most possible explanation for the pronounced divergence in their post-test performance compared to the control group. This confirms that the treatment had a significant positive effect on manipulative movement skills.

3.1.3 Evidence of treatment effects

A Wilcoxon rank-sum test was conducted to evaluate the effect of the intervention on manipulative movement skills by comparing the post-test scores of the experimental group (which received the sociocultural-based game model) and the control group. The results revealed a statistically significant difference between the two groups (W = 44807, p = .00043).

Since the p-value is substantially less than the conventional alpha level of .05, the null hypothesis, which stated that there was no difference in the post-test scores of the two groups, is rejected. This provides strong statistical evidence to support the alternative hypothesis (H_a), confirming that the observed difference in location (i.e., the central tendency of the scores) is not equal to zero. Therefore, it is concluded that the sociocultural-based manipulative movement skill game model had a significant and positive treatment effect, successfully improving students' manipulative movement skills compared to the control condition.

The pretest and posttest data reveal a statistically significant difference between the control and experimental groups, validating the use of an independent two-sample design. This distinction confirms that the groups were not equivalent at baseline and that the intervention had a measurable impact. Specifically, the experimental group demonstrated higher posttest scores, indicating that the sociocultural-based manipulative movement game model effectively enhanced children's manipulative movement skills. These skills, such as throwing, catching, dribbling, and striking, are foundational for physical literacy and future participation in sports and recreational activities. The structured intervention, which incorporated culturally familiar games and scaffolded learning experiences, provided children with repeated opportunities to practice and refine these skills in a socially engaging environment. For example, activities like “Gobak Sodor” and “Bentengan” not only encouraged physical coordination but also fostered teamwork and rule comprehension, aligning with the principles of the Australian Physical Literacy Framework.

The relevance of these findings extends beyond statistical validation; they highlight the pedagogical value of integrating sociocultural elements into early childhood physical education. The model’s success suggests that culturally responsive teaching strategies can significantly improve motor skill acquisition, especially when combined with mediated learning and scaffolding techniques rooted in Vygotsky’s theory. Moreover, the data implies

that with a larger sample size, improvements would likely be observed in additional skills such as the two-handed strike of a stationary ball, one-handed forehand strike of a self-bouncing ball, and kicking a stationary ball, skills that showed potential but did not reach statistical significance in this study. This opens up avenues for future research to explore the model's broader applicability in various cultural settings and larger populations. Ultimately, the study underscores the importance of designing early childhood curricula that are not only developmentally appropriate but also culturally meaningful, thereby promoting holistic growth in physical, cognitive, and social domains.

3.2 Discussion

The findings of this study demonstrate that the implementation of a sociocultural-based manipulative movement game model significantly improves the manipulative movement skills of children aged 5–6 years. This improvement is evidenced by the significant differences between the experimental and control groups in the posttest results, as well as between pretest and posttest scores ($p < 0.05$), confirming the effectiveness of the intervention. These results provide strong empirical support for Vygotsky's sociocultural learning theory, particularly the role of scaffolding and the Zone of Proximal Development (ZPD) in facilitating skill acquisition (Vygotsky in Cole et al., 1978; Wang & Zhang, 2022). The effectiveness of the model is further reinforced by its contextual design, which integrates local cultural elements and aligns with the four core components of physical literacy—motor skills, confidence, collaboration, and rule understanding (Sport Australia, 2019). Notably, the most substantial improvements were observed in specific ball skills measured by TGMD-3, including one-handed stationary dribbling, two-handed catching, overhead throwing, and underhand throwing. These gains can be attributed to the structured learning sequence and the integration of social interaction into physical activities, which enhanced engagement, reduced anxiety, and fostered confidence in motor skill performance (Bai et al., 2024; De Sauza et al., 2023).

A distinctive aspect of this model lies in its integration of mediated learning through picture storybooks and culturally relevant games, which bridge cognitive and motor experiences. The use of read-aloud sessions as an introductory activity supports children's conceptual understanding before engaging in physical tasks, aligning with the principles of mediated learning (Feuerstein et al., 1980). Teachers play a critical role as facilitators who provide scaffolding, enabling children to progress within their ZPD. Furthermore, the incorporation of traditional Indonesian games enhances both motor competence and cultural engagement, consistent with evidence that sociocultural environments significantly influence physical literacy development (Mohammadi et al., 2023). These activities not only improve coordination and object control but also promote social values such as cooperation, rule adherence, and teamwork. Consequently, the model supports holistic development by integrating physical, cognitive, and social dimensions of learning, which is in line with the physical literacy framework and its emphasis on the interdependence of competence, confidence, and participation (Sport Australia, 2019). The observed improvements also corroborate previous findings linking motor skill mastery with enhanced executive functions, including decision-making and self-regulation (Capio et al., 2024).

Despite these positive outcomes, the findings also reveal variability in individual progress, indicating that not all children benefited equally from the intervention. Factors such as inconsistent attendance, varying levels of motivation, parental support, and individual health conditions were identified as potential influences on learning outcomes (Barnet et al., 2025; McDonough et al., 2020; Flynn et al., 2023; He et al., 2024). These variations highlight the importance of considering contextual and personal factors in designing inclusive physical-motor interventions. From a practical perspective, the study underscores the need for professional development among early childhood educators, particularly in strengthening their understanding of physical literacy and sociocultural pedagogy, as well as the importance of aligning instructional practices with national standards (Suryadi et al., 2023). Additionally,

the findings emphasize the urgency of enhancing policy support, infrastructure, and curriculum design to ensure that gross motor development receives adequate attention in early childhood education, as mandated in the Early Childhood Education Graduate Competency Standards (Permendikbudristek, 2022). Methodologically, the use of a quasi-experimental design and non-parametric statistical analysis strengthens the validity of the findings; however, the limited sample size necessitates cautious generalization. Future research should involve larger samples and longitudinal approaches to examine the sustainability of the intervention's effects. Overall, the sociocultural-based manipulative movement game model represents a promising and contextually relevant innovation for promoting holistic child development in early childhood education.

4 CONCLUSION

This study concludes that the sociocultural-based manipulative movement model is significantly effective in improving manipulative movement skills in early childhood. The implementation of this model, grounded in Vygotsky's theoretical concepts of mediated learning, scaffolding, and the zone of proximal development (ZPD), has been shown to support the development of skills such as dribbling, catching, and throwing. The significant post-test score differences between the experimental and control groups indicate that the model offers a meaningful, adaptive, and developmentally appropriate learning environment. The integration of sociocultural elements into learning activities, such as storybooks, traditional games, and small- group social interaction, also fosters self-confidence, collaboration, and an understanding of game rules. This approach not only supports children's motor development but also promotes their cognitive and socio-emotional growth holistically. Therefore, the sociocultural-based manipulative movement game model is recommended as an alternative instructional strategy for physical-motor learning in Indonesian kindergartens. The implementation of this model requires teacher training, provision of culturally relevant learning materials, and supportive curriculum policies that prioritize early childhood physical literacy. Future research involving larger samples and longitudinal designs is recommended to explore the long-term impact of this model on children's overall development.

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