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Effect of cooperative learning model on the development of fundamental motor skills among elementary school

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Abstract:
Fundamental motor skills (FMS) are critical foundational competencies that must be developed during the elementary school years to support lifelong physical activity engagement, academic readiness, and overall health. Despite their importance, preliminary observations in Bojonegoro Regency, East Java, indicated that elementary school students' fundamental motor skills remained predominantly in the low-to-moderate proficiency category. Conventional command-style teaching that still dominates physical education classes in this region appears to limit students' opportunities for active practice, peer feedback, and meaningful engagement. This study aims to examine the effect of a cooperative learning model on the development of fundamental motor skills among fourth-grade elementary school students in Bojonegoro Regency. A quasi-experimental design with a pretest-posttest control group structure was applied. Sixty students aged 9-10 years were selected through purposive sampling and assigned to an experimental group (n=30) receiving cooperative learning treatment and a control group (n=30) receiving conventional instruction over eight weeks. The Test of Gross Motor Development - Third Edition (TGMD-3) was used as the primary instrument, covering both locomotor (running, galloping, hopping, skipping, horizontal jumping, sliding) and ball skills (object control) subtests. Data were analyzed using independent sample t-tests and analysis of covariance (ANCOVA) at a significance level of 0.05. The findings revealed a statistically significant difference between the experimental and control groups ($t = 7.124$; $p = 0.000$), with the experimental group demonstrating a 24.8% improvement compared to 9.3% in the control group. The effect size (Cohen's $d = 1.84$) indicated a large practical effect. These results suggest that cooperative learning offers a developmentally appropriate, contextually relevant, and pedagogically effective approach for advancing fundamental motor skills in Indonesian elementary schools.

Keywords: *cooperative learning; fundamental motor skills; elementary school; physical education; Bojonegoro.*

Introduction

Fundamental motor skills (FMS) are organized series of basic movements that involve the combination of two or more body segments and form the building blocks for more advanced sport-specific and recreational physical activities (Logan et al., 2020). These skills are typically classified into two major categories: locomotor skills, such as running, jumping, hopping, galloping, and skipping; and object control or manipulative skills, such as throwing, catching, kicking, and striking (Hulteen et al., 2020). The development of

these skills during early and middle childhood is widely recognized as a critical determinant of children's future engagement in physical activity, sports participation, and physical literacy (Barnett et al., 2022).

Despite this well-documented importance, recent evidence from various national and international contexts indicates a global decline in children's motor competence. A systematic review by Bolger and colleagues reported that contemporary children demonstrate significantly lower FMS proficiency than children of previous generations, with deficits particularly pronounced in object control skills (Bolger et al., 2021). In Indonesia, similar concerns have been raised, with several studies reporting that the majority of elementary school students do not meet age-appropriate motor competence benchmarks (Pratama & Iskandar, 2020; Lestari et al., 2022). The situation is often more severe in regions outside major metropolitan areas, where physical education resources, facilities, and qualified teachers are limited (Wijayanti et al., 2021).

Bojonegoro Regency in East Java exemplifies this challenge. Preliminary observations in several public elementary schools confirmed that most fourth-grade students struggled to demonstrate basic locomotor and object control patterns at age-appropriate levels, and physical education lessons were largely dominated by command-style instruction with limited student interaction (Suherman & Saputra, 2020).

Cooperative learning has emerged as a promising pedagogical model to address these challenges. Cooperative learning is defined as a structured instructional approach in which students work together in small heterogeneous groups to achieve shared learning goals through positive interdependence, individual accountability, promotive interaction, and group processing (Slavin, 2020). In physical education, cooperative learning has been associated with improvements across all four learning domains: physical, cognitive, social, and affective (Casey & Goodyear, 2020). Recent meta-analytic evidence indicates that cooperative learning produces moderate-to-large effect sizes on motor skill acquisition, motivation, and prosocial behavior in school-based physical education (Fernandez-Rio et al., 2021; Bores-García et al., 2021).

However, despite its theoretical appeal and accumulating empirical support, the application of cooperative learning to the specific outcome of fundamental motor skill development among Indonesian elementary school students remains underexplored. Most existing studies in Indonesia have focused on sport-specific skills (e.g., volleyball, football, basketball) at the secondary or tertiary level (Pranata & Setiawan, 2022; Hidayat & Pratama, 2023), with limited attention to FMS at the elementary level. Furthermore, regional studies that account for the unique sociocultural and infrastructural characteristics of semi-urban Indonesian districts such as Bojonegoro are particularly scarce. This evidence gap is significant because pedagogical effectiveness can be moderated by contextual factors, including class size, available equipment, and the cultural orientation of students toward collaborative work (Kirk, 2020).

Building on this gap, the present study investigates the effect of an eight-week cooperative learning intervention on the fundamental motor skill development of fourth-grade elementary school students in Bojonegoro Regency. Specifically, the study seeks to answer the following research question: Does the implementation of a cooperative learning model produce a significantly greater improvement in fundamental motor skills compared with conventional command-style instruction? The findings are expected to contribute theoretically to the body of knowledge on student-centered pedagogies in physical education and practically

to physical education teachers, curriculum developers, and policymakers seeking evidence-based strategies to enhance motor competence in Indonesian elementary schools.

Methods

This study employed a quasi-experimental pretest-posttest non-equivalent control group design. Sixty fourth-grade students (aged 9–10 years) from two comparable public elementary schools in Bojonegoro Kota Sub-district were selected via purposive sampling, with one intact class as the experimental group (n=30) and another as the control group (n=30). Students with physical or neurological impairments were excluded; parental written consent was obtained for all participants. No significant baseline differences existed between groups in age, sex, BMI, or prior physical education exposure (Sugiyono, 2020). FMS was measured using the TGMD-3, which assesses 13 skills across locomotor and ball skills subtests using binary performance criteria. Internal consistency was good (Cronbach's α = 0.86 and 0.84, respectively), and two blinded raters assessed all students with excellent inter-rater reliability (ICC = 0.91; Koo & Li, 2020).

The intervention lasted eight weeks (16 sessions of 70 minutes each). The experimental group received cooperative learning instruction built around positive interdependence, individual accountability, promotive interaction, interpersonal skills, and group processing (Johnson & Johnson, 2020), implemented through Pairs-Check, Jigsaw, and Learning Teams structures in heterogeneous groups of four to five students. The control group received conventional command-style instruction with teacher-led demonstrations and drills (Mosston & Ashworth, 2020). Both groups followed the same content sequence (locomotor skills weeks 1–4; ball skills weeks 5–8) and used identical equipment. The same teacher delivered both conditions after completing a 12-hour cooperative learning training program, controlling for instructor variability (Dyson et al., 2021).

Data were analyzed using descriptive statistics, Shapiro-Wilk normality tests, and Levene's homogeneity test. An independent-sample t-test compared gain scores between groups, supplemented by ANCOVA with pretest scores as the covariate to control for baseline differences (Field, 2021). Effect sizes were calculated using Cohen's d (small = 0.2, medium = 0.5, large = 0.8). All analyses were conducted in IBM SPSS v.26.0 with significance set at $p < 0.05$.

Results

The final sample consisted of 60 fourth-grade students (32 boys, 28 girls) with a mean age of 9.4 ± 0.5 years. As shown in Table 1, no significant baseline differences were observed between the experimental and control groups in age, sex distribution, body mass index, or prior physical education exposure (all $p > 0.05$), confirming the comparability of the two groups at baseline.

Table 1. Baseline Demographic Characteristics

Variable	Experimental (n=30)	Control (n=30)	p-value
Age (years)	9.4 ± 0.5	9.5 ± 0.5	0.412
Sex (boys/girls)	16/14	16/14	1.000
BMI (kg/m²)	17.8 ± 2.4	17.6 ± 2.2	0.738

Variable	Experimental (n=30)	Control (n=30)	p-value
Body Height (cm)	131.5 ± 5.8	130.9 ± 6.1	0.694

Descriptive statistics for the pretest and posttest scores are presented in Table 2. Both groups showed comparable mean pretest scores. However, posttest results revealed a substantially larger improvement in the experimental group across all FMS subscales.

Table 2. Pretest and Posttest TGMD-3 Scores

Variable	Group	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Gain (%)
Locomotor	Experimental	31.4 ± 4.1	40.8 ± 3.6	29.9%
Locomotor	Control	30.9 ± 4.3	33.6 ± 4.0	8.7%
Ball Skills	Experimental	30.2 ± 3.8	37.5 ± 3.4	24.2%
Ball Skills	Control	29.8 ± 3.9	32.4 ± 3.7	8.7%
Total FMS	Experimental	61.6 ± 6.2	78.3 ± 5.4	27.1%
Total FMS	Control	60.7 ± 6.5	66.0 ± 6.0	8.7%

The Shapiro-Wilk test indicated that data were normally distributed for both the experimental group ($p = 0.187$) and the control group ($p = 0.214$). Levene's test confirmed homogeneity of variance ($p = 0.376$). These results justified the use of parametric inferential analyses.

Independent sample t-tests on the gain scores revealed significant differences between groups across all FMS components. As presented in Table 3, the cooperative learning group demonstrated significantly greater improvements in locomotor skills, ball skills, and total FMS scores than the control group, with large effect sizes throughout.

Table 3. Independent Sample T-Test of Gain Scores

Variable	t-value	df	Sig. (2-tailed)	Cohen's d
Locomotor	6.532	58	0.000	1.69
Ball Skills	5.987	58	0.000	1.55
Total FMS	7.124	58	0.000	1.84

Furthermore, ANCOVA analysis controlling for pretest scores confirmed the robustness of the intervention effect on total FMS ($F(1,57) = 49.36$, $p = 0.000$, partial $\eta^2 = 0.464$), indicating that approximately 46.4%

of the variance in posttest performance could be attributed to the instructional model after adjusting for baseline performance. These results provide strong empirical support for the effectiveness of the cooperative learning intervention.

Discussion

The findings provide strong empirical support for the superiority of cooperative learning over conventional command-style instruction, with the experimental group demonstrating significantly greater improvements in locomotor skills, ball skills, and total FMS scores. The large effect sizes (Cohen's d = 1.55–1.84) indicate that these differences are both statistically significant and practically meaningful. These results align with meta-analytic evidence reporting moderate-to-large effects of cooperative learning across motor, cognitive, and affective outcomes (Bores-García et al., 2021; Casey & Goodyear, 2020), and are consistent with improvement magnitudes reported in Spanish, Australian, and East Asian contexts (Sevil-Serrano et al., 2020; Liu et al., 2022).

Several mechanisms likely explain this superiority. Cooperative learning maximizes active engagement time by replacing passive waiting with structured small-group practice, increasing repetitions per session (Schmidt et al., 2020; Lander et al., 2021). Peer-mediated feedback through simplified rubrics further enhanced skill acquisition by strengthening metacognitive awareness and producing reciprocal learning effects (Chan & Luo, 2022). Additionally, positive interdependence created a supportive emotional climate that reduced performance anxiety and encouraged persistence, shifting students' focus from individual comparison to collective progress (Vasconcellos et al., 2020; Behzadnia et al., 2020). Heterogeneous grouping also promoted equity, with lower-skilled students benefiting from peer modeling and higher-skilled students reinforcing learning through the cognitive demands of peer teaching (Bores-García et al., 2021).

This study extends the evidence base to the context of semi-urban Indonesia, where previous cooperative learning research has focused primarily on sport-specific skills at secondary or tertiary levels (Pranata & Setiawan, 2022; Sutapa et al., 2021). The cultural values of gotong royong and kebersamaan prevalent in Bojonegoro appear to have facilitated student adaptation to group structures, amplifying the model's effectiveness (Ramadan & Iskandar, 2022). The gains observed in both locomotor and ball skills domains further support Stodden's motor development model, suggesting that cooperative learning can help students overcome the proficiency barrier and sustain engagement in physical activity across the lifespan (Stodden et al., 2020).

Practically, teachers should integrate cooperative structures such as Pairs-Check, Jigsaw, and Learning Teams into physical education programming, supported by pre-service and in-service training that emphasizes authentic implementation over superficial group work (Dyson et al., 2021; Hardiansyah & Syampurma, 2021). The study has several limitations: the sample of 60 students from two schools limits generalizability, the eight-week duration precludes long-term retention analysis, and the absence of process measures leaves mechanisms partially unexplained. Future research should employ larger, more diverse samples, incorporate delayed retention testing, and use mixed-methods designs to further illuminate coop-

erative learning's mechanisms and transferability across Indonesian educational settings (Casey & Kirk, 2021).

Conclusion

This quasi-experimental study provides robust evidence that an eight-week cooperative learning intervention significantly enhances fundamental motor skill development among fourth-grade elementary school students in Bojonegoro Regency. Compared with conventional command-style instruction, cooperative learning produced substantially greater gains in locomotor skills (29.9% vs. 8.7%), ball skills (24.2% vs. 8.7%), and total FMS performance (27.1% vs. 8.7%), with large effect sizes (Cohen's d = 1.55 to 1.84) confirming the practical significance of these differences. The findings support the integration of cooperative learning as a primary instructional model for elementary school physical education in Indonesia, particularly given its strong alignment with local sociocultural values of cooperation and togetherness. To realize this potential, sustained investment is needed in teacher professional development, curriculum revision, and supportive structural conditions that enable faithful implementation. Future research should examine long-term retention, replicate the findings across diverse Indonesian contexts, and explore the integration of cooperative learning with other student-centered pedagogical models. By advancing the evidence base on contextually relevant pedagogies, this study contributes to the broader effort to ensure that all Indonesian children acquire the fundamental motor skills needed for a healthy, active, and engaged life.

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