Multidisciplinary Journal of Tourism, Hospitality, Sport and Physical Education
Vol. 3, No. 1, June 2026, pp. 72~85
ISSN: 3062-9551, DOI: 10.37251/jthpe.v3i1.3300

Traditional Sports for Enhancing Elementary Students' Physical Fitness: A Quasi-Experimental Study

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Article Info

Article history:

Received Feb 22, 2026
Revised Apr 14, 2026
Accepted Jun 15, 2026
OnlineFirst Jun 20, 2026

Keywords:

Elementary School
Physical Education
Physical Fitness
Quasi-Experimental
Traditional Sports

ABSTRACT

Purpose of the study: This study aimed to examine the effectiveness of traditional Indonesian sports activities as an alternative approach to improving the physical fitness of elementary school students compared to conventional Senam Kesegaran Jasmani (SKJ) exercises in primary school physical education settings.

Methodology: This study used a Pretest–Posttest Non-Equivalent Control Group quasi-experimental design (February–March 2025) involving 43 students (22 experimental, 21 control) from State Elementary School 1 Watugede, Kemusu, Boyolali. The Indonesian Physical Fitness Test (ages 6–9) and structured observations across 18 sessions were applied. Data were analyzed using Analysis of Covariance with pretest scores as covariate.

Main Findings: The experimental group receiving traditional sports activities demonstrated higher physical fitness achievement than the control group following the standard SKJ program. Learning completion reached 63.64% in the experimental group and 52.38% in the control group. Psychomotor performance, student activeness, and discipline scores were also higher, with an effectiveness coefficient of 0.98, Cohen's d = 0.57 (medium effect), and partial eta-squared = 0.121, collectively confirming a statistically and practically significant improvement.

Novelty/Originality of this study: This study introduces traditional Indonesian sports as a culturally grounded and play-based alternative to conventional school gymnastics programs for improving children's physical fitness. The integration of traditional games into structured physical education contributes new practical insights for enhancing student engagement, discipline, and psychomotor development in Indonesian primary education contexts.

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1. INTRODUCTION

Physical fitness remains one of the most critical determinants of health and well-being throughout the human lifespan [1]-[3]. For school-aged children, adequate levels of physical fitness are not merely desirable; they represent an essential prerequisite for effective learning, social development, and long-term disease prevention [4]-[6]. The World Health Organization recommends that children aged 5–17 years engage in at least 60 minutes of moderate-to-vigorous physical activity daily, a target that a substantial proportion of children in developing nations, including Indonesia, consistently fail to meet [7], [8]. Recent evidence further highlights that structured

school-based physical activity interventions and physical education programs significantly improve children's physical fitness and motor development outcomes [9]. Against this backdrop, the role of physical education in fostering fitness-enhancing behaviors and attitudes among young learners has never been more urgent or more scrutinized [10], [11].

In Indonesia, the subject of Physical Education, Sports, and Health, commonly abbreviated as Penjasorkes, represents the primary institutional vehicle through which children are exposed to structured physical activity within the school day [12], [13]. Penjasorkes is mandated across all levels of basic education and is explicitly tasked with developing students' physical capacities alongside their cognitive, social, and emotional competencies [14]-[16]. However, the gap between the stated aspirations of the curriculum and the lived reality of physical education instruction in Indonesian elementary schools, particularly in rural and semi-urban areas, is wide and well-documented [17], [18].

On Senam Kesegaran Jasmani, a standardized gymnastics-based exercise program introduced in the 1980s. Although originally designed to improve cardiovascular endurance, muscular strength, and flexibility, its effectiveness in practice is often limited. Repetitive movement patterns, low student engagement, and reduced motivation are commonly reported in classroom implementation [14]-[21]. Recent studies also show that traditional, drill-based physical education activities tend to produce lower enjoyment and moderate-to-low physical activity intensity compared to game-based or innovative pedagogical approaches [22], [23]. In addition, teacher enthusiasm during instruction is often a critical determinant of student engagement and learning quality in physical education settings [24]. As a result, physical fitness outcomes among elementary school students tend to show minimal improvement over time in schools that rely exclusively on this program.

This persistent stagnation carries consequences that extend well beyond the immediate classroom setting. Childhood is widely recognized as a sensitive developmental period during which fitness habits, motor competence, and attitudes toward physical activity are established and tend to persist into adolescence and adulthood [25], [26]. When a national fitness program fails to engage its youngest participants, the resulting deficits in cardiovascular endurance, muscular strength, and movement confidence are unlikely to self-correct as children grow older; instead, they accumulate into the broader pattern of physical inactivity that the World Health Organization has identified as a pressing concern among children in developing countries, including Indonesia [27], [28]. The urgency of addressing this issue is therefore not confined to a single school year or a single cohort of students, but bears directly on the long-term health trajectory of an entire generation of Indonesian children, making the search for more effective and engaging alternatives to the standard Senam Kesegaran Jasmani curriculum a pressing pedagogical and public health priority.

The theoretical case for diversifying the physical education curriculum and specifically for incorporating culturally meaningful activity forms has gained considerable traction in recent scholarship on pedagogy, motivation, and embodied learning. Self-Determination Theory posits that intrinsic motivation flourishes when individuals experience autonomy, competence, and relatedness in their activities [25]-[32]. Traditional sports, which are typically collaborative, voluntarily pursued, and embedded in shared cultural meaning, align naturally with these motivational prerequisites in ways that regimented exercise routines do not [29]-[31]. Children who find physical activities intrinsically enjoyable are more likely to move with genuine effort, to persist in the face of challenge, and ultimately to achieve greater physiological adaptations [30]-[32].

Indonesia possesses an extraordinarily rich inventory of traditional sports and games, collectively known as olahraga tradisional, spanning hundreds of regional variants with distinct rules, equipment, and cultural meanings. Activities such as terompah panjang (team stilts racing), lari balok (block relay running), tarik tambang (tug-of-war), and hadang (a territory-based chasing game) represent just a small subset of this cultural heritage [39], [40]. Beyond their recreational and cultural preservation value, these activities inherently demand a range of physical competencies including speed, coordination, balance, strength, agility, and endurance, precisely the fitness components that structured physical education programs aspire to develop [41], [42]. Yet despite this convergence between traditional sports' physical demands and physical education's fitness objectives, traditional activities remain conspicuously underrepresented in formal school curricula throughout Indonesia, a phenomenon lamented by scholars, policymakers, and cultural advocates alike [43], [44]. However, controlled experimental investigations specifically comparing the fitness outcomes of traditional Indonesian sports programming against the standard SKJ curriculum, particularly in under-resourced school settings, remain limited in number and methodological rigor. This constitutes a meaningful research gap: while educators and curriculum designers may intuitively recognize the potential value of traditional sports, the evidence base for their efficacy as fitness interventions within the school context remains insufficient to drive widespread policy change.

Elementary school students in rural Central Java exhibit stagnating physical fitness trajectories under exclusively SKJ-based programming, with observational data consistently showing low student initiative and mechanical, low-effort movement execution a problem attributable to the absence of intrinsic motivational affordances in standardised gymnastic routines [45], [46]. Traditional Indonesian sports such as terompah panjang, lari balok, tarik tambang, and hadang impose physiological demands across the full range of health-related and performance-related fitness components, making them theoretically appropriate substitutes or complements to

structured exercise routines in formal physical education curricula [47], [48]. Game-based learning interventions significantly improved engagement and fitness outcomes among elementary students in West Java, providing local empirical precedent for the motivationally superior learning environment created by play-based activities [49]. From Taiwan, physical education approaches substantially improve fitness parameters including sprint speed, agility, and explosive leg power in primary school children compared to conventional instruction, consistent with the predictions of Self-Determination Theory that activities fulfilling psychological needs for autonomy, competence, and relatedness generate superior intrinsic motivation and physical effort [50]. Uzbek folk outdoor games provide substantial developmental opportunities for motor abilities, physical fitness, and social qualities in primary school students, while simultaneously documenting a significant teacher awareness gap only 21% of surveyed teachers employed folk games for character development, and 49% used them primarily for motor skills a professional development deficit that is closely paralleled in the Indonesian and Taiwanese contexts. Physical activities consistently outperform standardised, regimented exercise routines in eliciting children's voluntary engagement and producing superior fitness outcomes, irrespective of geographic and cultural context. This cross-national convergence strengthens the theoretical and empirical foundation for the present study's hypothesis and underscores the need for a controlled experimental comparison that can contribute context-specific evidence to this growing international evidence base.

The present study was conducted at SD Negeri 1 Watugede, Kemusu, Boyolali, a rural elementary school in Central Java, Indonesia, where prior observation had revealed that SKJ programming was being implemented without meaningful student engagement, and physical fitness levels among third- and fourth-grade students had failed to demonstrate improvement over multiple academic years. The novelty of this investigation lies in its controlled comparison of two distinct fitness programming approaches within a real-world school setting, its use of both process-level observational data and product-level fitness testing outcomes, and its potential to generate evidence that can meaningfully inform pedagogical decision-making for physical educators across similar contexts.

This study therefore aimed to determine whether a systematically applied traditional sports curriculum could enhance the physical fitness of third-grade students more effectively than the conventional SKJ-based programming, while simultaneously examining its effects on psychomotor performance, student activeness, and discipline during instructional sessions. In pursuing this objective, the study sought to establish an empirical foundation for the broader integration of olahraga tradisional into Indonesian elementary physical education instruction, thereby contributing context-specific evidence to inform curriculum policy and classroom practice.

2. RESEARCH METHOD

2.1 Research Design

This study employed a quasi-experimental design using a Pretest-Posttest Non-Equivalent Control Group framework. This design is appropriate when random assignment to conditions is not feasible, a common constraint in school-based research where class groupings are predetermined but the researcher wishes to compare outcomes between groups while controlling for pre-existing differences through the use of pretest scores as covariates [21]. The design involved two intact classes: an experimental group receiving a traditional sports curriculum and a control group continuing with the standard SKJ program. Both groups were assessed at baseline (pretest) and post-intervention (posttest), with the pretest serving as a statistical covariate in the Analysis of Covariance (ANCOVA) procedure. The intervention was implemented over a six-week period between February and March 2025. Ethical clearance was obtained from the Research Ethics Committee of Universitas Negeri Surabaya prior to data collection.

2.2 Population and Sample

Participants consisted of forty-three students enrolled in the third and fourth grades of State Elementary School 1 Watugede, Kemusu District, Boyolali Regency, Central Java Province, Indonesia. The experimental group comprised 22 third-grade students, and the control group comprised 21 fourth-grade students. The use of different grade levels reflects the pragmatic constraints of school-based research, where intact class groupings precluded random assignment within the same grade. Pretest data confirmed comparable baseline fitness levels between the groups (experimental group mean = 15.36, control group mean = 15.86), and residual group differences were further controlled statistically through ANCOVA covariate adjustment. This cross-grade design is acknowledged as a limitation; future research should sample from equivalent grade levels to strengthen internal validity. The selection of third-grade students for the experimental condition was grounded in the developmental literature on childhood motor learning, which identifies the 6–9 year age range as a particularly sensitive period for motor development during which children are maximally responsive to varied physical stimulation. The complete participant characteristics by group are presented in Table 1.

Table 1. Participant Characteristics by Group

Characteristic	Experimental Group	Control Group	Total
Grade	Grade III	Grade IV	—
n (students)	22	21	43
Intervention	Traditional Sports	Standard SKJ	—
Sessions	18	18	36 total
Frequency per Week	3 times	3 times	—
Age Range (years)	6–9	9–12	—

Total n = 43. Cross-grade composition (Grade III experimental, Grade IV control) reflects intact classroom constraints and is addressed statistically through ANCOVA covariate adjustment.

Table 1 summarizes the demographic and intervention characteristics of both groups. The experimental group consisted of third-grade students receiving traditional sports-based instruction, while the control group consisted of fourth-grade students receiving standardized gymnastics-based instruction. Both groups completed the same number of intervention sessions with equal frequency per week. Although there was a difference in grade level between groups, baseline physical fitness scores indicated comparable starting levels, supporting group equivalence prior to intervention. Participant eligibility was further determined according to the inclusion and exclusion criteria presented in Table 2, which were applied consistently across both groups to ensure comparability of the analytic sample.

Table 2. Participant Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Enrolled as an active student in Grade III or Grade IV at SD Negeri 1 Watugede during the research period	Diagnosed musculoskeletal condition, chronic illness, or physical disability precluding safe participation in vigorous activity
Physically able to participate in moderate-intensity physical activity without medical restriction	Enrolled in a different grade level or transferred during the intervention period
Present for at least 80% of the 18 intervention sessions	Session attendance below 80% threshold
Parental or guardian written informed consent obtained prior to participation	Parental or guardian consent not obtained or withdrawn during the study
Completed both pretest and posttest physical fitness assessments	Incomplete pretest or posttest fitness data

Written parental or guardian informed consent was obtained for all participants prior to the intervention.

Table 2 presents the inclusion and exclusion criteria applied consistently to both groups. These criteria were used to ensure participant safety, data completeness, and methodological consistency. Only students who met attendance requirements, provided informed consent, and completed both pretest and posttest assessments were included in the final analysis. Participants with medical conditions or incomplete data were excluded to maintain the validity and reliability of the study findings.

2.3 Data Sources and Data Collection Techniques

Data were collected from primary sources through two complementary techniques: standardized physical fitness testing and structured behavioral observation. The traditional sports program was delivered over six weeks, comprising 18 sessions at a frequency of three sessions per week. Each session lasted approximately 60–90 minutes and was structured according to the Lesson Implementation Plan (Rencana Pelaksanaan Pembelajaran) developed specifically for this study. Each session followed a standardized three-phase structure: a warm-up phase of 10–15 minutes consisting of light jogging, dynamic stretching, and brief introductory movement drills; a core activity phase of 40–55 minutes in which students engaged in the primary traditional sport under teacher supervision, with corrective feedback on movement technique and rule enforcement; and a cool-down phase of 10 minutes comprising static stretching and a brief reflective discussion on participation and sportsmanship.

The curriculum systematically rotated among four traditional activities across the six-week period, as detailed in Table 3. Group sizes within each activity were standardized at four to six students per team to ensure equitable participation opportunities and adequate physical loading for all students. The researcher served as the instructional lead throughout all 18 sessions to ensure fidelity to the intervention protocol.

Table 3. Traditional Sports Activities, Fitness Components, and Implementation Schedule

Activity	Primary Fitness Components Developed	Category	Implementation Period
Terompah Panjang	Speed, coordination, balance, strength, teamwork	Health & Performance	Weeks 1–2
Tarik Tambang	Muscular strength, endurance, balance, teamwork	Health-Related	Weeks 2–3

Activity	Primary Fitness Components Developed	Category	Implementation Period
Lari Balok	Speed, endurance, reaction time, balance, agility	Health & Performance	Weeks 3–4
Hadang	Speed, agility, reaction time, endurance, coordination	Health & Performance	Weeks 5–6

Review and mixed-activity sessions were incorporated in the final week to reinforce all fitness components across the four traditional activities.

The control group continued with the school's existing SKJ curriculum, receiving the same number of sessions (18) and the same frequency (three times per week) as the experimental group. SKJ sessions were delivered by the regular class teacher following the school's established Lesson Implementation Plan. No modification was made to the control group's programming to ensure ecological validity and avoid Hawthorne effect contamination.

Physical fitness was assessed using the Tes Kesegaran Jasmani Indonesia battery for students aged 6–9 years, a nationally standardized test endorsed by the Indonesian Ministry of Education. For the 6–9 year age group, the battery comprises five items: a 30-meter sprint measuring speed, a hanging flexed arm test measuring upper body muscular endurance, a 30-second sit-up test measuring core muscular endurance, a standing broad jump measuring explosive leg power, and a 600-meter run measuring cardiovascular endurance. Composite scores range from 0 to 25, with normative categories ranging from Poor to Excellent. To capture the quality of student engagement and participation during instructional sessions, structured observational data were collected across all 18 sessions for both groups, assessing three behavioral dimensions: psychomotor performance, activeness, and discipline, each scored on a five-point Likert-type scale.

2.4 Research Instruments

Multiple instruments were deployed to measure the independent, dependent, process, and covariate variables of this study. Table 4 presents the complete research instrument framework, including variables, indicators, data collection techniques, instruments, and measurement scales.

Table 4. Research Instruments by Variable, Indicator, Technique, and Scale

Variable	Indicator	Data Collection Technique	Instrument	Scale
Physical Fitness (Dependent Variable)	30-meter sprint, hanging flexed arm, 30-second sit-ups, standing broad jump, 600-meter run	Standardized fitness testing (pretest and posttest)	Indonesian Physical Fitness Test for ages 6–9	Ratio (composite score 0–25)
Intervention Type (Independent Variable)	Traditional sports curriculum versus standard SKJ programme	Direct instructional delivery across 18 sessions	Lesson Implementation Plan (RPP)	Nominal (Experimental / Control)
Psychomotor Performance (Process Variable)	Movement quality and technical accuracy during sessions	Structured behavioral observation across 18 sessions	Observation Sheet (5-point Likert scale)	Ordinal (1–5)
Student Activeness (Process Variable)	Frequency and initiative of participation during sessions	Structured behavioral observation across 18 sessions	Observation Sheet (5-point Likert scale)	Ordinal (1–5)
Discipline (Process Variable)	Rule adherence, sportsmanship, and attentiveness	Structured behavioral observation across 18 sessions	Observation Sheet (5-point Likert scale)	Ordinal (1–5)
Baseline Fitness Equivalence (Covariate)	Pretest composite fitness score prior to intervention	Standardized fitness testing	Indonesian Physical Fitness Test for ages 6–9	Ratio (composite score 0–25)

TKJI = Tes Kesegaran Jasmani Indonesia (Indonesian Physical Fitness Test). Student learning completion was defined as achieving at least 75% of the maximum possible score on each assessment dimension, consistent with the national minimum learning mastery standard.

As shown in Table 4, the study employed a dual-instrument measurement strategy combining product-level outcomes, captured through standardized fitness testing, with process-level outcomes, captured through structured behavioral observation. This combination allows the study to assess not only whether the intervention produced fitness gains, but also the behavioral mechanisms through which those gains were achieved, addressing

a methodological limitation common in single-instrument quasi-experimental designs in physical education research.

2.5 Data Analysis Techniques

Data analysis proceeded through two stages. First, descriptive statistical analysis was conducted to summarize group performance across observational dimensions and to characterize pretest and posttest physical fitness score distributions. Second, inferential statistical analysis was performed using Analysis of Covariance, with pretest TKJI scores serving as the covariate. Prior to ANCOVA, three prerequisite assumption tests were conducted, as summarized in Table 5.

Table 5. Prerequisite Statistical Tests for ANCOVA

Assumption Tested	Statistical Test	Purpose	Decision Criterion
Normality	One-Sample Kolmogorov-Smirnov test	Tests whether pretest and posttest score distributions deviate significantly from a normal distribution	$p > .05$ = normality assumption met
Homogeneity of Variance	Levene's Test	Tests whether error variances are equal across groups, with and without covariate adjustment	$p > .05$ = homogeneity assumption met
Linearity	ANOVA with Deviation from Linearity	Tests whether the relationship between covariate (pretest) and dependent variable (posttest) is linear	$p > .05$ for deviation term = linearity assumption met

All three assumptions were satisfied prior to proceeding with the main ANCOVA analysis; detailed results are reported in Section 3.1.

The practical magnitude of the intervention effect was quantified using three complementary measures. The gain-score effectiveness coefficient was calculated using the formula Effect equals the difference between posttest and pretest means of the experimental group, minus the difference between posttest and pretest means of the control group. Cohen's d was calculated from the pooled standard deviation of gain scores to enable comparison with international literature. Partial eta-squared was derived from the ANCOVA F-statistic, calculated as the treatment sum of squares divided by the sum of the treatment and error sums of squares. All inferential analyses were performed using SPSS Version 17.

2.6 Research Procedure

The study was conducted through seven systematic stages between January and March 2025. First, preliminary observation was carried out at SD Negeri 1 Watugede during January 2025 to confirm stagnating fitness trends under existing SKJ programming and to establish the rationale for the intervention. Second, ethical clearance and informed consent were obtained, with institutional approval secured from the Research Ethics Committee of Universitas Negeri Surabaya and written parental consent collected from all participating students' guardians. Third, baseline pretest assessment was conducted in early February 2025, administering the TKJI battery to both the experimental and control groups under standardized conditions. Fourth, intervention implementation proceeded over six weeks from mid-February to late March 2025, comprising 18 sessions per group delivered according to the schedules described in Section 2.3, with structured behavioral observation conducted concurrently at every session. Fifth, posttest assessment was conducted immediately following the completion of the eighteenth session for each group, again using the standardized TKJI battery. Sixth, data compilation and verification were performed, cross-checking fitness scores and observational ratings for completeness and consistency prior to analysis. Seventh, statistical analysis was conducted following the procedures detailed in Section 2.5, beginning with prerequisite assumption testing and proceeding to descriptive analysis, ANCOVA, and effect size estimation. The complete research workflow is presented in the following figure 1.

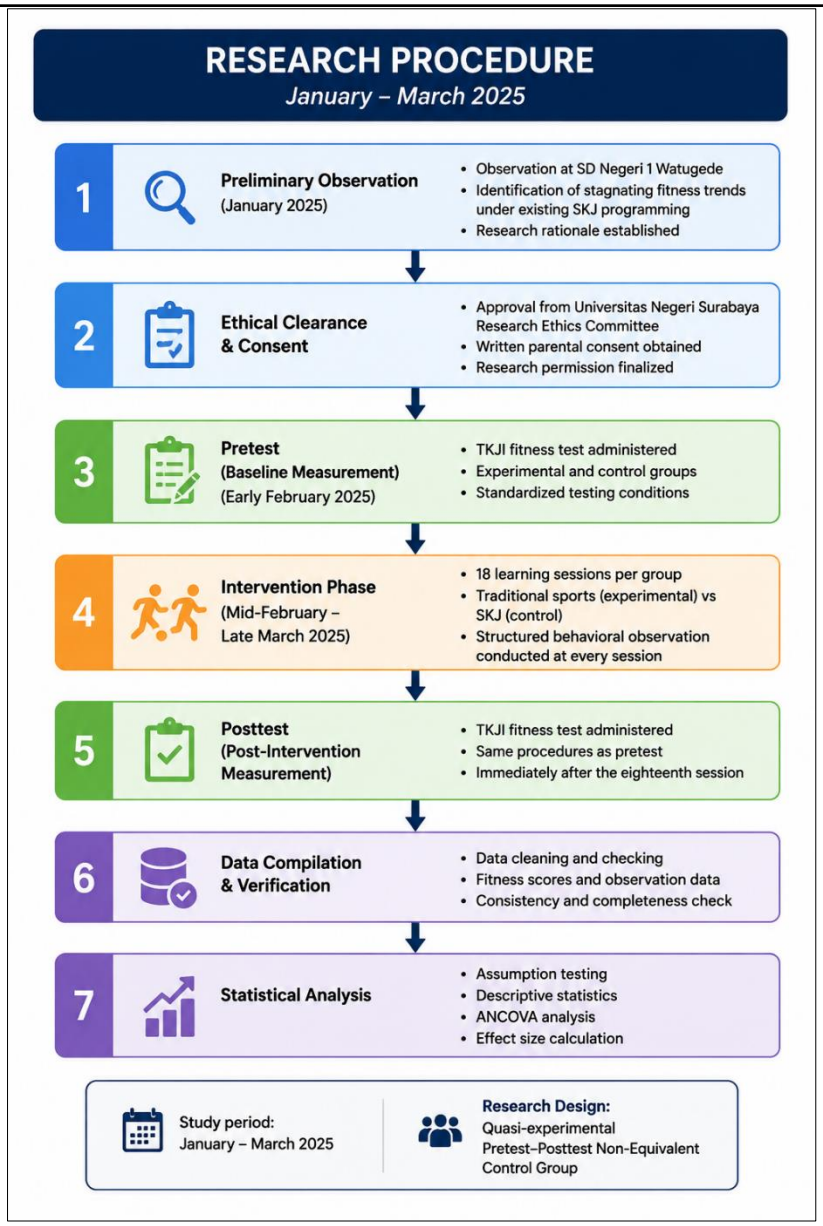

Figure 1. Research Prosedure

As illustrated in the flowchart, the study followed a sequential quasi-experimental procedure beginning with field observation and ethical clearance, and continuing through pretest, intervention, and posttest phases. Data were systematically compiled, verified, and analyzed using descriptive statistics, ANCOVA, and effect size estimation. This structured approach ensured consistency across experimental and control groups and strengthened the validity of the research findings.

3. RESULTS AND DISCUSSION

3.1 Prerequisite Statistical Tests

Prior to hypothesis testing, the data were evaluated against the statistical prerequisites for ANCOVA. Normality testing using the One-Sample Kolmogorov-Smirnov procedure yielded non-significant results for all groups and time points ($p > .05$ for all), confirming that the data distributions did not significantly deviate from normality. Specifically, the experimental group's pretest data produced a KS-Z of 0.594 ($p = .872$) and posttest data a KS-Z of 0.733 ($p = .655$). The control group's pretest yielded KS-Z = 0.508 ($p = .958$) and posttest KS-Z = 0.774 ($p = .586$). Combined group analysis similarly confirmed normality assumptions, as summarized in Table 6.

Table 6. Summary of Prerequisite Statistical Test Results

Test / Group	KS-Z (Pre)	p (Pre)	KS-Z (Post)	p (Post)
Experimental Group	0.594	.872	0.733	.655
Control Group	0.508	.958	0.774	.586
Combined Groups	0.549	.924	0.960	.316

KS-Z = Kolmogorov-Smirnov Z statistic. All p-values exceed .05, confirming normality.

Homogeneity of variance tested via Levene's F was 1.943 ($p = .171$) without covariate adjustment and 2.683 ($p = .109$) with covariate inclusion, both exceeding the alpha = .05 threshold, confirming that variance homogeneity assumptions were satisfied. Linearity tests demonstrated that regression models across all group configurations were statistically linear (Deviation from Linearity $F < 1.5$, $p > .35$ for all), confirming the suitability of using pretest scores as linear covariates in the ANCOVA model.

3.2 Descriptive Statistics: Physical Fitness Test Outcomes

Table 7 presents descriptive statistics for TKJI scores at pretest and posttest for both groups. Prior to intervention, the two groups demonstrated comparable baseline fitness levels: the experimental group's mean pretest score was 15.36 (SD = 3.672), and the control group's mean was 15.86 (SD = 3.054).

Table 7. Descriptive Statistics of Physical Fitness Scores (TKJI)

Group	Test	N	Max	Min	Mean	SD
Experimental	Pretest	22	22	9	15.36	3.672
Experimental	Posttest	22	23	14	17.77	3.161
Control	Pretest	21	21	11	15.86	3.054
Control	Posttest	21	21	14	17.29	2.552

TKJI = Tes Kesegaran Jasmani Indonesia composite score (range 0–25).

The initial comparability of the groups is noteworthy, particularly given that they were intact classes drawn from different grade levels. After the six-week intervention period, both groups showed improvements in mean TKJI scores. The experimental group increased from 15.36 to 17.77, yielding a mean gain of 2.41 points, whereas the control group increased from 15.86 to 17.29, yielding a mean gain of 1.43 points. The magnitude of improvement was greater in the experimental group, indicating a stronger positive effect of the traditional sports-based intervention on students' physical fitness outcomes compared to the control condition.

3.3 Observational Outcomes: Process-Level Analysis

Observational data collected across all 18 instructional sessions revealed a consistent pattern of superior process-level performance in the experimental group relative to the control group, as presented in Table 8.

Table 8. Final Session Observational Outcomes, Experimental versus Control Groups

Assessment Dimension	Experimental (EG)	Control (CG)	Difference (EG−CG)
Overall Learning Completion	63.64%	52.38%	+11.26%
Psychomotor Performance	68.18%	57.14%	+11.04%
Student Activeness	72.12%	57.14%	+14.98%
Discipline	45.45%	38.10%	+7.35%

EG = Experimental Group; CG = Control Group. Learning completion threshold = 75% of maximum score.

The experimental group's overall learning completion rate by session 18 stood at 63.64% (14 of 22 students meeting the 75% mastery threshold), compared to 52.38% (11 of 21 students) in the control group, a difference of 11.26 percentage points. The most pronounced between-group difference was observed in student activeness, where the experimental group outperformed the control group by nearly 15 percentage points (72.12% vs. 57.14%). This finding is substantively meaningful: activeness scores reflect the frequency and initiative with which students engaged in physical activity during sessions, and a 15% advantage in this dimension suggests that traditional sports activities were substantially more successful in drawing students into active participation. This aligns with theoretical predictions from Self-Determination Theory and empirical findings from game-based learning research, which consistently demonstrate that physical activities characterized by playfulness, competition, and social interaction generate higher levels of voluntary engagement.

The psychomotor performance advantage of the experimental group (68.18% vs. 57.14%) is equally noteworthy, as it suggests that students engaged with traditional sports activities not merely more frequently, but with higher quality movement. This may reflect the inherently demanding nature of the traditional activities, which require genuine physical exertion and technical skill to execute successfully, in contrast to SKJ, where students can perform movements minimally or superficially without consequence. The discipline dimension showed the smallest between-group difference (+7.35%), which is interpretable in light of the fact that SKJ, as a highly

structured routine, inherently demands compliance and attention, potentially inflating discipline scores relative to a more freewheeling traditional sports context.

3.4 Inferential Analysis: ANCOVA Results

The central statistical test of the study, ANCOVA examining the effect of intervention type on posttest TKJI scores with pretest scores as covariate, produced a statistically significant result. The design variable yielded $F(1, 40) = 5.515$, $p = .024$, indicating that the between-group difference in posttest fitness scores, after controlling for baseline fitness levels, was unlikely to have arisen by chance. The complete ANCOVA summary is presented in Table 9.

Table 9. ANCOVA Results: Effect of Intervention Type on Posttest Physical Fitness Scores

Source	Type III SS	df	Mean Square	F	Sig.
Corrected Model	284.154	2	142.077	97.075	.000
Intercept	54.620	1	54.620	37.320	.000
Pretest (Covariate)	281.606	1	281.606	192.409	.000
Design (Intervention)	8.071	1	8.071	5.515	.024*
Error	58.543	40	1.464	—	—
Total	13564.000	43	—	—	—
Corrected Total	342.698	42	—	—	—

Note: *p < .05. Dependent variable: Posttest TKJI score. R-squared = .829 (Adjusted R-squared = .821).

The ANCOVA model demonstrated a strong overall explanatory power, with a statistically significant corrected model, $F(2, 40) = 97.075$, $p < .001$. The pretest covariate showed a very strong effect on posttest TKJI scores, $F(1, 40) = 192.409$, $p < .001$, indicating that baseline fitness level was the most dominant predictor of post-intervention performance. The intervention effect remained statistically significant after controlling for pretest scores, $F(1, 40) = 5.515$, $p = .024$, confirming that the type of intervention independently influenced students' physical fitness outcomes, although with a smaller effect compared to the covariate. The model explained 82.1% of the variance in posttest scores (Adjusted $R^2 = .821$), whereas the model without covariate inclusion explained only 1.7% of the variance. This indicates that incorporating the pretest score as a covariate substantially improved the explanatory power of the model and reinforces the importance of controlling for initial fitness differences in quasi-experimental designs.

3.5 Effect Size and Practical Significance

Beyond statistical significance, the practical magnitude of the intervention effect was assessed through three complementary effect size metrics, summarized in Table 10.

Table 10. Summary of Effect Size Estimates for Intervention Effectiveness

Effect Size Measure	Value	Interpretation	Benchmark Reference
Effectiveness Coefficient	0.98	Meaningful gain	Difference in mean gain scores (TKJI points)
Cohen's d	0.57	Medium effect	Small: 0.20; Medium: 0.50; Large: 0.80 (Cohen, 1988)
Partial Eta-Squared	0.121	Medium-to-large	Medium: ≥0.06; Large: ≥0.14 (Cohen, 1988)

Cohen's d and partial eta-squared benchmarks follow Cohen (1988) conventional standards.

The gain-score effectiveness coefficient yielded a value of 0.98. Cohen's d, computed from the pooled standard deviation of gain scores, produced $d = 0.57$, which falls in the medium effect range according to Cohen's (1988) conventional benchmarks. Partial eta-squared was calculated as 0.121, indicating that intervention type explained approximately 12.1% of the variance in posttest fitness scores after controlling for baseline, a medium-to-large effect by conventional standards. The convergence of all three effect size indicators in the small-to-medium range confirms that the observed intervention effect, while statistically significant, represents a meaningful but not dramatic practical difference, consistent with the relatively brief six-week intervention duration and the modest sample size. The consistency of the experimental group's advantage across both product outcomes and process outcomes strengthens confidence that the observed differences reflect genuine intervention effects rather than statistical artifacts.

3.6 Comparative Analysis: Traditional Sports versus SKJ in the Indonesian Context

The current findings contribute meaningfully to a growing body of evidence suggesting that the blanket reliance on SKJ as the default tool for physical fitness development in Indonesian elementary schools may be suboptimal. The observed advantages of the traditional sports curriculum, greater student engagement, higher movement quality, and superior fitness gains, are consistent with contemporary literature on intrinsically motivating physical activity, game-based learning in physical education, and culturally grounded education.

Despite increasing evidence supporting game-based and culturally responsive physical education approaches, comparative evidence regarding the effectiveness of traditional sports versus standardized exercise routines such as SKJ in Indonesian elementary school settings remains limited. Previous studies have largely examined either structured physical exercise programs or individual traditional games, while limited attention has been given to whether culturally embedded traditional sports can provide superior outcomes across multiple dimensions, including fitness, student engagement, movement quality, and behavioral development. The present study addresses this gap by directly comparing traditional sports-based physical education with SKJ-based instruction within an Indonesian elementary school context.

A central mechanism underlying traditional sports' superiority in this context appears to be their capacity to elicit voluntary, wholehearted physical effort from participants. As discussed in the theoretical framework, traditional sports satisfy fundamental psychological needs that SKJ largely frustrates: they offer genuine choice and agency within game structures, provide clear performance feedback and skill mastery opportunities, and embed physical activity within richly social and collaborative contexts. When children move because they want to, because they are genuinely absorbed in a game, the quality and intensity of their movement naturally increases, generating the physiological overload necessary for fitness improvement.

This interpretation is directly corroborated by the observational data: the 14.98% advantage in student activeness observed in the experimental group is not merely a process quality indicator but likely explains, at least partially, the superior fitness outcomes observed at posttest. Children who are more active during sessions accumulate more physical work, creating stronger stimuli for cardiovascular and neuromuscular adaptation. The traditional sports curriculum thus appears to have leveraged motivational dynamics to produce a virtuous cycle of engaging activities leading to increased effort, greater physical work, and superior fitness gains.

The discipline dimension findings warrant separate interpretive attention. The relatively modest advantage of the experimental group in discipline (45.45% vs. 38.10%) is instructive because it reveals a potential limitation of traditional sports programming: the less structured, more playful character of these activities may create environments where rule adherence and focused discipline are more challenging to maintain than in the highly prescribed SKJ context. Physical educators implementing traditional sports must therefore invest deliberate effort in establishing clear behavioral expectations and rule structures to ensure that motivational benefits are not offset by behavioral management challenges [47]-[49]. From a broader cultural and educational policy perspective, the results of this study reinforce calls for a more prominent role for olahraga tradisional in Indonesia's national physical education curriculum. Traditional sports serve a dual function as both fitness vehicles and cultural heritage carriers, representing a remarkable pedagogical resource that has been allowed to languish at the margins of formal education [54], [55]. Integrating these activities into physical education instruction does not require sophisticated equipment or specialized facilities, an important practical consideration for under-resourced rural schools like the one examined in this study, but does require teacher professional development and curriculum support to ensure activities are implemented safely, effectively, and in ways that maximize their fitness-enhancing and culturally enriching potential [56].

While previous studies have demonstrated the effectiveness of game-based physical education and folk games in improving physical outcomes, the current study extends this evidence by showing that traditional sports can simultaneously influence fitness, engagement, movement quality, and discipline within a single instructional framework. This multidimensional effect suggests that culturally grounded physical activities may provide broader educational benefits than fitness-oriented interventions alone.

Taiwanese research corroborates the present study's motivational mechanism: game-based and play-based physical education interventions have been shown to significantly improve fitness parameters including sprint speed, agility, and standing long jump in primary school children, consistent with Self-Determination Theory's prediction that activities satisfying the psychological needs for autonomy, competence, and relatedness will generate greater intrinsic motivation and, consequently, greater physical effort and superior fitness outcomes than externally imposed, uniform routines [57], [58]. In Uzbekistan, the country of the third author, a parallel body of evidence similarly supports the integration of traditional folk sports into formal school physical education: research from Jizzakh State Pedagogical University confirms that Uzbek folk outdoor games offer substantial opportunities not only for the development of motor abilities and physical fitness, but also for the education of physical and social qualities in primary school students, mirroring the present study's findings on superior psychomotor performance, student activeness, and discipline in the traditional sports group [59], [60]. However, studies on physical education teachers in Central Asia and similar contexts indicate that knowledge and pedagogical use of folk games remain limited, with implementation largely focused on motor skill development rather than broader outcomes such as character education and holistic student development [61]. This suggests a consistent teacher professional development gap across Indonesia and other related educational systems, particularly in relation to the effective integration of culturally based and game-oriented physical education approaches.

The findings have several implications for physical education theory and practice. Theoretically, this study contributes to the literature by demonstrating that culturally embedded physical activities can function not

only as vehicles for cultural preservation but also as effective pedagogical approaches for improving children's physical fitness and psychosocial engagement. Practically, physical education teachers may consider integrating traditional sports as complementary alternatives to standardized exercise routines, particularly in schools with limited facilities. From a policy perspective, curriculum developers should provide greater institutional support, teacher training, and implementation guidelines to facilitate the systematic integration of traditional sports into elementary physical education programs.

Several limitations should be acknowledged when interpreting the findings of this study. First, the sample size was relatively small (N = 43) and drawn from a single rural elementary school in Boyolali, Central Java, which substantially limits the generalizability of the findings to other school types, geographic contexts, and student populations. Second, the six-week intervention duration, while sufficient to detect short-term fitness changes, precludes any assessment of long-term fitness retention or the durability of motivational gains following the cessation of the program; a follow-up measurement at 12 or 24 weeks post-intervention would have substantially strengthened the evidence base. Third, the experimental and control groups originated from different grade levels, introducing a potential developmental confound that, while attenuated through ANCOVA covariate adjustment, cannot be entirely eliminated; future studies should assign equivalent-grade classes to conditions. Fourth, the absence of observer blinding in the process-level observational assessments introduces potential observer bias, as the data collector was aware of each student's group assignment during scoring. Fifth, the Hawthorne effect cannot be ruled out as a partial explanation for the experimental group's superior engagement and activeness scores: students who perceived themselves as receiving a novel, specially designed program may have exerted greater effort irrespective of the intrinsic qualities of the traditional sports activities themselves. Sixth, the TKJI battery, while nationally standardized and appropriate for the target age group, does not capture all dimensions of physical fitness, notably flexibility and body composition, and its five-item structure may not be sufficiently sensitive to detect differential improvements in specific fitness components. Future research should employ larger multi-school samples with randomized controlled designs, include blinded assessors, and incorporate longer intervention periods with follow-up assessments to more rigorously establish the causal efficacy and sustained impact of traditional sports programming in Indonesian elementary physical education.

4. CONCLUSION

This study demonstrated that traditional Indonesian sports constitute a more effective alternative than conventional Senam Kesegaran Jasmani (SKJ) for improving elementary school students' physical fitness. Students participating in traditional sports activities showed higher levels of physical fitness improvement, psychomotor performance, activeness, discipline, and learning completion compared to those following the standard SKJ program. These findings indicate that culturally grounded and play-based physical education approaches can enhance both student engagement and fitness outcomes, consistent with the motivational mechanisms proposed by Self-Determination Theory and with parallel evidence reported in Taiwan and Uzbekistan.

The integration of traditional sports into primary school physical education curricula is therefore recommended as a practical, low-cost, and culturally meaningful strategy for promoting children's health and physical development, one that simultaneously preserves Indonesia's cultural heritage and addresses a documented gap in national curriculum policy. For successful implementation, this integration should be accompanied by structured teacher professional development to help educators balance the motivational benefits of play-based activities with the behavioral management required to maintain student discipline.

Future research should address the limitations identified in this study by employing larger, multi-school samples drawn from equivalent grade levels, incorporating randomized assignment where feasible, extending intervention periods beyond six weeks, and including follow-up assessments to evaluate the long-term retention of fitness gains. Future studies should also consider blinded observational assessment to reduce potential observer bias, and should expand fitness measurement to capture dimensions such as flexibility and body composition that the TKJI battery does not assess. Such efforts would further strengthen the evidence base supporting the broader adoption of olahraga tradisional within Indonesian elementary physical education and inform comparable curriculum reforms in other Southeast and Central Asian educational contexts.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the elementary school students who enthusiastically participated in this study, as well as to the teachers, school principals, and parents for their cooperation and support throughout the research process. Special appreciation is extended to the physical education teachers and research assistants at State Elementary School 1 Watugede, Kemusu District, Boyolali Regency, who assisted in implementing the traditional sports activities and collecting research data during the intervention program.

AUTHOR CONTRIBUTIONS

Conceptualization, H. and T.T.P.; Methodology, H. and T.T.P.; Software, H.; Validation, T.T.P. and B.M.; Formal Analysis, H. and T.T.P.; Investigation, H.; Resources, H. and B.M.; Data Curation, H.; Writing – Original Draft Preparation, H.; Writing – Review and Editing, T.T.P. and B.M.; Visualization, H.; Supervision, T.T.P.; Project Administration, H.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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