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EFFECT OF MODIFIED VOLLEYBALL FACILITIES ON LEARNING INTEREST AMONG ELEMENTARY SCHOOL STUDENTS

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Abstrak

Inadequate sports facilities in Indonesian elementary schools persistently suppress students' learning interest in physical education, yet evidence-based facility modification strategies remain underexplored at this level. This study examined the effect of volleyball facility modification on learning interest among Grade V students at SDN Gunungsari, Dawarblandong District, Mojokerto, East Java. A one-group pretest-posttest pre-experimental design was employed with 25 students selected via total sampling. Three modifications were applied across three instructional sessions: substituting the standard volleyball with a lightweight sponge ball, reducing the court from 18m × 9m to 12m × 4m, and lowering net height from the FIVB standard (2.43m/2.24m) to 2 meters. Learning interest was assessed using a 25-item Likert-scale questionnaire validated by two expert lecturers from Universitas Negeri Surabaya, yielding strong reliability (Cronbach's α = 0.790). Data were analyzed via descriptive statistics, the Shapiro-Wilk normality test, and paired-samples t-test. Results revealed a highly significant increase in learning interest (pre-test M = 62.76; post-test M = 85.28; gain = +22.52 points, 35.88%; t = −52.538, df = 24, p = .000), with all 25 students improving and a very large effect size (Cohen's d = 10.51). The findings confirm that contextually appropriate facility modification is not merely an emergency workaround but a proactive pedagogical strategy that substantially elevates affective engagement with volleyball at the elementary level, grounded in Self-Determination Theory (Deci & Ryan, 1985) and self-efficacy theory (Bandura, 1997).

INTRODUCTION

Physical Education, Health, and Sports (PJOK) plays a foundational role in holistic student development, cultivating physical, mental, and social capacities through purposeful, structured movement (Alifia et al., 2023). Beyond motor competency, it fosters character formation, psychosocial resilience, and long-term health behaviors, including reduced risk of non-communicable diseases such as obesity, hypertension, and cardiovascular disorders (Wahyudi & Sulistiyono, 2020). Effective PJOK teaching operates simultaneously on cognitive, affective, and psychomotor dimensions, making the learning environment and its material resources inseparable from pedagogical outcomes (Hidayat et al., 2023; Indrawathi et al., 2021). Within this broad curriculum, spanning athletics, small-ball games, and major-ball games, volleyball holds a prominent position in Indonesian schools.

Volleyball, invented by William G. Morgan in 1895 and governed internationally by the FIVB and nationally by PBVSI, is among the most widely played team sports across age groups in Indonesia. Its technical repertoire of serving, passing, spiking, and blocking offers rich, graduated opportunities for motor skill acquisition, teamwork, and tactical thinking (Hidayat, 2021; Kurniawan et al., 2022). Contemporary pedagogy has grown increasingly attentive to how equipment specifications interact with learner characteristics: Fauzi & Hakim (2021) note that ball weight, court dimensions, and net height measurably influence engagement and motor skill development, particularly in elementary settings where standard adult equipment can be developmentally mismatched to children's size and strength, while Puspita Sari & Kusuma (2022) similarly find that innovative facility adjustments reliably increase student participation and motivation.

Learning interest, defined as the stable affective orientation that drives voluntary, sustained engagement (Arus, 2023; Dwi Handayani & Siti Nurhalis, 2020), is widely recognized as a pivotal mediator between instructional conditions and learning outcomes. Nuhasanah & Sri Wahyuni (2021) show that high learning interest predicts more active participation and deeper processing of PE content, and this interest is not purely dispositional; it is substantially shaped by contextual factors such as media, learning atmosphere, and, above all, the availability and suitability of facilities (Ningsih & Setiawan, 2021; Siti Nurhayati et al., 2020). Scholars classify its determinants into internal factors (physiology and psychology) and external factors, with school-level resources, particularly the condition of sports equipment, constituting a primary external driver (Siti Nurhayati et al., 2020). When facilities are age-inappropriate or unavailable, students disengage, motivation declines, and PJOK's broader goals become unreachable (Sari & Fitriani, 2021; Siti Aisyah & Budi Santoso, 2022).

The condition of PE infrastructure in many Indonesian elementary schools remains inadequate. Mochammad Cholid et al. (2020) classify PE facilities into apparatus (fixed equipment) and devices (portable items such as balls and nets), both essential for quality instruction, and note that when either category is lacking or mismatched to learners' characteristics, teaching effectiveness is directly compromised (Suryani & Putra, 2021). An initial interview with the PE teacher at SDN Gunungsari (Suwanto, S.Pd., 28 November 2025) confirmed this scenario: volleyball facilities are insufficient, visibly suppressing students' learning interest. Students struggle with regulation equipment; the standard 260 to 280 gram volleyball is heavy and causes hand pain on contact, the official 18m by 9m court is too large to afford all students meaningful ball contact time, and the standard net height (2.43m for men, 2.24m for women) is unreachable for most Grade V

children. These conditions collectively create affective barriers of fear, discomfort, and frustration that erode interest before competence can develop.

Facility modification, the creative adaptation of equipment, spatial configuration, or rules to preserve a sport's essential structure while aligning it with learners' developmental level, has emerged as the leading pedagogical response to such resource gaps (Budi, 2021; Hidayat et al., 2023). Arus (2023) established that modification positively influences both learning interest and learning outcomes in long jump (sig. = 0.000). Hayati (2023) demonstrated that replacing the standard volleyball with a plastic ball significantly elevated motivation at the junior secondary level (sig. = 0.025). Witanto (2023) confirmed that appropriate facility availability directly predicts active student participation (sig. = 0.013), and Syahputra (2022) extended these findings to volleyball-specific modifications at the same school level. Collectively, this evidence base is persuasive, yet it remains predominantly concentrated at junior secondary level, focused on single-element modifications, and rarely validated with psychometrically robust interest instruments in elementary settings. Rina Kurniawati & Agus Suryono (2021) underscore that teachers must be creative and proactive in adapting equipment, yet practical evidence grounded specifically in elementary volleyball contexts remains scarce.

The present study addresses this gap by investigating the effect of a three-component volleyball facility modification, sponge ball substitution, court size reduction, and net height adjustment, on the learning interest of Grade V students at SDN Gunungsari, while quantifying the magnitude of change through both descriptive statistics and effect-size estimation. Theoretically, the intervention is grounded in Self-Determination Theory (Deci & Ryan, 1985), which holds that intrinsic motivation flourishes when the basic psychological needs of competence, autonomy, and relatedness are met, and in Bandura's (1997) self-efficacy framework, which identifies repeated mastery experiences as the most powerful source of efficacy beliefs. By modifying facilities to match children's physical capacities, teachers create precisely the conditions both theories prescribe: students succeed, confidence builds, and interest sustains. This study provides empirical grounding for that theoretically motivated claim at the elementary school level.

LITERATURE REVIEW

Physical education in school settings serves as a structured vehicle for developing the whole person. PJOK promotes physical fitness, motor competence, and psychosocial well-being simultaneously, and its value extends well beyond the gymnasium: through systematic physical activity, it reduces the risk of non-communicable diseases and cultivates discipline, cooperation, and sportsmanship as transferable life skills (Wahyudi & Sulistiyono, 2020; Alifia et al., 2023). For these outcomes to materialize, Dhedhy (2021) argues that PE content must be delivered in ways that genuinely stimulate students' potential and interest rather than merely covering prescribed curriculum material. Effective PJOK, as characterized by Siti Nurjanah & Ahmad Fauzi (2022), is inquiry-based, actively involves students in exploring movement, and deploys varied instructional techniques calibrated to each learner's developmental level. It is within this framework that volleyball instruction at the elementary level must be situated.

Volleyball is a globally popular team sport in which two teams of six players compete across a net, accumulating points under the rally-point system until one side

reaches 25 points with a two-point advantage (Kurniawan et al., 2022). In the PJOK curriculum, the game's movement repertoire, passing (underarm and overarm), serving (underarm and overarm), spiking, and blocking, offers a developmentally rich set of motor challenges (Andi Setiawan & Rina Mahdiyah, 2021; Achmad et al., 2020). Fauzi & Hakim (2021) observe that volleyball functions not only as a competitive sport but as a recreational activity with significant benefits for fine and gross motor skill development, and Kusuma & Anwar (2022) establish that equipment-level adjustments, lighter balls, scaled court dimensions, and adaptable net heights, produce measurable gains in participation and motivation, signaling that the standard adult configuration of the game is not a fixed pedagogical requirement at the elementary level.

Learning interest is central to understanding why students engage differently with PE content. Arus (2023) defines it as the affective state in which a person feels genuinely drawn to an activity and voluntarily directs sustained attention toward it, aligning with the broader conceptualization offered by Dwi Handayani & Siti Nurhalis (2020), who distinguish the change-oriented nature of learning from the directional quality of interest. Siti Nurhayati et al. (2020) identify three analytically distinct forms: situational interest, arising from immediate environmental stimuli; individual interest, a durable psychological preference; and topic interest, generated by the inherent attractiveness of specific content, all implicated in PE contexts. Minat, as Fitriyanti & Sutarno (2020) emphasize, is the foundational variable determining how active a student will be; without it, even well-designed instruction produces minimal engagement. Nuhasanah & Sri Wahyuni (2021) confirm the empirical link, showing that interest and motivation together significantly predict learning achievement. The five-indicator model adopted in the present study, enjoyment, sustained attention, involvement, active engagement, and participation in activities, reflects this multidimensional understanding and follows the operationalization advanced by instrument validation scholars in the PE field (Fitriani & Wahyuni, 2022).

Learning interest is shaped by an interplay of internal and external factors. Internal factors include physical condition and psychological states such as concentration, memory, and self-confidence; external factors encompass family environment, school climate, peer dynamics, and, crucially for the present study, the quality and suitability of educational facilities (Siti Nurhayati et al., 2020). Sarana (portable equipment such as balls, nets, and rackets) and prasarana (fixed infrastructure such as courts, swimming pools, and gymnasiums) together constitute the material substrate of PE instruction (Suryani & Putra, 2021), with Hidayat et al. (2023) further categorizing sarana into apparatus and devices, underscoring the variety of physical resources implicated in a single subject. When these resources are adequate, Siti Aisyah & Budi Santoso (2022) demonstrate, learning quality and student motivation improve substantially; when inadequate, Sari & Fitriani (2021) find, instructional effectiveness is directly constrained and student engagement suffers. Facility quality is thus not merely a logistical concern but a pedagogically significant variable with direct consequences for learning interest.

Modification, defined by Budi (2021) as the deliberate adaptation of equipment, methods, or media to make them more engaging and developmentally appropriate without compromising the essential character of the activity, provides the practitioner-oriented response to facility inadequacy. Arus (2023) extends this definition to encompass any simplification or redesign that enables students to understand content and achieve learning objectives, while Fitria & Ramadhan (2021) stress that effective modification

demands creativity and contextual sensitivity, citing lighter synthetic balls, reduced courts suited to constrained spaces, and height-adjustable nets as practical forms modification takes in volleyball. Muhammad et al. (2021) frame teacher creativity as the linchpin of this process, noting that educators who synthesize contextual resources, instructional strategies, and real-world experience produce the most adaptive and effective learning environments.

The theoretical underpinning for facility modification as a motivational tool is grounded in Self-Determination Theory (Deci & Ryan, 1985), which posits that intrinsic motivation is sustained when three basic psychological needs are met: competence, autonomy, and relatedness. A student who repeatedly fails to pass a heavy ball over a net two meters above their eye line experiences competence deprivation, an erosion of the very psychological foundation that sustains intrinsic motivation and, by extension, learning interest; modification directly addresses this need by calibrating task difficulty to actual developmental capacity. Bandura's (1997) self-efficacy framework further theorizes this mechanism, identifying mastery experiences as the most potent source of efficacy beliefs: when modified equipment lowers barriers to initial success, a virtuous cycle is initiated in which early successes build efficacy, heightened efficacy sustains effort, and sustained effort yields further competence, all of which amplify learning interest. Vygotsky's concept of the Zone of Proximal Development offers an additional lens, by adjusting task difficulty to sit within students' proximal zone rather than beyond it, modification transforms potentially frustrating encounters with standard adult equipment into scaffolded, meaningful learning experiences (Hidayat et al., 2023).

The empirical record consistently supports these theoretical expectations. Arus (2023) found a statistically significant positive effect of facility modification on both learning interest and achievement in long jump instruction (sig. = 0.000). Hayati (2023) reported that substituting a plastic ball in volleyball lessons significantly raised students' learning motivation (sig. = 0.025). Witanto (2023) demonstrated that facility availability is a significant predictor of active student participation across school types (sig. = 0.013). Syahputra (2022) confirmed positive modification effects specifically in volleyball at the junior secondary level. These converging findings establish a coherent evidence base, although direct experimental evidence from elementary school volleyball with multi-component modification and a psychometrically validated interest instrument remains absent, the gap the present study fills. Teacher creativity in the modification of facilities and infrastructure, as Herpratana & Nur (2022) and Slamet & Wahyuningsih (2022) argue, is not incidental to effective PE teaching but constitutive of it..

RESEARCH METHODS

Research Design

This study employed a quantitative approach using a one-group pretest-posttest pre-experimental design. All 25 participants were measured on the dependent variable (learning interest) before and after a three-session volleyball modification treatment, enabling within-group comparison. No control group was used, a deliberate design choice given the naturalistic school context and the focus on within-subject change, though this limitation is acknowledged in the discussion. The symbolic notation of the design is: $O_1 \times O_2$, where O_1 represents the pretest, $\times$ represents the treatment, and O_2 represents the posttest.

Participants

Participants were all 25 students enrolled in Grade V at SDN Gunungsari, Jl. Gunungsari, Dawarblandong District, Mojokerto Regency, East Java (postal code 61354). Total sampling (saturated sampling) was applied, meaning the entire available population constituted the sample, eliminating sampling error and strengthening internal validity. All participants attended PJOK as a compulsory curricular subject. Their baseline condition was characterized by limited exposure to volleyball due to the school's inadequate standard equipment, as confirmed through a pre-study interview with the PE teacher, Suwanto, S.Pd. (28 November 2025).

Treatment

Data collection and treatment were conducted in December 2025 across three sessions. The first session administered the pretest questionnaire before any intervention. Sessions two and three constituted the treatment, during which participants engaged in volleyball learning using three systematically modified facility components: (1) Ball modification the regulation volleyball (260–280 g) was replaced with a sponge ball, which is lighter, softer on contact, and substantially reduces the fear of pain during passing practice; (2) Court modification the standard 18m × 9m court was reduced to 12m × 4m, increasing each student's ball-contact frequency, facilitating team communication, and reducing the physical demands of court coverage; (3) Net height modification net height was lowered from the FIVB standard (2.43m for men, 2.24m for women) to a uniform 2 meters, a specification consistent with the mini-volleyball net standard (Sulistiyati & Imam Roziq, 2020), enabling students to execute basic serving and setting techniques with correct form rather than compensatory strength. The posttest questionnaire was administered immediately after the final treatment session.

Instrument

Learning interest was measured with a 25-item self-report questionnaire scored on a four-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree). The items were organized around five theoretically grounded indicators: (1) enjoyment/voluntariness, (2) sustained attention, (3) involvement, (4) active engagement in learning, and (5) participation in physical activities (Fitriani & Wahyuni, 2022). Maximum attainable score was 100 (25 items × 4 points). The questionnaire underwent expert content validation by two senior lecturers from Universitas Negeri Surabaya: Dr. Heryanto Nur Muhammad, S.Pd., M.Pd. (Validator 1) and Yuni Fitriyah Ningsih, S.Pd., M.Pd. (Validator 2). Both validators approved the instrument as suitable for use following minor revisions. Item-level validity was subsequently confirmed via Pearson Product Moment correlation in SPSS, with all 25 items achieving significance values below the $\alpha = 0.05$ threshold. Internal consistency reliability, assessed via Cronbach's Alpha, yielded $\alpha = 0.790$, placing the instrument in the strong reliability category ($\alpha > 0.70$) and confirming its suitability for repeated measurement across the pretest-posttest design.

Data Analysis

Descriptive statistics (mean, minimum, maximum, standard deviation, and gain score) were computed for both pretest and posttest distributions. Prior to inferential testing, the Shapiro-Wilk test was applied to verify distributional normality (criterion: Sig. > 0.05), given the sample size of n = 25. Both pretest (Sig. = 0.700) and posttest (Sig.

= 0.570) data satisfied this criterion, confirming the assumptions required for parametric analysis. The Paired Samples T-Test was then applied to determine whether the mean difference between pretest and posttest scores was statistically significant at α = 0.05. In addition to significance testing, the pre-post correlation (Pearson r) was examined to assess the consistency of individual trajectories across conditions, and Cohen's d was computed as a standardized effect size measure to quantify the practical magnitude of the observed change (Cohen, 1988). All computations were performed using IBM SPSS Statistics.

RESULT AND DISCUSSION

Instrument Validity and Reliability

Prior to examining treatment effects, the psychometric properties of the learning interest questionnaire were verified on the study sample. Pearson Product Moment correlations confirmed that all 25 items achieved significance values at or below α = 0.05 against the total score, establishing item-level convergent validity. The highest individual item correlation was recorded for P1 (I enjoy participating in volleyball learning, r = .715, Sig. = .000), followed by P5 (I feel confident when practicing basic volleyball techniques, r = .618, Sig. = .001), indicating that enjoyment and self-confidence are the most structurally central dimensions of learning interest in this context a finding with direct interpretive weight for the treatment analysis. Internal consistency, assessed via Cronbach's Alpha across all 25 items, yielded α = 0.790, placing the instrument in the strong reliability category and justifying its use as the study's single measurement instrument across both assessment points.

Descriptive Statistics

The descriptive results summarized in Table 1 reveal a substantial shift in learning interest scores following the volleyball facility modification treatment.

Table 1. Descriptive Statistics for Pre-Test and Post-Test Learning Interest Scores (n = 25)

Variable	n	Min	Max	Mean	Std. Deviation
Pre-Test	25	54.00	71.00	62.76	3.515
Post-Test	25	78.00	93.00	85.28	3.518
Gain Score	25	+19.00	+27.00	+22.52	

Before the intervention, mean learning interest stood at 62.76 out of a maximum of 100, with scores ranging from 54 to 71 a distribution that, with reference to the instrument's theoretical benchmarks, situates the group in the moderate interest category. This baseline is consistent with the pre-study observation that students at SDN Gunungsari experienced meaningful affective barriers to volleyball engagement. Following the modification treatment, the group mean rose to 85.28, with a compressed range of 78–93, placing all participants in the high interest category. The gain score averaged 22.52 points a 35.88% improvement relative to the pretest mean and, notably, every single one of the 25 participants recorded a positive gain. The minimum individual improvement was 19 points and the maximum was 27 points, with no cases of stagnation or decline, underscoring the uniformity of the treatment effect across individuals with differing baseline interest levels.

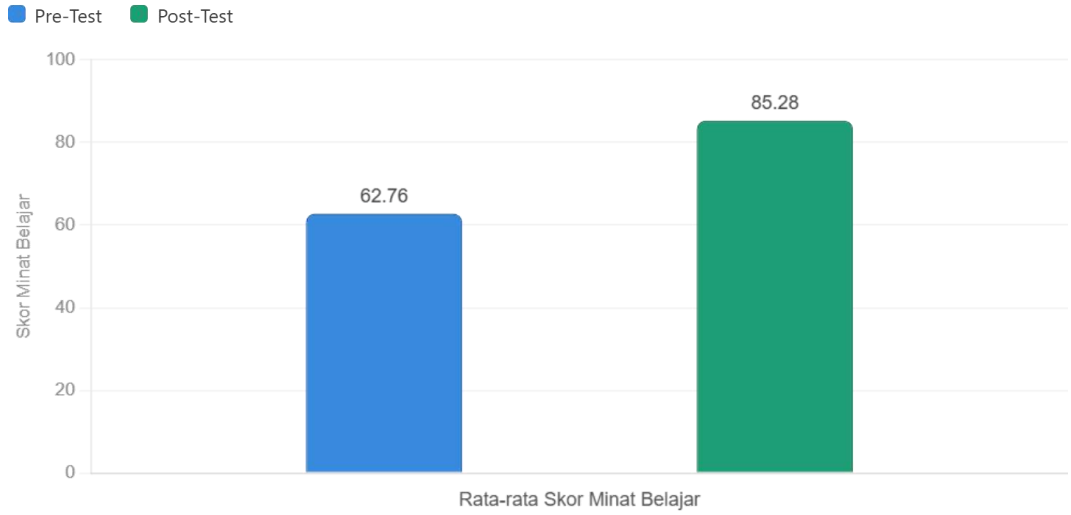

Figure 1. Comparison of mean learning interest scores before and after volleyball facility modification treatment.

The near-identical standard deviations at pretest (3.515) and posttest (3.518) are analytically significant: they indicate that the distribution of scores remained homogeneous across both measurement occasions. The treatment did not selectively benefit high-interest or low-interest students it elevated the entire group by a roughly consistent margin. This homogeneity of gain rules out the possibility that a small number of highly responsive outliers are inflating the mean difference, lending credibility to the group-level inference.

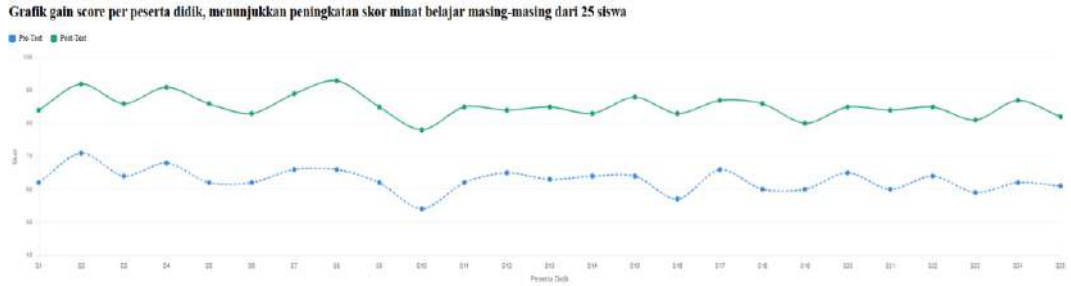

Figure 2. Individual pre-test and post-test learning interest scores for each of the 25 participants.

Normality Testing

The Shapiro-Wilk test, appropriate for sample sizes below 50, confirmed that both score distributions met the normality assumption prerequisite for parametric analysis: pre-test W = .972, Sig. = .700; post-test W = .967, Sig. = .570. Both p-values substantially exceeded the $\alpha = 0.05$ criterion. Supplementary examination of skewness and kurtosis values further supported this conclusion pre-test skewness of −0.159 and kurtosis of 1.187, and post-test skewness of 0.359 and kurtosis of 0.447, all fell well within the acceptable ±2.0 range for normal distributions. The paired-samples t-test was therefore fully justified as the inferential procedure.

Hypothesis Testing

Table 2. Paired Samples Correlation: Pre-Test and Post-Test

Pair	n	Pearson r	Sig.
Pre-Test & Post-Test	25	.814	.000

The very strong pre-post correlation (r = .814, p = .000) confirms that individual rank-ordering of interest scores was largely preserved across conditions: students who entered the study with higher baseline interest also tended to record higher post-test scores. This consistency is theoretically expected and substantively important it indicates that the treatment effect is systematic rather than random, and that individual differences in interest are stable enough across short intervention windows to meaningfully track through a pretest-posttest design.

Table 3. Paired Samples T-Test Results

Pair	Mean Difference	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pre-Test − Post-Test	−22.520	2.143	.429	−52.538	24	.000

Table 4. Paired Samples Statistics

Variable	n	Mean	Std. Deviation	Std. Error Mean
Pre-Test	25	62.76	3.515	.703
Post-Test	25	85.28	3.518	.704

The paired-samples t-test yields t(24) = −52.538, p = .000, decisively rejecting the null hypothesis and confirming that the observed mean improvement of 22.52 points is statistically attributable to the modification treatment rather than chance variation. The negative sign of the t-statistic reflects the computational convention of subtracting the larger posttest value from the smaller pretest value and carries no substantive implication. The 95% confidence interval for the true population mean difference ranges from −23.405 to −21.635, meaning one can assert with 95% confidence that the actual gain in learning interest produced by this intervention falls between approximately 21.6 and 23.4 points a remarkably tight interval that speaks to the precision of the estimate. Computing Cohen's d as the mean difference divided by the standard deviation of the difference scores yields d = 22.52 / 2.143 = 10.51, a value that dwarfs even the conventional threshold for a very large effect (d > 0.80; Cohen, 1988). This effect size places the intervention among the most impactful short-term educational manipulations reported in the PE literature, a point that warrants both confidence in the result and interpretive caution given the single-group design.

Theoretical Interpretatio

The magnitude and uniformity of the treatment effect can be meaningfully explained through three converging theoretical frameworks. Self-Determination Theory (Deci & Ryan, 1985) proposes that intrinsic motivation and by extension, learning interest flourishes when three basic psychological needs are satisfied: competence, autonomy, and relatedness. The pre-intervention context at SDN Gunungsari systematically frustrated the competence need: students confronted a ball too heavy for confident handling, a court too large for regular ball contact, and a net beyond their functional reach. Each of these conditions generated repeated failure experiences that Deci and Ryan's framework predicts will suppress intrinsic motivation. The three-component modification intervened directly and simultaneously on the competence dimension: the sponge ball

eliminated the pain and apprehension associated with passing, the reduced court increased each student's ball-contact opportunities per session, and the lowered net created achievable success conditions for serving and overhead play. The result, as the questionnaire data confirm, was a wholesale shift from moderate to high interest, reflecting precisely the motivational reorientation SDT predicts when competence barriers are removed.

Bandura's (1997) self-efficacy theory offers a complementary and granular account of the mechanism. Self-efficacy the belief in one's capacity to execute the behaviors required to produce specific outcomes is shaped primarily by enactive mastery experiences, with minor contributions from vicarious observation, verbal persuasion, and physiological states. In the unmodified volleyball context, students accumulated failure experiences that degraded efficacy beliefs; fear of the ball (evidenced by high salience of item P18, I do not feel afraid when practicing volleyball techniques) and inability to clear the net reinforced a perception of incompetence. The sponge ball and lowered net engineering a high density of success experiences across three sessions, generating what Bandura describes as an efficacy-building cascade. The strong item correlations for P1 (enjoyment, r = .715) and P5 (self-confidence, r = .618) at the instrument level directly index this dynamic: confidence and enjoyment co-vary most strongly with overall learning interest, and both were the primary affective targets of the modification.

A third theoretical lens Vygotsky's Zone of Proximal Development situates the intervention within a broader developmental framework. Standard volleyball equipment was designed for adult athletes, not ten-year-old elementary students; imposing it on Grade V learners places the task well outside their proximal zone, closer to the frustration threshold than the learning zone. The modified configuration scaled court, lighter ball, accessible net repositioned the task within each student's proximal zone, where challenge and capability intersect productively. This repositioning is exactly what the descriptive data show: every student improved, minimum gains were substantial (19 points), and the distribution remained tight, indicating that no student was so far above or below the modified challenge level that the treatment lost its efficacy. The modification, in Vygotskian terms, functioned as a structural scaffold that the teacher removed iteratively as competence accrued.

Comparison with Prior Research

The present findings extend and reinforce a consistent pattern in the existing literature. Arus (2023) reported a significant positive effect of facility modification on both learning interest and achievement in long jump instruction (p = .000), and the directional consistency between that study and the current results strengthens the argument that modification is a generalizable pedagogical lever across PE content domains. Hayati (2023) similarly found that plastic ball substitution elevated volleyball motivation at the junior secondary level (p = .025); the current study corroborates this mechanism at elementary level and with a more sensitive, validated interest instrument. Witanto (2023) established that facility availability predicts active participation across institutional types (p = .013), a structural claim that the current study operationalizes at the within-student level by documenting what happens when inadequacy is remediated through modification. Syahputra (2022) provided evidence from volleyball-specific modification at junior secondary level, and the current study furnishes the first elementary-level counterpart. Taken together, these studies now constitute a multi-study, multi-context evidentiary chain linking facility modification to affective engagement with

PE content a chain that was incomplete at the elementary volleyball intersection before the present investigation.

The effect size reported here (Cohen's d = 10.51) substantially exceeds values reported in comparable intervention studies, which warrants careful contextualization. The pre-experimental design without a control group means that factors beyond the modification itself including novelty effects, increased teacher attentiveness during the study period, and the Hawthorne effect cannot be fully disentangled from the treatment. The very large t-statistic (−52.538) and narrow confidence interval suggest that, regardless of design limitations, the observed change is real and substantial rather than artifactual; however, future designs incorporating control conditions are necessary to isolate the net effect of modification per se. The brevity of the intervention (three sessions across one month) also precludes conclusions about the durability of the interest gain over time, a limitation that Longitudinal investigation would need to address.

Pedagogical Implications

The combined statistical and theoretical evidence reframes facility modification not as crisis management under resource scarcity, but as an evidence-based pedagogical strategy with its own affirmative rationale. Herpratana & Nur (2022) and Slamet & Wahyuningsih (2022) have argued that teacher creativity in adapting the physical learning environment is constitutive of effective PE teaching; the current data supply the effect-size magnitude that gives this argument empirical teeth. Imposing adult-standard equipment on elementary students is pedagogically counterproductive it systematically undermines the competence need identified by SDT and depletes the efficacy reserves tracked by Bandura's theory. Conversely, modification designed around students' actual developmental characteristics creates the motivational infrastructure from which genuine skill acquisition and sustained sports participation can grow. The practical accessibility of the modifications tested here sponge balls, portable court markers, and a height-adjustable net means that this strategy requires minimal financial investment while delivering, as the data demonstrate, transformative affective returns. PE teachers in elementary schools with constrained budgets have in these findings both a justification and a blueprint for rethinking how standard sports content is delivered to young learners.

CONCLUSION

This study provides robust empirical evidence that a three-component volleyball facility modification sponge ball substitution, court size reduction from 18m × 9m to 12m × 4m, and net height lowering to 2 meters produces a statistically significant and practically substantial increase in learning interest among Grade V elementary students at SDN Gunungsari ($t(24) = -52.538$, $p = .000$), with all 25 participants recording gains and a mean improvement of 22.52 points (35.88%) accompanied by a very large effect size (Cohen's d = 10.51). Anchored in Self-Determination Theory (Deci & Ryan, 1985) and Bandura's (1997) self-efficacy framework, the findings demonstrate that facility modification addresses a fundamental pedagogical problem: standard adult volleyball equipment systematically frustrates the competence need and depletes efficacy beliefs in young learners, whereas developmentally calibrated equipment creates high-density mastery experiences that restore both. These results reframe modification not as an improvisational response to resource scarcity but as a principled, proactive pedagogical strategy that belongs in every elementary PE teacher's instructional repertoire, particularly in underresourced school contexts. The present study nonetheless carries

methodological constraints that must be acknowledged: the one-group pre-experimental design without a control condition cannot fully rule out competing explanations Hawthorne effects, history effects, or natural maturation for the observed gains; the sample of 25 students from a single school limits generalizability; and the three-session intervention window is insufficient to establish whether interest gains persist, deepen, or attenuate over time. Future research should address these limitations through true or quasi-experimental designs with matched control groups, larger and more diverse samples spanning multiple school contexts, and longitudinal tracking of interest trajectories to assess the sustainability of modification-induced motivational gains. Researchers may also profitably extend this design by examining the differential contributions of each modification component independently, and by connecting learning interest outcomes to downstream variables such as motor skill acquisition, lesson attendance rates, and long-term sport participation.

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