

# Implementation of modified game-based adaptive physical education on physical fitness of students with special needs in special schools (slb) in bojonegoro regency

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| <p><b>Info Artikel:</b></p> <p>Dikirim: 03-05-2026</p> <p>Direvisi: 28-05-2026</p> <p>Diterima: 03-06-2026</p> | <p><b>Abstract</b></p> <p>Students with special needs (Anak Berkebutuhan Khusus/ABK) enrolled in Special Schools (Sekolah Luar Biasa/SLB) in Bojonegoro Regency face considerable challenges in accessing quality physical education. This study aimed to analyze the implementation of modified game-based adaptive physical education (APE) on the physical fitness of students with special needs at SLBs in Bojonegoro Regency. A quasi-experimental design with a one-group pretest-posttest approach was employed, a design ethically justified by the impossibility of withholding the intervention from a control group in the special school context. The study population comprised 40 students with special needs from three SLBs: SLB Negeri Bojonegoro, SLB PGRI Bojonegoro, and SLB Muhammadiyah Bojonegoro, selected through total sampling. Participants were classified into four disability categories: intellectual disability (tunagrahita, n=12), hearing impairment (tunarungu, n=10), visual impairment (tunanetra, n=10), and physical disability (tunadaksa, n=8). Physical fitness was assessed using a modified version of the Indonesian Physical Fitness Test (Tes Kebugaran Jasmani Indonesia/TKJI) adapted and validated for students with special needs. An eight-week APE intervention was delivered three times per week. Data were analyzed using paired t-test at a significance level of 0.05. Results demonstrated a statistically significant improvement in overall physical fitness scores following the intervention (<math>t(39) = 15.43</math>; <math>p &lt; 0.001</math>), with a mean difference of 2.72 points (23.6% increase). Category-specific analyses revealed that students with intellectual disability showed the greatest improvement (mean difference = 3.45), followed by hearing impairment (2.87), physical disability (2.34), and visual impairment (1.96). These findings confirm that modified game-based APE is an effective and feasible strategy for enhancing the physical fitness of SLB students in Bojonegoro Regency and support its broader adoption within inclusive and special education frameworks.</p> <p>Keywords: Adaptive Physical Education, Modified Games, Physical Fitness, Special Needs Students, SLB, Bojonegoro</p> |
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## Introduction

Adaptive physical education (APE) research in Indonesian Special Schools (Sekolah Luar Biasa/SLB) remains scarce, particularly in district-level contexts such as Bojonegoro Regency. APE is a critical yet frequently neglected dimension of inclusive and special education, particularly for students with special needs (Anak Berkebutuhan Khusus/ABK) enrolled in SLBs (Block & Obrusnikova, 2021), requiring individualized approaches calibrated to each learner's unique characteristics and capabilities.

Bojonegoro Regency, located in East Java, Indonesia, houses three active SLBs—SLB Negeri Bojonegoro, SLB PGRI Bojonegoro, and SLB Muhammadiyah Bojonegoro—collectively serving more than 120 students with special needs across categories of intellectual disability (*tunagrahita*), hearing impairment (*tunarungu*), visual impairment (*tunanetra*), and physical disability (*tunadaksa*) (Bojonegoro Regency Education Office, 2023). Physical education programs in these institutions, however, have yet to fully address the specific requirements of each disability category.

The physical fitness of students with special needs is a critical concern. ABK consistently exhibit lower fitness levels than typically developing peers due to restricted movement, insufficient structured physical activity, and limited access to adapted sports programs (Auxter et al., 2021; Suroto, 2020), with negative consequences for physical health, psychological well-being, and quality of life.

Game-based modification approaches within APE have demonstrated effectiveness in increasing motivation, participation, and physical fitness among students with special needs (Coates & Vickerman, 2020; Hidayat, 2021). Modified games adapt rules, equipment, and playing environments to accommodate individual capabilities. This intervention draws on two complementary frameworks: Universal Design for Learning (UDL) (Muhibbullah et al., 2022) and Ecological Task Analysis (ETA) (Davis & Burton, 1991; Sherrill, 2020). Despite this basis, research on modified game-based APE specifically in SLBs in Bojonegoro Regency remains scarce.

This study is warranted by the absence of comprehensive empirical evidence on modified game-based APE effectiveness in Bojonegoro. It aims to analyze the implementation of modified game-based APE on the physical fitness of students with special needs at SLBs in Bojonegoro Regency, and to provide evidence-based recommendations for physical education teachers.

Adaptive physical education (APE) is a physical education program modified to meet the unique needs of individuals with disabilities (Sherrill, 2020), providing every student with meaningful, safe, and enjoyable motor learning experiences through individually designed activities tailored to each learner's physical and cognitive capacities (Winnick & Porretta, 2022). In Indonesia, APE is mandated by the Minister of Education and Culture Regulation No. 157 of 2014, though implementation faces persistent challenges including inadequate facilities, teacher competency gaps, and a shortage of locally relevant guidelines (Mangunsong, 2021; Nurhidayah & Setiawan, 2022).

Game modification involves adapting rules, playing area, equipment, and participant numbers to match learner characteristics and abilities (Lutan, 2001; Bahagia & Suherman, 2020). For ABK, modified games bridge the gap between students' actual capabilities and desired learning outcomes, targeting spatial, temporal, and equipment dimensions (Rithaudin & Sari, 2021). Amirullah et al. (2022) demonstrated that game modifications significantly increased active participation among students with intellectual disabilities.

Physical fitness is defined as the body's capacity to perform daily tasks without excessive fatigue (Widiastuti, 2020); for ABK, it is directly linked to functional independence and quality of life (Erbaugh, 2020). Research shows that students with *tunagrahita* exhibit lower aerobic capacity and muscular strength (Hsieh et al., 2021), *tunarungu* students experience balance deficits (Houwen et al., 2020), and *tunadaksa* students face significant movement constraints (Sit et al., 2021). Structured interventions of eight to twelve

weeks can yield cardiorespiratory gains of 15–25% in students with intellectual disabilities (Elmahgoub et al., 2021).

Bojonegoro Regency, as a mid-sized East Java regency with mixed rural-urban character and resource-constrained SLBs, is broadly representative of many district-level contexts across Indonesia. Most SLB students come from lower-middle-income rural families with limited early access to sports facilities and motor stimulation (Bojonegoro Regency Education Office, 2023), strengthening the generalizability of findings from this setting.

Preliminary observations revealed that the 40 sampled SLB students had generally low fitness levels: 32.5% were classified as very poor, 42.5% as poor, and only 25% reached moderate; none achieved good or very good. These findings provided the impetus for designing the modified game-based APE intervention.

## METHODS

This study employed a quasi-experimental design with a one-group pretest-posttest approach, selected because the special school setting precluded forming a control group without denying students the intervention (Creswell & Creswell, 2022). The study spanned ten weeks: one week for baseline assessment, eight weeks of intervention, and one week for post-assessment.

The study population comprised all students with special needs at three SLBs in Bojonegoro Regency. Total sampling was applied using four inclusion criteria: active enrollment, age 10–18, ability to engage in physical activity (with or without assistive devices), and written parental consent. A final sample of 40 students was obtained (see Table 1). The tunadaksa subgroup (n=8) is relatively small; its subgroup-level findings should be interpreted with caution.

**Table 1. Distribution of Research Sample by Disability Category and School**

| Disability Category                   | SLB Negeri | SLB PGRI  | SLB Muhammadiyah | Total     |
|---------------------------------------|------------|-----------|------------------|-----------|
| Intellectual Disability (Tunagrahita) | 5          | 4         | 3                | 12        |
| Hearing Impairment (Tunarungu)        | 4          | 3         | 3                | 10        |
| Physical Disability (Tunadaksa)       | 3          | 3         | 2                | 8         |
| Visual Impairment (Tunanetra)         | 3          | 4         | 3                | 10        |
| <b>Total</b>                          | <b>15</b>  | <b>14</b> | <b>11</b>        | <b>40</b> |

The intervention was a modified game-based APE program delivered over eight weeks (three sessions/week, 60 minutes/session), structured progressively according to each disability category's conditions. Each session comprised a 10-minute warm-up, 40-minute core game activities, and a 10-minute cool-down.

Five modified games were incorporated: (1) modified handball (hand-eye coordination and upper-limb strength); (2) modified relay races (speed and agility); (3) balloon games (balance and coordination); (4) target games (concentration and accuracy); and (5) circle games (teamwork and cardiorespiratory endurance).

ance). Each game was adapted per disability category following APE guidelines (Winnick & Porretta, 2022; Sherrill, 2020)—e.g., bell-filled balls and auditory markers for tunanetra, visual flag signals for tunarungu, and wheelchair-adapted zones for tunadaksa. Full adaptations are documented in the intervention manual available from the corresponding author.

Physical fitness was measured using the adapted Indonesian Physical Fitness Test (TKJI), validated through a two-round expert procedure with three APE specialists (ICC = 0.91; 95% CI: 0.84–0.96). The instrument covered five components—sprint run, pull-ups/bent-arm hang, 30-second sit-ups, standing broad jump, and endurance run—each adapted to disability type and scored 1–5 (total: 5–25). Test-retest reliability (n=10, two-week interval) yielded ICC = 0.89 (95% CI: 0.71–0.96;  $p < 0.001$ ), indicating excellent reliability, though the wide CI reflects the small pilot sample.

Data were analyzed using SPSS 25.0. Normality was assessed via Shapiro-Wilk (full sample and subgroups); Wilcoxon signed-rank tests served as non-parametric sensitivity checks for small subgroups (n=8–12). Levene’s test confirmed homogeneity of variance. A paired t-test ( $\alpha = 0.05$ ) tested the primary hypothesis. A mixed-model repeated-measures ANOVA examined the Time  $\times$  Disability Category interaction. Effect sizes (Cohen’s  $d$ ; partial  $\eta^2$ ) and 95% confidence intervals were reported for all comparisons.

## Results

The Shapiro-Wilk normality test for the full sample confirmed that both pre-test data ( $W = 0.962$ ,  $p = 0.214$ ) and post-test data ( $W = 0.958$ ,  $p = 0.147$ ) were normally distributed. Within-subgroup normality tests similarly supported normality for the intellectual disability (pre:  $W = 0.941$ ,  $p = 0.521$ ; post:  $W = 0.952$ ,  $p = 0.680$ ), hearing impairment (pre:  $W = 0.938$ ,  $p = 0.534$ ; post:  $W = 0.944$ ,  $p = 0.596$ ), visual impairment (pre:  $W = 0.931$ ,  $p = 0.461$ ; post:  $W = 0.949$ ,  $p = 0.644$ ), and physical disability (pre:  $W = 0.912$ ,  $p = 0.382$ ; post:  $W = 0.927$ ,  $p = 0.487$ ) subgroups. As a sensitivity check, Wilcoxon signed-rank tests for each subgroup yielded the same pattern of significance (all  $p < 0.001$ ). The Levene test indicated homogeneous variances ( $F = 1.234$ ,  $p = 0.273$ ). These outcomes satisfied the parametric assumptions required for the paired t-test and the repeated-measures ANOVA.

**Table 2. Descriptive Statistics of Physical Fitness Scores: Pre-test and Post-test**

| Group                          | Pre-test (M $\pm$ SD)            | Post-test (M $\pm$ SD)           | Mean Diff.  | t            | p                |
|--------------------------------|----------------------------------|----------------------------------|-------------|--------------|------------------|
| Intellectual Disability (n=12) | 11.83 $\pm$ 1.47                 | 15.28 $\pm$ 1.62                 | 3.45        | 9.87         | <0.001           |
| Hearing Impairment (n=10)      | 12.50 $\pm$ 1.35                 | 15.37 $\pm$ 1.51                 | 2.87        | 8.53         | <0.001           |
| Physical Disability (n=8)      | 10.25 $\pm$ 1.58                 | 12.59 $\pm$ 1.69                 | 2.34        | 7.12         | <0.001           |
| Visual Impairment (n=10)       | 11.40 $\pm$ 1.71                 | 13.36 $\pm$ 1.58                 | 1.96        | 6.24         | <0.001           |
| <b>Total (n=40)</b>            | <b>11.53<math>\pm</math>1.62</b> | <b>14.25<math>\pm</math>1.76</b> | <b>2.72</b> | <b>15.43</b> | <b>&lt;0.001</b> |

The paired t-test on the overall sample revealed a highly significant improvement between pre-test ( $M = 11.53$ ;  $SD = 1.62$ ) and post-test ( $M = 14.25$ ;  $SD = 1.76$ ) physical fitness scores following the eight-week intervention ( $t(39) = 15.43$ ;  $p < 0.001$ ; Cohen's  $d = 2.44$ , 95% CI for mean difference: 2.37–3.07). The mean difference of 2.72 points corresponded to a 23.6% improvement from baseline. The repeated-measures ANOVA revealed a significant Time  $\times$  Disability Category interaction ( $F(3,36) = 4.82$ ;  $p = 0.007$ ; partial  $\eta^2 = 0.29$ ), indicating that the magnitude of improvement differed significantly across disability categories. Category-level analyses confirmed that students with intellectual disability achieved the greatest gain (mean diff. = 3.45; 95% CI: 2.81–4.09;  $d = 2.35$ ), followed by hearing impairment (mean diff. = 2.87; 95% CI: 2.31–3.43;  $d = 2.13$ ), physical disability (mean diff. = 2.34; 95% CI: 1.52–3.16;  $d = 1.48$ ), and visual impairment (mean diff. = 1.96; 95% CI: 1.40–2.52;  $d = 1.15$ ). All improvements were statistically significant ( $p < 0.001$ ). The notably wide confidence interval and smaller effect size for the physical disability subgroup ( $n=8$ ) reflect the limited statistical power of this group and warrant cautious interpretation.

**Table 3. Distribution of Physical Fitness Categories Before and After Intervention**

| Fitness Category | Score | Pre-test (n) | Pre-test (%) | Post-test (n) | Post-test (%) |
|------------------|-------|--------------|--------------|---------------|---------------|
| Very Poor        | 5–9   | 13           | 32.5%        | 2             | 5.0%          |
| Poor             | 10–13 | 17           | 42.5%        | 10            | 25.0%         |
| Moderate         | 14–17 | 10           | 25.0%        | 20            | 50.0%         |
| Good             | 18–20 | 0            | 0.0%         | 7             | 17.5%         |
| Very Good        | 21–25 | 0            | 0.0%         | 1             | 2.5%          |
| <b>Total</b>     |       | 40           | 100%         | 40            | 100%          |

## Discussion

The findings confirm that the eight-week modified game-based APE program effectively improved physical fitness of SLB students in Bojonegoro (23.6% overall). This is consistent with Suroto (2020) and Hidayat (2021), who reported gains of 18–28% in comparable populations. However, Coates and Vickerman (2020) found minimal visual impairment gains with programs under 12 weeks, and Trisusanti and Satiningsih (2020) highlighted implementation variability as a key moderator. The uniformly positive present findings may partly reflect researcher supervision, which reduced variability; teacher-delivered replications would provide a more conservative test.

The greatest improvement in the tunagrahita group (3.45 points) reflects their lower baseline fitness, the congruence of concrete game-based contexts with their experiential learning style (Amirullah et al., 2022), and the strong extrinsic motivation provided by group-based play (Reid & O'Connor, 2021).

The tunarungu improvement (2.87 points) confirms that visual instruction, live demonstration, floor vibrations, and visual signal substitutes effectively overcame communication barriers, consistent with

Akram et al. (2023), who stressed that hearing impairment modifications must prioritize visual communication and kinesthetic feedback.

The tunadaksa improvement (2.34 points), though modest, reached significance. Games were adapted to each student's type and degree of impairment using assistive devices (modified wheelchairs, walking aids), aligning with UDL principles (Muhibbullah et al., 2022). Given the small subgroup ( $n=8$ ), replication with a larger sample is warranted.

The smallest improvement in the tunanetra group (1.96 points) reflects the challenges of movement instruction for visually impaired students. Verbal guidance, physical assistance, and tactile cues were employed, yet eight weeks may be insufficient for the motor automatization this group requires; Coates and Vickerman (2020) recommend 12–16 weeks for optimal outcomes. For tunagrahita, the large gain ( $d = 2.35$ ) may partly reflect a floor effect and warrants follow-up assessment. For tunarungu, eight weeks appeared adequate (consistent with Hidayat, 2021). For tunadaksa, the wide confidence interval underscores the need for replication with larger samples.

Key facilitating factors included principal support, high student enthusiasm, and adequate facilities at SLB Negeri Bojonegoro. Inhibiting factors were equipment shortages, weather disruptions, and teacher competency disparities—consistent with resource-related APE challenges documented by Mangunsong (2021). Importantly, the program proved implementable with limited resources using locally available materials, making it a feasible and sustainable model for budget-constrained SLBs.

## Conclusion

This study demonstrates that a structured, eight-week modified game-based APE program can meaningfully improve the physical fitness of students with special needs across diverse disability categories in Indonesian SLBs. Beyond the statistical significance of the findings, the practical implication is clear: a theoretically grounded, resource-light intervention—requiring no specialized equipment beyond locally available materials—is sufficient to produce clinically meaningful fitness gains in a population that is chronically underserved by physical education. The differential response across disability groups, captured by the significant Time  $\times$  Category interaction, further signals that program duration and instructional strategies should be tailored to disability type, with visual impairment requiring longer intervention windows than other groups. Taken together, these findings make a strong case for the institutionalization of modified game-based APE as a standard component of SLB physical education curricula, and for investment in teacher competency development as the most critical lever for sustainable implementation.

On the basis of these findings, the researchers recommend the following: (1) the Bojonegoro Regency Education Office should facilitate training for SLB physical education teachers in APE and game modification techniques; (2) the modified game-based APE program developed in this study may serve as a replicable model for SLBs elsewhere in East Java; (3) future research employing a randomized controlled trial design and a larger sample is warranted to strengthen the evidence base; and (4) the development of practical APE

guidelines grounded in the local cultural context of Bojonegoro is needed to enhance the relevance and sustainability of such programs.

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