

Evaluating Traditional Game-Based Instructional Strategies to Enhance Cognitive Skills in Physical Education Learning

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ABSTRAK

This study aimed to evaluate the effectiveness of traditional game-based instructional strategies in enhancing elementary school students' cognitive skills in physical education (PE) learning. The research employed a quasi-experimental design with a pretest–posttest control group approach. The study was conducted in a primary school located in a mountainous area with limited access to digital learning resources, emphasizing the importance of contextual and low-cost instructional alternatives.

The participants consisted of eighteen fourth- and fifth-grade students who were divided into an experimental group ($n = 9$) and a control group ($n = 9$). The experimental group received PE instruction integrated with traditional games, while the control group was taught using conventional instructional methods. Students' cognitive skills were measured using a cognitive assessment instrument administered before and after the intervention. Data were analyzed using descriptive statistics, paired-samples t-tests, independent-samples t-tests, and normalized gain (N-Gain) analysis.

The results indicated that both groups experienced significant improvements in cognitive performance; however, the experimental group demonstrated substantially higher learning gains. The experimental group achieved a mean gain of 12.56 (52.7%), compared to 7.67 (37.9%) in the control group. Inferential analysis revealed a statistically significant difference in posttest scores favoring the experimental group. These findings suggest that traditional game-based instructional strategies are effective in improving students' cognitive skills in physical education learning, particularly in educational settings with limited technological resources.

Keywords: instructional strategies; traditional games; cognitive skills; physical education; game-based learning

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INTRODUCTION

Physical education (PE) is an essential component of the school curriculum that contributes significantly to students' holistic development, encompassing physical, cognitive, and affective dimensions. In contemporary educational discourse, PE is no longer viewed solely as a means of improving physical fitness or motor skill proficiency. Instead, it is increasingly understood as a learning domain that can actively promote higher-order cognitive processes, such as decision making, problem solving, anticipation, and strategic thinking (Bailey et al., 2020). When students engage meaningfully in physical activities that require them to interpret situations and make decisions, they are encouraged to think critically while moving. Research has demonstrated that cognitively engaging physical activities can enhance executive functions and cognitive performance across different age groups, highlighting the strong interconnection between movement and cognition (Pesce & Ben-Soussan, 2021).

Despite this recognized potential, the implementation of cognitively enriched physical education remains a considerable challenge in many educational contexts, particularly in rural, remote, or mountainous areas. Schools in these regions often experience limitations related to infrastructure, sports facilities, and access to digital learning technologies. Such constraints reduce opportunities to implement technology-based or digitally supported instructional models that are increasingly prevalent in urban schools. Consequently, physical education teachers in resource-limited settings must rely on instructional strategies that are pedagogically effective, contextually appropriate, and feasible within existing conditions.

In this regard, traditional games represent a promising instructional alternative that aligns well with the realities of under-resourced educational environments. Traditional games are deeply rooted in local culture and community practices, making them familiar, meaningful, and engaging for students. From an educational perspective, these games are characterized by structured rules, social interaction, cooperation, competition, and dynamic movement patterns. Participation in traditional games requires learners to continuously observe their surroundings, anticipate opponents' actions, and adapt strategies in response to changing situations. As a result, cognitive engagement is naturally embedded within physical activity, allowing students to develop thinking skills alongside motor performance. Previous studies have indicated that traditional games can effectively stimulate cognitive processes while also supporting social development and cultural continuity (Supriyanto et al., 2024).

The educational value of traditional games becomes even more evident when considered within the framework of game-based learning approaches, particularly the Teaching Games for Understanding (TGfU) model. TGfU emphasizes learning through modified and representative games that reflect authentic game situations, rather than focusing on repetitive technical drills. This pedagogical approach encourages students to understand tactical concepts and make informed decisions during gameplay, thereby enhancing their cognitive involvement. Recent empirical studies conducted between 2020 and 2025 have consistently reported that game-based learning in physical education positively influences students' tactical understanding, decision-making abilities, and overall cognitive engagement during learning activities (González-Valero et al., 2024; Jiménez-Parra et al., 2024).

However, although the benefits of game-based instruction in physical education have been widely acknowledged, research that specifically examines the effects of traditional game-based instructional strategies on elementary school students' cognitive skills remains limited. This lack of empirical evidence is particularly apparent in studies conducted in geographically constrained or resource-poor settings, where traditional games may serve as one of the most practical and culturally relevant instructional options. The scarcity of context-specific research creates a gap in the literature and limits the availability of evidence-based guidance for physical education teachers working in such environments.

Therefore, the present study seeks to address this gap by evaluating the effectiveness of traditional game-based instructional strategies in enhancing cognitive skills among elementary school students in physical education learning. By focusing on a pedagogical approach that is both culturally grounded and adaptable to resource-limited contexts, this study aims to contribute meaningful empirical evidence to support the development of cognitively oriented and inclusive physical education practices.

METHODS

Research Design

This study adopted a quasi-experimental research design employing a pretest–posttest control group approach. The use of this design was considered appropriate because it enables the examination of instructional effects within real classroom settings, where random assignment of participants is often impractical or ethically constrained. By comparing pretest and posttest scores between the experimental and control groups, this design allowed for a systematic

evaluation of changes in students' cognitive skills attributable to the instructional intervention.

Participants

The participants in this study were eighteen elementary school students enrolled in grades IV and V at SDN 1 Banjaririgasi, Lebak Regency, Indonesia. Participants were selected using purposive sampling, with consideration given to accessibility, school context, and the similarity of students' learning characteristics. The sample was divided into two groups:

- an experimental group consisting of nine students ($n = 9$), and
- a control group consisting of nine students ($n = 9$).

Both groups were comparable in terms of age, grade level, and initial cognitive ability, as indicated by pretest results. This comparability was essential to minimize potential bias and to ensure that observed differences in posttest outcomes could be attributed primarily to the instructional treatment.

Instructional Treatment

The experimental group received physical education instruction through traditional game-based instructional strategies. Locally familiar traditional games, including *gobak sodor*, *engklek*, and *bentengan*, were systematically integrated into physical education lessons as structured learning activities. These games were selected based on their potential to stimulate cognitive engagement, as they require students to:

- understand and apply game rules;
- engage in strategic planning;
- demonstrate spatial awareness; and
- make decisions in dynamic and competitive situations.

The instructional intervention was implemented over four instructional sessions, with each session lasting approximately 60 minutes. During these sessions, the teacher facilitated gameplay, guided students' reflection on strategies, and encouraged active participation and problem solving within the game context.

In contrast, the control group received conventional physical education instruction. This approach primarily emphasized basic motor skills, physical exercises, and repetitive movement activities, with minimal emphasis on structured cognitive engagement or tactical decision making. The duration and frequency of instruction for the control group were matched with those of the experimental group to ensure consistency in instructional exposure.

Instrument

Students' cognitive skills were measured using a cognitive assessment instrument adapted specifically for physical education contexts. The instrument was designed to assess key cognitive domains relevant to game-based learning, including problem-solving ability, logical reasoning, decision making, and strategic thinking. To ensure content validity, the instrument was reviewed and evaluated by experts in physical education, who provided feedback on the relevance, clarity, and appropriateness of the test items for elementary school students.

Data Analysis

Data analysis was conducted using both descriptive and inferential statistical techniques. Descriptive statistics were used to summarize students' cognitive performance before and after the intervention. Inferential analysis included paired-samples t-tests to examine within-group differences between pretest and posttest scores, as well as independent-samples t-tests to compare posttest outcomes between the experimental and control groups. In addition, N-Gain analysis was employed to determine the magnitude of improvement in students' cognitive skills following the instructional intervention. All statistical analyses were performed using a significance level set at $p < 0.05$.

RESULTS

Overall, both the experimental and control groups demonstrated improvements in cognitive skill scores following the instructional intervention. However, the magnitude of improvement

differed notably between the two groups, with the experimental group showing superior learning gains.

Descriptive Statistics of Cognitive Skills Scores

Table 1 presents the mean scores of students' cognitive skills before and after the intervention for both groups.

Table 1. Cognitive Skills Scores

Group	Pretest Mean	Posttest Mean	Mean Gain	Percentage Increase
Experimental	23.67	36.22	12.56	52.7%
Control	20.33	28.00	7.67	37.9%

As shown in Table 1, the experimental group experienced a substantial increase in mean cognitive skill scores from pretest to posttest. The mean gain of 12.56 points represents a percentage increase of 52.7%, indicating a strong improvement following the implementation of traditional game-based instructional strategies. In contrast, although the control group also showed progress, the improvement was more modest, with a mean gain of 7.67 points and a percentage increase of 37.9%.

Inferential Statistical Analysis

Further statistical analyses were conducted to examine the significance of these improvements.

- Paired-samples *t*-test results revealed statistically significant differences between pretest and posttest scores in both the experimental and control groups ($p < 0.05$). This finding indicates that instructional activities in both groups contributed to improvements in students' cognitive skills.
- Independent-samples *t*-test analysis of posttest scores showed a statistically significant difference between the two groups ($p < 0.05$), with the experimental group outperforming the control group. This result suggests that the traditional game-based instructional strategy had a stronger impact on students' cognitive development compared to conventional physical education instruction.

Instructional Effectiveness (N-Gain Analysis)

To further evaluate instructional effectiveness, N-Gain analysis was applied. The results indicated that the experimental group achieved a higher N-Gain score than the control group, reflecting greater learning effectiveness. This finding reinforces the conclusion that integrating traditional games into physical education lessons more effectively enhances students' cognitive skills than traditional, exercise-based instruction.

In summary, while both instructional approaches contributed to cognitive improvement, the traditional game-based instructional strategy demonstrated a more pronounced and meaningful effect on students' cognitive skill development.

DISCUSSION

The findings of this study provide clear evidence that traditional game-based instructional strategies are more effective in enhancing students' cognitive skills than conventional physical education instruction. The superior outcomes observed in the experimental group can be attributed to the nature of traditional games, which inherently integrate cognitive challenges into physical activity. During gameplay, students are required to continuously interpret game situations, make decisions under time constraints, and modify strategies in response to opponents' actions. This combination of physical movement and cognitive processing promotes deeper and more sustained cognitive engagement compared to instructional approaches that primarily emphasize repetitive motor execution.

Several key factors help explain why traditional game-based instruction produced stronger cognitive outcomes:

- Traditional games present dynamic and unpredictable situations that require active problem solving and decision making.
- Cognitive demands are embedded naturally within gameplay, rather than added as separate instructional components.
- Students are encouraged to reflect on tactics and outcomes, which supports higher-order thinking processes.

These findings are consistent with previous research demonstrating that game-based learning in physical education enhances cognitive engagement and tactical understanding (Jiménez-Parra et al., 2024; Smith & Wesson, 2025). In particular, traditional games can be viewed as authentic learning tasks that stimulate executive functions such as attentional control, working memory, cognitive flexibility, and decision making. By engaging these functions simultaneously, students are more likely to develop transferable cognitive skills that extend beyond the physical education context.

From an instructional effectiveness perspective, the higher N-Gain values observed in the experimental group further underscore the importance of instructional design quality in physical education. The results suggest that meaningful learning outcomes are not determined solely by the presence of physical activity, but by how learning experiences are intentionally structured and facilitated by the teacher. Well-designed game-based instruction allows students to actively construct understanding through experience, interaction, and reflection, thereby enhancing both learning efficiency and depth.

The pedagogical value of traditional games is further strengthened by their strong contextual relevance, particularly in educational settings with limited resources. Traditional games are typically low-cost, require minimal equipment, and can be adapted to various spaces and class sizes. In addition, their cultural familiarity increases students' motivation and sense of belonging, which may further enhance engagement and learning. These characteristics make traditional games especially suitable for schools with restricted access to modern facilities or digital technologies, as highlighted by Wiyarko and Adhi (2025).

Overall, the findings of this study suggest that integrating traditional game-based instructional strategies into physical education can serve as an effective and contextually appropriate approach to fostering students' cognitive development. By combining physical activity with meaningful cognitive challenges, traditional games offer a practical pathway for delivering high-quality physical education that is both pedagogically sound and accessible across diverse educational contexts.

CONCLUSION

Based on the findings of this study, it can be concluded that traditional game-based instructional strategies are effective in enhancing elementary school students' cognitive skills within physical education learning. Students who engaged in instruction grounded in traditional games demonstrated greater cognitive improvement than those who participated in conventional physical education activities. This difference highlights the capacity of traditional games to meaningfully integrate cognitive demands into physical movement.

The effectiveness of traditional game-based instruction can be attributed to several key factors:

- Traditional games actively engage students in cognitive processes such as strategic thinking, decision making, and problem solving while they are physically active.
- The dynamic and interactive nature of gameplay encourages continuous information processing and adaptation to changing situations.
- Learning occurs in an authentic and enjoyable context, which supports sustained engagement and deeper understanding.

From a practical perspective, traditional game-based instructional strategies represent a pedagogically sound and contextually appropriate approach for improving cognitive learning outcomes in physical education. Their low cost, cultural relevance, and flexibility make them

particularly suitable for schools operating in resource-limited environments, where access to modern facilities and digital technologies may be restricted.

Despite these positive findings, this study has certain limitations that should be acknowledged. The relatively small sample size and the short duration of the intervention may limit the generalizability of the results. Therefore, future research is recommended to involve larger and more diverse participant groups, as well as longer intervention periods, in order to further validate and extend the empirical evidence regarding the cognitive benefits of traditional game-based instruction in physical education.

Overall, this study contributes to the growing body of literature supporting game-based learning approaches in physical education and underscores the potential of traditional games as effective tools for fostering students' cognitive development in diverse educational contexts.

IMPLICATION

The findings of this study highlight important implications for physical education practice, particularly in relation to instructional planning and assessment. Traditional games should be viewed not merely as recreational or supplementary activities, but as intentional and purposeful instructional strategies that can support meaningful learning outcomes.

Several key implications can be drawn from this study:

- Physical education teachers are encouraged to systematically integrate traditional games into lesson planning as core learning activities, with clear cognitive objectives such as decision making, problem solving, and strategic thinking.
- Instructional design should emphasize how traditional games are structured and facilitated, ensuring that students are guided to reflect on tactics, rules, and decision-making processes during and after gameplay.
- Assessment practices in physical education should move beyond a sole focus on physical performance and motor skill execution, and instead incorporate cognitive learning outcomes to support a more holistic evaluation of student learning.

In addition, the use of traditional games offers a practical solution for schools facing limitations in facilities, equipment, or access to digital learning technologies. Their cultural relevance and adaptability allow teachers to design engaging learning experiences that align with students' backgrounds and local contexts.

Overall, these implications underscore the potential of traditional game-based instruction to enhance the quality of physical education by fostering cognitive engagement and supporting comprehensive student development. By intentionally integrating traditional games into instruction and assessment, physical education can more effectively fulfill its role as a holistic learning domain.

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