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Field game-based learning as an integrative approach to motor competence in elementary school children: a pre-experimental study

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ABSTRACT

Background: Motor competence is a key component of physical education, integrating motor skill proficiency and game understanding. However, instructional approaches often separate technical skill development from its contextual application, limiting students' holistic competence development. **Objectives:** This study aimed to examine the preliminary effects of a field game-based learning approach on elementary school students' motor competence. **Methods:** A pre-experimental one-group pretest–posttest design was employed with 12 elementary school children. Motor skills were assessed using the Test of Gross Motor Development-2 (TGMD-2), while game understanding was measured using the Game Performance Assessment Instrument (GPAI). Data were analysed using paired-sample t-tests and Cohen's d effect size. **Results:** The results indicated a statistically significant improvement in motor competence ($t = 2.81$, $p = 0.017$), with a large effect size ($d = 0.81$). Improvements were observed in both motor skill execution and decision-making aspects of game performance. **Conclusion:** Field game-based learning demonstrates potential as an integrative approach to enhancing motor competence by combining physical and cognitive learning components. However, given the pre-experimental design and small sample size, the findings should be interpreted as preliminary. Further research using more rigorous experimental designs is recommended.

Keywords: Motor competence; field game-based learning; TGfU; game performance; elementary physical education

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INTRODUCTION

The phenomenon that occurs today is that many children and adolescents spend more time watching television or playing gadgets, so they are less physically active. The increase in inactive behaviour reached 70% due to changes in transportation patterns, increased use of technology, and urbanisation (WHO, 2019). These were crucial

factors influencing health outcomes in overweight children and adolescents (Dai et al., 2024). In addition, it must be recognised that many schools and parents focus on stimulating cognitive abilities (Mahmud, 2019), and consider movement activities futile (Barnett, Stodden, et al., 2016). Schools also lack time and stimulus to improve students' motor competence (Piercy et al., 2018), and teachers have limitations in motor skill development models and equipment (Casey et al., 2021; Dyson et al., 2016). This is also reinforced by the decrease in activity and physical condition of school children due to the pandemic (Jiménez-Loaisa et al., 2023). Thereby, motor competence can play a vital role in reversing these effects, helping students regain lost physical and mental capacities through structured movement activities. Motor competency directly impacts physical activity levels, which are essential for overall health because it encourages active lifestyles, reducing the risk of obesity, cardiovascular diseases, and related health issues (Palit et al., 2024).

The importance of motor competence should be the concern of parents and also the school because it is an integral part of the student's holistic development (Estevan & Barnett, 2018). Motor competence needs learning and training processes so that the child can master them (Robinson et al., 2015). For this, stimulation is needed to optimise the motor competence of students (Moon et al., 2024; Simpson et al., 2021). Stimulation should be given from an early age because it is a critical time for the development of motor skills that enable students to successfully participate in various types of physical activities (Cairney et al., 2019). Motor competence emerges in the age range of 6 to ≥11 years (Shams et al., 2021), so it is a good time to do the intervention (Xin et al., 2020). Furthermore, motor competence becomes the focus in learning movement for students (Xin et al., 2020).

Physical activity can be used to promote the development of motor competence in early childhood through a variety of exploratory movement experiences (Stodden et al., 2008). The problem with current efforts to promote motor competence is that it remains unclear which correlates should be targeted to ensure the most effective, targeted, and tailored interventions are developed (Barnett, Lai, et al., 2016). Research that has been conducted related to motor competence stimulus and its role in promoting physical activity still focuses on measuring physical activity in students without any understanding (Khodaverdi et al., 2022; Jones et al., 2020). However, studies that attempt to stimulate primary school students' motor competencies combined with thinking skills are limited. This is certainly a serious problem considering that the achievement of motor competence is based on understanding (Stephanou & Karamountzs, 2020). Motor competence without understanding results in students only being able to execute skills in a training environment and having difficulty in a different environment (Ab Rahman et al., 2020). For this reason, stimulation of motor competence does not only focus on improving fundamental movement skills but also includes student understanding.

Despite the expanding body of literature on motor competence and game-based approaches in physical education, a critical gap persists in the empirical investigation of how field-based game pedagogies, particularly those grounded in TGfU principles, integrate cognitive game understanding and motor skill development in elementary school contexts. The capacity to develop pedagogically robust interventions that comprehensively improve students' motor competence is restricted by the absence of integrative evidence. In relation to this description, a study was conducted to find a series of learning activities that can be used to stimulate the improvement of students' motor competence. The series of physical activities was packaged in the form of structured games using the field games approach. Of course, teachers have an important role in the

success of learning (Aziz, Okilanda, Permadi et al., 2023; Aziz, Okilanda, Rozi et al., 2023; Mashud, Arifin et al., 2023; Mashud, Warni et al., 2023; Tanri et al., 2023; Umar et al., 2023). The basis for choosing field games as an approach is that students will be encouraged to represent complex games through simplified games and learn to make important decisions (Morales-Belando et al., 2022). Field games are a tactical approach recommended for developing technique, understanding, tactical knowledge, and decision-making required in gameplay (Robles et al., 2020).

Furthermore, enhanced decision-making, skill execution, successful game performance, number of decisions made, number of game involvements, and purpose to be physically active via play and use information in the game (Barquero-Ruiz et al., 2021; Levenberg et al., 2020; Morales-Belando & Arias-Estero, 2017). The utilisation of field games as an educational technique is a highly effective approach to ensure that students not only have a positive learning experience but also meet the necessary objectives, focal points, and educational outcomes (Usher et al., 2015). While numerous studies have explored the connection between motor competence and other factors (Niemistö et al., 2022; Sheehan & Lienhard, 2019; Valentini et al., 2020). However, most of them are limited to measuring this correlation; there have not been many studies that specifically explore its impact on the development of motor competence of primary school students. In addition, the importance of field games has been recognised.

Adapting games to match learners' abilities and then progressively challenging them proves more effective in enhancing learning than traditional, technique-focused methods, as this approach fosters continuous engagement and growth, catering to individual skill levels and promoting a deeper understanding and application of skill (Harvey et al., 2018; MacPhail & Lawson, 2020; Light & Curry, 2021). For a long time, we have understood the importance of tailoring games to fit learners' abilities, observing that it significantly improves learning and motivation compared to traditional, technique-focused methods (Barquero-Ruiz & Kirk, 2023). Despite the ongoing debate between these perspectives, it is argued that this discussion has not significantly contributed new insights to the discourse. Therefore, there is an immediate need to investigate the use of field games as a teaching activity to enhance motor competence.

In this context, "motor competence" denotes the proficiency in motor skills and the students' grasp of these skills, encompassing their application in areas such as skill execution, decision-making, and defending against opponents. Based on these issues, this study aims to investigate the effectiveness of using field games as an instructional activity to improve the motor competence of primary school students. The study was conducted by implementing field games as an approach used by teachers in PE teaching. The results of this study are expected to provide a reference for teachers in implementing PE teaching integrated with games. This research contributes uniquely by adopting a TGfU-based field game approach to improve motor competence and game understanding. This certainly provides new insights related to the development of motor competence, which must involve stimulation of students' cognitive skills. These results can certainly be integrated in physical education learning in elementary schools.

METHOD

Research Design

This study aimed to examine the preliminary effects of a field game-based learning approach on students' motor competence. Field games were implemented as modified game-based activities derived from traditional Indonesian games, involving two teams of six players engaging in hitting and base-running tasks. A pre-experimental one-group pretest–posttest design was employed to assess changes in motor competence following

the intervention. This design was used to generate initial evidence prior to more rigorous experimental investigations. The intervention was grounded in the Teaching Games for Understanding (TGfU) model, emphasising the integration of tactical awareness, decision-making, and skill execution within game contexts.

The learning process followed six TGfU stages adapted from Barquero-Ruiz and Kirk (2024): game form, game appreciation, tactical awareness, decision-making, skill execution, and performance. These stages were implemented through structured gameplay activities. The study was conducted over eight sessions across five meetings, consisting of four phases: introduction, pretest, intervention, and posttest. Each session lasted approximately 80 minutes. A detailed overview of the intervention procedure is presented in **Table 1**.

Table 1. Intervention Procedure

Phase	Session	Activity	TGfU Component	Meeting
Introduction	1–2	Game introduction	Game form & appreciation	1
Pretest	3	Motor competence assessment	Performance test	2
Intervention	4–7	Game-based activities	Tactical awareness to performance	3–4
Posttest	8	Motor competence assessment	Performance test	5

Participants

Participants were 12 fifth-grade students (5 girls, 7 boys; age range = 10.6-11.4 years) recruited from a public elementary school in Batu Ampar, West Kalimantan, Indonesia. Participants were purposively selected from a larger cohort (N = 56) to meet the structural requirements of the field game intervention, which involved two teams of six players.

The selection of fifth-grade students was based on developmental considerations, as they are typically transitioning from fundamental movement skills to more complex motor applications (Goodway et al., 2019). Participants were required to be able to participate in regular physical education activities and to attend all intervention sessions. Participation was voluntary, and parental consent was obtained prior to data collection. Given the small sample size, the findings should be interpreted as preliminary and are not generalisable.

Procedure

The study was conducted through a field game-based intervention using a modified baseball game, implemented across four phases: introduction, pretest, intervention, and posttest. Students were first introduced to the game rules and objectives, followed by a baseline motor competence assessment. The intervention consisted of four sessions of TGfU-based game activities (Morales-Belando et al., 2022) designed to develop decision-making, tactical awareness, and skill execution. Posttest assessment was conducted after the intervention. The procedure was completed over eight sessions across five meetings, with each session lasting approximately 80 minutes.

Instruments

Two instruments were used to assess motor competence, encompassing motor skills and game understanding. Motor skills were evaluated using the Test of Gross Motor Development-2 (TGMD-2), which measures locomotor and object control skills across 12 fundamental movement components (Ulrich, 2000). The TGMD-2 has demonstrated

acceptable validity and reliability in the Indonesian context (Apriyani et al., 2018). Game understanding was assessed using the Game Performance Assessment Instrument (GPAI), adapted from (Memmert & Harvey, 2008). The GPAI evaluates three components: decision-making (DM), skill execution (SE), and support/covering (CV). This instrument has also been applied in Indonesian physical education settings (Sucipto, 2020).

All GPAI assessments were conducted by a trained observer with experience in physical education evaluation. To enhance scoring consistency, the observer underwent a calibration process prior to data collection. Although inter-rater reliability was not established due to the use of a single observer, efforts were made to maintain scoring consistency throughout the assessment.

Statistical Analysis

Data were analysed using both descriptive and inferential statistics. TGMD-2 scores were used to assess motor skills, while GPAI scores were calculated as performance indices. Composite motor competence scores were obtained by combining standardised TGMD-2 and GPAI scores. Descriptive statistics (mean and standard deviation) were used to summarise the data. Prior to inferential analysis, data normality was assessed using the Shapiro–Wilk test. Differences between pre-test and post-test scores were analysed using paired-sample t-tests. Effect size was calculated using Cohen's d for dependent samples to determine the magnitude of the intervention effect. The level of statistical significance was set at $p < 0.05$. All statistical analyses were conducted using SPSS version 26.

RESULTS AND DISCUSSION

Results

Motor Skills

The distribution of students' motor skill levels based on TGMD-2 categories is presented in **Table 2** and illustrated in **Figure 1**. As shown in **Table 2**, the pretest results indicate that the majority of students were classified in the below-average category (n = 7), while the remaining students were in the average category (n = 5). Notably, no students achieved above-average or higher levels at baseline, suggesting that the overall motor skill proficiency of participants was relatively limited prior to the intervention.

Following the implementation of the field game-based learning intervention, a clear positive shift in motor skill distribution was observed. Specifically, two students progressed to the above-average category, six students were categorised as average, and the number of students in the below-average category decreased from seven to four. This shift indicates that several students experienced meaningful improvements in their motor skill performance.

As visualised in **Figure 1**, the redistribution of students across performance categories demonstrates a general upward trend in motor competence. Although not all students reached higher performance levels, the reduction in lower-category classifications and the emergence of students in the above-average category suggest that the intervention contributed to enhancing motor skill development. These findings provide descriptive evidence that the field game-based approach facilitated improvements in students' motor abilities.

Table 2. Distribution of Motor Skill Levels (TGMD-2)

Gross Motor Quotient	Pretest (n)	Posttest (n)	Category
> 130	0	0	Very Superior
121-130	0	0	Superior
111-120	0	2	Above Average

Gross Motor Quotient	Pretest (n)	Posttest (n)	Category
90-110	5	6	Average
80-89	7	4	Below Average
70-79	0	0	Poor
< 70	0	0	Very Poor

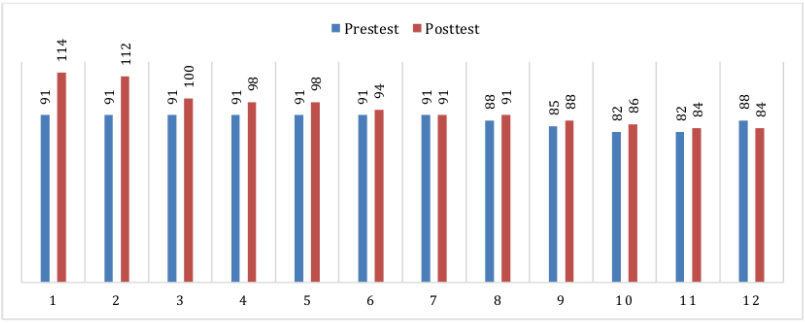

Figure 1. Comparison of Students' Motor Skills Between Pretest and Posttest

Game Understanding

Students' game understanding, as assessed using the GPAI, is summarised in **Table 3** and presented visually in **Figure 2**. The pretest results reveal that the majority of students were categorised as moderately effective (n = 8), while four students were classified as effective. This distribution suggests that, prior to the intervention, students demonstrated limited ability to apply decision-making, skill execution, and tactical awareness within game situations.

After the intervention, a substantial improvement in game understanding was observed. As shown in **Table 3**, ten students were categorised as effective, and two students reached the very effective category. Importantly, no students remained in the moderately effective category, indicating a complete shift away from lower performance levels.

The pattern illustrated in **Figure 2** clearly reflects this improvement, with a concentration of students moving into higher performance categories. This shift suggests that the intervention not only enhanced students' technical abilities but also improved their capacity to interpret game situations, make appropriate decisions, and execute skills effectively within a dynamic context. Overall, these results indicate that the field game-based learning approach contributed positively to students' game understanding.

Table 3. Distribution of Game Understanding Levels (GPAI)

Game Performance Score	Pretest (n)	Posttest (n)	Category
0.80 1.00	0	2	Very Effective
0.60-0.79	4	10	Effective
0.40-0.59	8	0	Moderately Effective
0.20-0.39	0	0	Weak
0.00-0.19	0	0	Very Weak
Total	**12**	**12**	

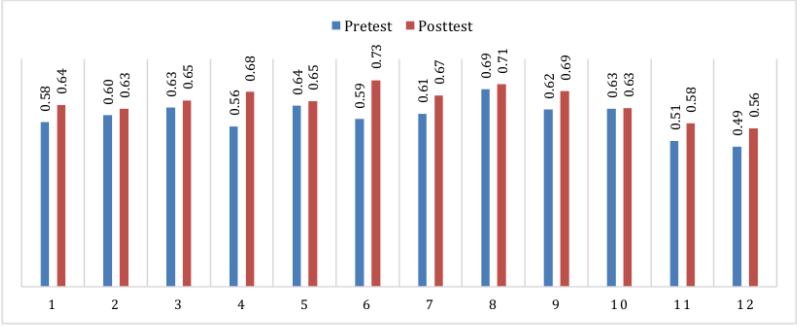

Figure 2. Comparison of Students' Game Understanding Between Pretest and Posttest

Motor Competence (Combined Scores)

Motor competence was calculated by combining standardised TGMD-2 and GPAI scores to represent an integrated measure of motor skill and game understanding. The descriptive statistics for these variables are presented in **Table 4**.

As shown in **Table 4**, the mean scores for both TGMD-2 and GPAI increased slightly from pretest to posttest. Similarly, the combined motor competence score (GC) showed an increase from pretest (M = 99.99, SD = 18.28) to posttest (M = 100.00, SD = 18.28). However, it is important to note that these values were derived from standardised (z-score) data, which inherently centre the distribution around a fixed mean. As a result, the observed mean differences appear minimal and should be interpreted with caution.

Despite the small numerical differences in mean scores, the increase in minimum and maximum values across TGMD-2 and GPAI measures suggests that individual student performance improved following the intervention. This indicates that the descriptive statistics alone may not fully capture the magnitude of change, thereby necessitating inferential analysis to determine statistical significance and practical impact.

Table 4. Descriptive Statistics of Motor Competence Variables

Variable	N	Min	Max	Mean	SD
GPAI Pretest	12	27.24	71.43	49.99	11.99
GPAI Posttest	12	27.51	67.73	50.00	12.00
TGMD Pretest	12	28.21	58.38	49.99	12.00
TGMD Posttest	12	36.79	72.82	50.00	11.99
GC Pretest	12	60.15	119.75	99.99	18.28
GC Posttest	12	64.29	119.97	100.00	18.28

Inferential Analysis

Prior to hypothesis testing, data normality was assessed using the Shapiro–Wilk test. As presented in **Table 5**, all variables met the assumption of normality ($p > 0.05$), indicating that parametric statistical analysis was appropriate.

Table 5. Normality Test Results (Shapiro–Wilk)

Variable	Statistic	df	Sig.
GC Pretest	0.485	12	0.45
GC Posttest	0.496	12	0.36

A paired-sample t-test was conducted to examine differences between pretest and posttest motor competence scores. As shown in **Table 6**, the analysis revealed a

statistically significant improvement following the intervention, t(11) = 2.81, p = 0.017. This result indicates that the field game-based learning approach was associated with measurable changes in students' motor competence.

To further assess the magnitude of this change, an effect size analysis was conducted using Cohen's d for dependent samples. The results indicated a large effect size (d = 0.81), suggesting that the observed improvement was not only statistically significant but also practically meaningful. This finding strengthens the evidence that the intervention had a substantial impact on students' motor competence.

Table 6. Paired-Sample t-test Results

Variable	t	df	Sig. (2-tailed)
Motor Competence (Pre–Post)	2.81	11	0.017

Discussion

This study examined the preliminary effects of a field game-based learning approach on students' motor competence, conceptualised as the integration of motor skills and game understanding. The findings indicate that the intervention was associated with improvements in both domains, supported by statistically significant results and a large effect size. These results provide initial evidence that game-based learning environments may facilitate more holistic motor competence development.

One possible explanation for these findings lies in the inherent characteristics of field games, which integrate physical, cognitive, and contextual learning processes. Previous research has shown that game-based approaches not only enhance fundamental motor skills but also improve students' ability to interpret game situations and develop tactical reasoning (Sun & Chen, 2024; Harvey et al., 2020). In contrast to traditional technique-centered instruction, which often isolates skill execution, field game-based learning situates skills within dynamic and unpredictable environments. This encourages learners to continuously adapt their movements in response to contextual demands, thereby promoting more meaningful and transferable learning (Robles et al., 2020).

From a motor learning perspective, this approach aligns with the motor-praxis framework, which emphasises the role of structured game experiences in shaping both motor behaviour and cognitive understanding (Robles et al., 2020; Martínez-Santos et al., 2020). The integration of perception and action during gameplay enables students to simultaneously process information and execute movements, which is essential for developing tactical competence (Cassidy et al., 2024). This may explain the observed improvements in decision-making, skill execution, and overall game understanding.

Despite these positive outcomes, variability in student performance was also evident. Not all participants demonstrated the same level of improvement, with some remaining in lower performance categories after the intervention. This variation may be attributed to individual differences in motor learning capacity, prior experience, and baseline competence (Tomassini et al., 2011; Golenia et al., 2014). Students with lower initial skill levels may require additional instructional scaffolding to effectively engage in complex, game-based tasks. Furthermore, although game-based environments are generally engaging, they do not guarantee equal participation. Differences in confidence, motivation, and engagement may influence the extent to which students benefit from the learning process.

This study also contributes to the literature by providing empirical support for the integration of motor skills and game understanding within a single pedagogical framework. While many previous studies have examined these components separately, the present findings suggest that combining them through field game-based learning may

enhance overall motor competence development. This integrative perspective represents an important step toward addressing gaps in the existing literature on motor competence and physical education pedagogy.

From a practical standpoint, the findings suggest that physical education teachers may consider incorporating field-game-based approaches as part of their instructional strategies. Such approaches should be carefully designed to accommodate varying levels of student ability, ensure active participation, and provide appropriate scaffolding to support both motor and cognitive development. By doing so, teachers can create inclusive learning environments that promote progressive improvement for all students.

Nevertheless, several limitations should be acknowledged. First, the use of a pre-experimental one-group design limits the ability to draw causal conclusions, as improvements may be influenced by external factors such as maturation or testing effects. Second, the relatively small sample size restricts the generalisability of the findings. Third, the use of a single observer in GPAI assessment may introduce potential measurement bias, despite efforts to ensure scoring consistency. Future research should employ more rigorous experimental designs, larger sample sizes, and multiple raters to strengthen the validity and generalisability of findings.

CONCLUSION

This study provides preliminary evidence that a field game-based learning approach may support the development of motor competence among elementary school students. The findings indicate improvements in both motor skill performance and game understanding following the intervention, suggesting that integrating physical and cognitive components of learning can contribute to more holistic motor competence development. The results highlight the potential of field game-based approaches, grounded in the Teaching Games for Understanding (TGfU) model, to engage students in decision-making, tactical awareness, and skill execution within meaningful learning contexts. From a practical perspective, these findings suggest that incorporating structured game-based activities into physical education may enhance student engagement while supporting the development of fundamental movement skills and physical literacy.

However, several limitations should be acknowledged. The study employed a pre-experimental one-group design with a relatively small sample size, which limits the generalisability of the findings and the ability to draw causal conclusions. Future research is recommended to use more rigorous experimental designs, larger samples, and control groups to strengthen the validity of the results. Despite these limitations, this study contributes to the literature by providing empirical support for an integrative approach to motor competence development that combines motor skills and game understanding within a field game-based learning context. This approach offers a promising direction for enhancing physical education practices, particularly in elementary school settings.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

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