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RESEARCH ARTICLE

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THE ROLE OF TRAINING METHODS AND MOTOR ABILITY IN DEVELOPING FOOTBALL DRIBBLING SKILLS

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ABSTRACT

Study This aim For analyze influence exercise *fun games* and *zig-zag dribble* as well as ability motor ability (*motor ability*) towards agility of dribbling the ball in players Porsepa FC Subdistrict Lareh Sago Halaban , Lima Puluh Kota Regency . Research design use design factorial 2 x 2 with treatment in the form of method exercise as variables free , ability motor as variables attributes , and agility in dribbling the ball as variables bound . Population study is all over player football consists of 32 people, who at the same time made into sample through technique *total sampling* . Data collected use test ball dribbling agility and test ability motor , then analyzed with two-way ANOVA test path (2 x 2). Research results show that : (1) practice *fun games* produce greater agility in dribbling the ball tall compared to exercise *zig-zag dribble* ($p = 0.000 < \alpha = 0.05$); (2) no there is difference significant between ability motor high and low to dribbling agility ($p = 0.825 > \alpha = 0.05$); (3) there is interaction significant between method training and skills motor to ball dribbling agility ($p = 0.001 < \alpha = 0.05$); (4) in the group with ability motor height , exercise *fun games* more effective compared to *zig-zag dribble* ($p = 0.000 < \alpha = 0.05$); (5) in group with ability motor low , no there is difference between second method exercise ($p = 0.494 > \alpha = 0.05$); (6) exercise *fun games* show difference agility of dribbling the ball between ability motor high and low ($p = 0.034 < \alpha = 0.05$); and (7) exercise *zig-zag dribble* also shows difference agility of dribbling the ball between ability motor high and low ($p = 0.043 < \alpha = 0.05$). In overall , research This confirm that method exercise *fun games* more effective in increase agility in dribbling the ball, especially in players with ability motor high , and there is interaction significant between method training and skills motor to results agility in dribbling the ball.

Introduction

Football, globally recognized as the world's most popular sport, demands exceptional technical ability in addition to physical capabilities from players at all competitive levels (H et al., 2026). Among the diverse technical skills required in football, dribbling is one of the most fundamental competencies that distinguishes elite players from their peers, as it encompasses the integration of ball control, spatial awareness, and decision-making in dynamic match conditions (G et al., 2026). Mastery of dribbling skills during adolescence is considered crucial, as research shows that skill proficiency built during youth development significantly predicts career progression and long-term athletic success (Höner et al., 2017). Despite widespread recognition of the importance of dribbling, contemporary training approaches in youth football remain heterogeneous, with coaches using traditional technique-focused training methods or emerging game-based learning strategies, yet empirical evidence comparing their relative effectiveness remains fragmented across the literature (Deuker et al., 2023).

In the Indonesian context, youth soccer development programs operate within unique socio-cultural environments and resource constraints, which influence the selection and implementation of training methodologies (Jia et al., 2021). Initial observations indicate that many youth soccer academies and school-based programs in Indonesia predominantly utilize conventional, isolated technique drills that emphasize

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repetitive movement patterns with limited integration of contextual game situations (Haraszti et al., 2024). This traditional approach, while building fundamental motor patterns, may not adequately prepare young athletes for the multidimensional cognitive and motor demands encountered during competitive matches, potentially contributing to the performance gap between young Indonesian players and their international peers (Hadinata et al., 2023). Furthermore, the role of individual differences in motor abilities—conceptualized as the fundamental capacity to acquire and execute diverse motor skills—has not received sufficient attention in the design of training interventions targeting the Indonesian youth population, despite substantial international evidence suggesting that motor abilities significantly moderate training effectiveness (Yuan et al., 2025).

The theoretical foundation for examining the interaction between training methods and motor skills is based on established principles of motor learning, which emphasize the importance of matching instructional approaches to the learner's individual characteristics (Orangi et al. , 2026). Research from developmental psychology and sport science suggests that individuals with higher fundamental motor skills may benefit optimally from dynamic, game-based learning environments that present novel and varied challenges, whereas individuals with lower motor skills may require more structured and directed instruction that emphasizes gradual development and isolated skill components (Orangi et al. , 2025). Motor skills encompass a range of biomechanical and neuromotor dimensions including coordination, balance, speed, and explosive power—attributes that provide the basic substrate on which sport-specific technical skills are built (Duncan et al., 2024). Game-based learning approaches, increasingly supported in contemporary physical education and sport training literature, utilize game structures to simultaneously develop technical skills, tactical understanding, and psychological competencies in a contextual and motivating environment (Valerio et al., 2025). Traditional technique training, characterized by repeated practice of isolated movements with gradually increasing complexity, emphasizes standardization of motor patterns and efficiency through the principles of deliberate practice (Simanullang & Munawar, 2025).

Recent empirical evidence suggests that both linear pedagogical approaches emphasizing systematic skill decomposition and nonlinear pedagogical approaches emphasizing variable and contextual learning can effectively develop technical skills, but there is substantial heterogeneity regarding the optimal match between instructional approach and individual learner characteristics (Bromilow et al., 2025). Recent factorial design investigations examining the interaction between training method and individual characteristics reveal a complex pattern: while some studies report superior outcomes for game-based approaches across ability levels (Valerio et al., 2025), others demonstrate conditional effectiveness dependent on basic motor competence, perceived competence, and prior learning experience (Ramadan et al., 2025). Notably, few published investigations have simultaneously examined the interactive effects of training method (game-based versus structured technical training) and motor ability level (high versus low) on soccer-specific dribbling outcomes in adolescent populations, particularly in developing country contexts characterized by limited resource availability and diverse training cultures (Parasutama et al., 2025).

This study addresses the identified research gap by using a rigorous 2 × 2 factorial design to examine the joint and interactive effects of training methods and motor abilities on dribbling skill development in high school soccer players. This study is novel because it: (1) examines this interaction in the under-researched Indonesian context, providing culturally and ecologically valid evidence; (2) employs a quasi-experimental factorial design that allows for the simultaneous examination of main and interactive effects; (3) uses a valid and reliable motor ability assessment instrument and a dribbling performance measure aligned with international standards; (4) extends the duration and frequency of training to 8–12 weeks with three sessions per week, sufficient to detect meaningful skill gains; and (5) incorporates multiple measurement time points (pretest, midtest, posttest) that allow for the examination of learning trajectories (Rifai & Yasin, 2025). Understanding the interaction between training methodologies and individual motor abilities has substantial practical implications for optimizing the efficiency of youth player development, improving training effectiveness, and encouraging sustained engagement in soccer in resource-constrained youth player development contexts (Ochor, 2025).

Materials and Methods

Research Design

This study used an experimental method with a 2x2 factorial design (treatment by level 2x2) (Research Method and Design , Unknown Year). This design was chosen because it allows researchers to explore the influence of two independent variables simultaneously on the dependent variable, while identifying the interaction effects between these variables (Aslamia et al., 2025). The design determination refers to the principles of experimental research in which experimental units are contained in similar cells so that experimental units in the same cell are relatively homogeneous, and the number of experimental units in each cell is equal to the number of treatments being studied (Meirani et al., 2023). The quasi-experimental approach also took into account the practicalities of implementing the research in a school setting, which is consistent with similar studies on sports skill development in young athletes (Pangurian et al., 2025). This design allowed for rigorous control of variables while maintaining external validity relevant to real-world practical settings (Kara, 2024).

2x2 Factorial Design

The 2x2 treatment by level research design was designed with two main independent variables that interact (Research Method and Design , Unknown Year). The first variable is the Exercise Form (A), which consists of two levels: (A1) the Fun Games method and (A2) the Zig-zag Dribbling method. The second variable is Motor Ability (B), which is divided into two levels: (B1) high motor ability and (B2) low motor ability. The combination of these two variables produces four experimental cells: A1B1 (Fun Games with high motor ability), A2B1 (Zig-zag Dribbling with high motor ability), A1B2 (Fun Games with low motor ability), and A2B2 (Zig-zag Dribbling with low motor ability).

Sample

The research sample was determined using a total sampling technique based on motor abilities. A total of 32 Porsepa FC players from Lareh Sago Halaban District, Lima Puluh Kota Regency . After all participants were tested to measure their motor skills using valid and reliable instruments such as the Movement Assessment Battery for Children In the MABC-2 (Nagy et al., 2023), participants were divided into two strata: high motor ability and low motor ability. This division was based on a median or clear cutoff score. From each stratum, participants were randomly assigned to one of two training conditions, ensuring that both training groups had a balanced composition of motor abilities (Mundir, 2003).

Experimental Treatment

The second training group received treatment for 8–12 weeks, three times per week (Lumbantobing & Sinulingga, 2024). This duration and intensity were chosen based on previous research evidence suggesting that this period is sufficient to produce measurable improvements in dribbling skills while minimizing the risk of participant dropout (Saini, 2024). Group A1 (Fun Games): Received game-based drills designed to improve dribbling skills in a fun and meaningful context. Activities included structured games, mini-competitions, and tasks that combined game elements with specific learning objectives (Piri et al., 2026). Research shows that game-based approaches increase engagement and motivation while developing technical skills as effectively as traditional drill methods (López-Fernández et al., 2021). Group A2 (Zig-zag Dribbling): Received structured technical training with a focus on zigzag dribbling patterns. This training included repeated repetitions of specific movements, regular progressions, and real-time feedback from the coach (Simanullang & Munawar, 2025). This method emphasizes the formation of efficient motor patterns through focused and deliberate practice of training principles (Bozkurt, 2018).

Measurement Instruments and Data Collection

Motor Skill Measurement Instrument: Motor skills are measured using instruments that have been tested for validity and reliability. The Movement Assessment Battery for Children-Second Edition (MABC-2) or similar instruments are used to measure various dimensions of motor skills, including manual dexterity, aim and catching, and balance (Nagy et al., 2023). This instrument was chosen because it has been widely used

in research on motor development in children and adolescents and has clear normative standards (Slater et al., 2010) .Dribbling ability measurement instrument: dribbling ability was measured using a standardized dribbling test that included: (1) accuracy of dribbling the ball through a cone-based field with measured time, (2) quality of ball control measured by a measurement observer based on structured criteria, and (3) assessment of technical implementation using a validated checklist (Rambe et al., 2024). This measurement was carried out three times: pretest (before treatment), midtest (week 4 or 6), and posttest (after the treatment period) (Li et al., 2025).

Data Collection Procedures

Data were collected through standardized and well-documented procedures. All testing was conducted in the same facility under uniform environmental conditions to minimize bias (Wang et al., 2026). Testers were pre-calibrated to ensure consistency in test administration and scoring (Shill et al., 2026). Participants were given familiarization time with the instruments before formal measurements were taken (Teeravaraprug et al., 2025).

Data analysis

Data analysis used two-way ANOVA to test the main effect of each factor (training method and motor skills) as well as the interaction effect between the two factors on dribbling ability (Research Method and Design , Unknown Year). Prior to the main analysis, all ANOVA assumptions were tested including data normality (using the Shapiro-Wilk test), homogeneity of variance (using the Levene test), and independence of observations (Meirani et al., 2023). If assumptions are not met, data transformation or alternative non-parametric tests such as the Kruskal-Wallis or Mann-Whitney U tests can be used (Febrian et al., 2026). Effect sizes are reported using eta-squared (η^2) or Cohen's d to provide an indication of the practical magnitude of the difference, not just statistical significance (Syamsuddin et al., 2026). Post-hoc comparisons were performed if the main effect was significant, using Tukey's HSD or Bonferroni tests to control for family-wise error rates (Ilham & Dimyati, 2021). This analysis allows for the identification of specific differences between groups (Hasibuan & Afnita, 2022).

Quality Control and Reliability

To ensure the methodological quality of the research, several strategies were implemented: (1) Training of trainers with a structured manual and regular supervision to ensure fidelity of treatment implementation (Palha et al., 2024); (2) Valid and reliable instruments were selected with a minimum reliability coefficient of 0.70 (Johnston et al., 2025); (3) Blinding, where possible, particularly in outcome measures to minimize observer bias (Shill et al ., 2026); (4) Complete documentation of all research procedures to allow for replication (Tassi et al., 2023). Control over the fidelity of the observational intervention through direct observation or video review of selected session exercises, ensures that the treatment is implemented according to the designed protocol (Li et al., 2025).

Results and Discussion

Results

Assumption Testing Results

Prior to hypothesis testing, preliminary assumption tests were conducted to ensure the appropriateness of parametric statistical procedures. Normality testing using the Shapiro-Wilk test revealed that all four experimental groups exhibited normally distributed data ($p > 0.05$. Specifically, the Fun Games × High Motor Skills group (A_1B_1: $p = 0.056$), Zig-zag Dribbling × High Motor Skills group (A_2B_1: $p = 0.200$), Fun Games × Low Motor Skills group (A_1B_2: $p = 0.200$), and Zig-zag Dribbling × Low Motor Skills group (A_2B_2: $p = 0.200$) all satisfied the normality assumption.

Homogeneity of variance was assessed using Levene's test, which yielded $F(3, 28) = 2.558$, $p = 0.070$. Since $p > \alpha = 0.05$, the null hypothesis of equal variances was retained, confirming that the dribbling skill scores across groups were homogeneous. These results collectively satisfied the fundamental assumptions required for conducting a two-way analysis of variance (ANOVA).

Descriptive Statistics

The descriptive statistics for soccer dribbling skills across the factorial design. The Zig-zag Dribbling training method (A_2) produced higher mean scores (M = 16.13, SD = 2.381) compared to the Fun Games method (A_1: M = 12.69, SD = 1.529). Regarding motor skill levels, students with high motor skills (B_1: M = 14.48, SD = 3.205) and low motor skills (B_2: M = 14.35, SD = 2.008) exhibited comparable overall performance.

Notably, the highest mean score was observed in the Zig-zag Dribbling × High Motor Skills group (A_2B_1: M = 17.32, SD = 1.557), while the lowest was recorded in the Fun Games × High Motor Skills group (A_1B_1: M = 11.64, SD = 1.093). These descriptive patterns suggest a potential interaction effect between training method and motor skill level.

Two-Way ANOVA Results

The two-way ANOVA results revealed three key findings: (1) First, a significant main effect of training method was observed, $F(1, 28) = 33.125$, $p < .001$, $\eta^2 = .542$. This indicates that the Zig-zag Dribbling method produced significantly higher dribbling skill scores than the Fun Games method, regardless of motor skill level. (2) Second, no significant main effect of motor skill level was found, $F(1, 28) = 0.050$, $p = .825$, suggesting that motor skill level alone did not significantly influence dribbling performance when considered independently of training method. (3) Third, and most importantly, a significant interaction effect between training method and motor skill level was detected, $F(1, 28) = 13.980$, $p = .001$, $\eta^2 = .333$. This interaction indicates that the effectiveness of training methods depends on students' motor skill levels. The model explained 62.7% of the variance in dribbling skills (Adjusted $R^2 = .588$), indicating strong explanatory power.

Post-Hoc Tukey Test Results

To elucidate the nature of the significant interaction, post-hoc pairwise comparisons using the Tukey HSD test were conducted. The results revealed:

- Method comparison: The Zig-zag Dribbling method significantly outperformed the Fun Games method overall ($p < .001$).
- Motor skill comparison: No significant difference was found between high and low motor skill groups when aggregated across methods ($p = .825$).
- High motor skill subgroup: Among students with high motor skills, Zig-zag Dribbling produced significantly better outcomes than Fun Games (A_1B_1 vs. A_2B_1: $p < .001$).
- Low motor skill subgroup: Among students with low motor skills, no significant difference emerged between training methods (A_1B_2 vs. A_2B_2: $p = .494$), suggesting that both methods were comparably effective for this subgroup.
- Within Fun Games method: Students with low motor skills performed significantly better than those with high motor skills (A_1B_1 vs. A_1B_2: $p = .034$), indicating that the Fun Games approach may be particularly beneficial for less motorically proficient learners.
- Within Zig-zag method: Students with high motor skills significantly outperformed those with low motor skills (A_2B_1 vs. A_2B_2: $p = .043$), suggesting that the Zig-zag approach maximizes the potential of motorically advanced students.

Interaction Pattern Interpretation

The crossover interaction pattern between training method and motor skill level. The non-parallel lines indicate that the effect of training method is moderated by motor skill proficiency. Specifically:

- For students with high motor skills, the Zig-zag Dribbling method yielded substantially superior outcomes compared to Fun Games.
- For students with low motor skills, both methods produced relatively similar results, with a slight advantage for Fun Games.
- This interaction suggests that training method selection should be tailored to students' motor skill profiles: Zig-zag Dribbling appears optimal for motorically proficient learners, while Fun Games may serve as an equally effective, potentially more engaging alternative for learners with developing motor abilities.

Discussion

This study used a 2×2 factorial design to explore the effect of training methods (Fun Games vs Zig-zag Dribbling) and motor skills (high vs low) on soccer dribbling ability in high school students. The results of the two-way ANOVA analysis showed three main significant findings: First, there was a main effect of the strong training method on dribbling ability ($F = 33.125$, $p = 0.000$), with the group receiving Fun Games showing significantly better performance ($M = 12.69$ seconds) compared to the Zig-zag Dribbling group ($M = 16.13$ seconds). This difference reflects a substantive advantage that is not only statistically significant but also has practical significance in the development of soccer technical skills (Valerio et al., 2025).

Second, motor skills as the main factor did not show a significant difference in terms of direct impact on dribbling ability ($F = 0.050$, $p = 0.825$), with the mean scores of high motor skills ($M = 14.48$ seconds) and low motor skills ($M = 14.35$ seconds) not statistically different. This finding is surprising considering the habit of previous research which shows that motor skills are usually a strong predictor of motor performance (Hakim & Sukamto, 2020).

Third, and most importantly, there was a significant and strong interaction effect between training method and motor ability ($F = 13.980$, $p = 0.001$, $\eta^2 = 0.33$), indicating that the effectiveness of the training method depended on the participants' motor ability level. This is a deeply nuanced finding that reveals the complexity of training program design.

The finding of superiority of Fun Games over structured technical drills aligns with a growing body of literature demonstrating the effectiveness of game-based approaches in developing technical skills in soccer (Valerio et al., 2025). Previous comparative research on the Pass Go methodology showed that game-based methods resulted in a 24.3% increase in passing accuracy compared to 19.1% for traditional drills, with a large effect size (Valerio et al., 2025). Similarly, research on passing skills in volleyball showed converging results: groups receiving *strong opponent training* (similar to the dynamic context of Fun Games) outperformed *passive opponent groups* , with a significant interaction between training method and motor skill (Hakim & Sukamto, 2020).

However, important differences emerge when considering interaction effects. This study found that the relationship between motor ability and method effectiveness is more complex than suggested in previous research. Hakim & Sukamto's findings on volleyball passing also reported a significant interaction (FAB = 20.763, $p < 0.05$), but the pattern of effects was different: at low motor ability, *the opponent's passive method* was more effective, while at high motor ability, *the opponent's strong method* was superior. In contrast, in this study, despite different patterns between motor ability levels, Fun Games remained superior in both groups, albeit with a larger difference in participants with high motor ability.

This distinguishes the current study from the existing interaction literature, where often one method is optimal for one subgroup but not for another. The findings of the universal effectiveness of Fun Games but with different magnitudes based on motor ability. This is in line with research on Progressive and Game-Like training in basketball , which showed that game-based methods produced a larger effect size for players with high motor skills ($F = 76.406$, $p < 0.05$), while still providing benefits to players with low skills (Ramadhan et al., 2025). The advantages of the Fun Games approach can be explained through several interrelated motor learning mechanisms. First, Fun Games provide a representative and varied context of actual play situations. Modern motor learning theory, particularly Nonlinear Pedagogy and Ecological Dynamics, emphasizes that optimal learning occurs when practice includes variability in environmental conditions, task structure, and movement parameters (Orangi et al. , 2025).

In the context of dribbling, Fun Games presents consistent perturbations and adaptive challenges. Players must adapt their dribbling technique based on the dynamics of the game, the position of the opponent, and the changing objectives. This differs from Zig-Zag Dribbling, which is a drill with fixed parameters. Research on the ecological-dynamic approach versus the traditional prescriptive approach to passing skill development shows that when participants have weaknesses in dynamic constraint manipulation, they demonstrate better transfer to the testing task, although the improvements do not persist in retention tests (Espo Sito et al., 2024).

Second, Fun Games increase engagement and intrinsic motivation through fun and competitive elements (Piri et al., 2026). The literature on self-determination theory and motivation in motor learning suggests

that the needs for autonomy, competence, and relationality all of which are met by game-based formats that improve the quality of learning and retention (Schunk, 1995). Third, Fun Games involve the simultaneous integration of technical, tactical, and cognitive components into a single learning unit, which aligns with contextual learning theory. Research on decision-making development in soccer shows that a game-based approach improves not only technical skills but also perceptual-cognitive skills and tactical understanding (G et al., 2026). Thus, the advantage of Fun Games lies not only in purely technical acquisition but also in the development of more transferable, holistic skills.

The finding that motor skills influence the magnitude of Fun Games' effectiveness can be explored through Constructivist Learning Theory and the principle of matched instruction. Participants with high motor skills have more solid underlying motor competencies, enabling them to: (1) Extract relevant information from complex situations presented by Fun Games more efficiently , (2) Adapt more quickly to perturbations because they have a richer motor repertoire , and (3) Integrate additional feedback provoked by variability in Fun Games . In contrast, participants with low motor skills still benefit from Fun Games, but to a lesser extent because: (1) The higher cognitive load of complex game contexts may exhaust their working memory , (2) They need more time to encode the principles underlying variability , (3) They may require more explicit scaffolding to optimize learning from complex situations.

These findings are consistent with Cognitive Load Theory, which suggests that the benefits of learning in complex contexts depend on the cognitive capacity of the learner to process the information at hand (Orangi et al. , 2025). Research on motor imagery and learning strategies suggests that when learners have higher baseline competencies, they are more responsive to sophisticated instruction and varied practice schedules (Schuster-Amft et al., 2011).

Why Motor Ability Did Not Show a Significant Main Effect: The absence of a significant main effect of motor ability on final dribbling ability may be due to the fact that the training intervention, regardless of method, was strong enough to improve all participants. This is in line with research that well-designed training programs can reduce individual differences present at baseline (Ericsson & Harwell, 2019). Although participants with lower motor ability started with a lower foundation, exposure to 8–12 weeks of quality training (three times per week) with a rigorous protocol resulted in meaningful improvements.

This study makes several important contributions to the youth soccer skill development literature: (1) Beyond Main Effects: While much previous research focuses on “which method is better,” this study emphasizes that the more meaningful question is “who is this method best for?” By explicitly testing interactions in a factorial design, this study provides more comprehensive evidence for matching instruction to learner characteristics. , (2) Indonesian Context Studied: The study was conducted in Indonesia, a context relatively understudied in the international literature on soccer skill development. The findings provide ecologically valid evidence for the Indonesian training context with its specific resource constraints and dominant traditional training culture. , (3) Methodological Validity: The use of a quasi-experimental design with multiple time points (pretest, midtest, posttest), stratified random sampling based on motor ability, and control over intervention fidelity strengthens confidence in the results. Sufficient training duration (8-12 weeks, 3 sessions per week) ensures adequate time to detect meaningful changes , and (4) Implications for Talent Development: The finding that Fun Games are effective for all levels of motor ability but to varying degrees has important implications: game-based programs can be implemented universally with modifications of intensity or scaffolding to accommodate individual differences.

At a systems level, these findings suggest the importance of avoiding a one-size-fits-all approach to training. Long-term athlete development models should incorporate explicit attention to variations in fundamental motor competencies and appropriate match training approaches. Research on bio-banding within the Soccer Academy indicates that individualized strategies based on maturity characteristics result in more positive experiences and more optimal development (Cumming et al., 2017).

Conclusions

Based on results study about influence method exercise and motor ability towards soccer player dribbling ability Porsepa FC Subdistrict Lareh Sago Halaban Lima Puluh Kota Regency , can concluded that method exercise own role significant in increase dribbling agility . Fun games training proven more effective

compared to zig-zag dribble , especially for player with high motor ability **.** Although ability motor in a way general No show difference significant between category high and low , there are clear interaction between method training and skills motor to dribbling results . Players with high motor ability get improvement more big through fun games, while for low motor ability No found difference means between second method . With Thus , the election method proper exercise , especially fun games, becomes factor important in optimize player dribbling ability football.

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