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The effect of game-based agility training on students' agility in football extracurricular activities

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ABSTRACT

Agility, the ability to change direction rapidly and accurately in response to a stimulus, is a decisive physical component in football. Preliminary observation of the football extracurricular activity at MTsN 5 Tanah Laut indicated that the students' agility was still relatively low and that the training provided tended to be conventional and monotonous. This study aimed to determine the effect of game-based agility training on the improvement of students' agility. A pre-experimental one group pretest-posttest design was used. The sample consisted of 18 students selected through total sampling, comprising the entire population of the activity. Agility was measured using the Illinois Agility Test, and each participant performed two trials with the fastest time recorded. The treatment, namely game-based agility training, was delivered for four weeks at three sessions per week with a progressive load. Data were analysed using descriptive statistics, the Shapiro-Wilk and Levene tests, and a paired sample t-test, complemented by the effect size (Cohen's d) and the 95% confidence interval of the mean difference. The mean completion time decreased from 16.95 seconds in the pretest to 15.66 seconds in the posttest, a mean difference of 1.29 seconds (95% CI = 1.07 to 1.51). The paired sample t-test yielded $t = 12.324$ with a significance of 0.000 ($p < 0.05$) and a very large effect size (Cohen's $d = 2.90$). Therefore, there was a significant effect of game-based agility training on the improvement of students' agility. Within the limits of a single-group design, this training can serve as an effective and enjoyable alternative for developing the agility of school-age football players.

Keywords: agility; extracurricular; football; game-based agility; Illinois Agility Test

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INTRODUCTION

Physical education is an integral part of the overall education system because, through structured physical activity, students develop not only cognitively but also physically, socially, and emotionally. One of the most important avenues for this development is extracurricular sport, and football is among the activities most favoured by students. Beyond its recreational value, well-

managed extracurricular football helps build discipline, cooperation, responsibility, and character, so that it supports the broader goals of schooling (Arifudin, 2022). At the same time, participation alone is not enough; the quality of the training process determines whether students actually improve their physical abilities and enjoy the activity (Saputra et al., 2023).

Football is also among the most widely played sports in Indonesian schools, which makes the extracurricular setting a natural place to develop the physical qualities the game demands. Yet school programmes often operate with limited time, facilities, and specialised coaching, so the training methods chosen must be efficient, low-cost, and motivating if they are to work. Selecting a method that builds agility while keeping students engaged is therefore both a pedagogical and a practical priority for physical education teachers.

Football is a complex sport that demands an interplay of technical, tactical, physical, and psychological qualities. Among the physical components, agility is one of the most decisive because a player must repeatedly change direction quickly and accurately while keeping balance in a constantly changing game situation. Contemporary literature distinguishes agility from pure change-of-direction (COD) speed: agility integrates a rapid COD with a perceptual and decision-making response to an external stimulus, whereas COD speed refers to pre-planned movement without a reactive component (Young et al., 2022; Morral-Yepes et al., 2023). This distinction matters for training design, because agility that is expressed in real matches is stimulus-driven rather than choreographed.

The importance of agility and COD in youth football has been confirmed by a growing body of evidence. Systematic reviews report that both are trainable qualities that respond to appropriate stimuli during adolescence (Neag et al., 2024), and that they are related to, yet distinct from, sprinting and jumping abilities (Michailidis et al., 2023). Because agility underpins actions such as dribbling past an opponent, transitioning between attack and defence, and reacting to the ball, a lack of agility directly limits a young player's overall performance and the effectiveness of the team.

Preliminary observation of the football extracurricular activity at MTsN 5 Tanah Laut, however, indicated that many students still changed direction slowly and lost balance during play. The training provided tended to be conventional, repetitive, and dominated by isolated drills, so that students became bored easily and their agility did not develop optimally. In addition, the existing programme had not specifically targeted agility. A comparable situation has been documented for junior football players in the same regency, where the physical condition still required structured and progressive training to reach an adequate level (Arifin et al., 2022).

One method that responds to these problems is *game-based agility* training, a form of agility work embedded within game situations that require the player to respond to stimuli such as an opponent's movement, the direction of the ball, or a coach's cue. Because it resembles the actual match environment and simultaneously trains perception and decision making, the game-based approach is considered more representative than isolated drills. Recent studies and reviews consistently show that small-sided games and game-based interventions improve COD speed and agility in youth football players (Neag et al., 2025; Suryadi et al., 2023; Neag et al., 2024), and that speed, agility, and quickness programmes enhance both physical and cognitive performance in young players (Sun et al., 2025; Trecroci et al., 2022).

Supporting evidence comes from several directions. Small-sided games have been shown to produce neuromuscular and change-of-direction adaptations comparable to other high-intensity methods (Wen et al., 2024); plyometric and reactive interventions improve COD speed and reactive agility in young athletes (Michailidis et al., 2023; Sinkovic et al., 2023); and a range of Indonesian studies report that structured agility training such as ladder, cone, zig-zag, and circuit work improves

the agility of students and club players (Alrizal & Muhafid, 2024; Santoso et al., 2023; Lestari & Herawati, 2023; Mirpana & Mahfud, 2024). Taken together, this literature suggests that agility is best developed with representative, enjoyable, game-based tasks rather than isolated drills alone.

Conceptually, game-based agility training is grounded in game-based and tactical approaches to physical education, in which learning is situated within modified games rather than decontextualised drills. Such approaches place the learner in authentic problem-solving situations that couple movement with perception and decision, which is exactly what agility requires in open sports like football. For adolescent students, this design also raises enjoyment and time-on-task, and enjoyment is increasingly recognised as a determinant of adherence and of the quality of physical outcomes in youth training (Trecroci et al., 2022; Arifudin, 2022). Framing agility work as games therefore aligns the physiological aim of the session with the pedagogical aim of keeping students engaged.

Despite this evidence, studies applying game-based agility specifically to junior high school extracurricular students in Indonesia, and at MTsN 5 Tanah Laut in particular, remain scarce. Most existing work involves club or higher-level athletes, or focuses on isolated drill methods. This gap justifies the present study, whose objective was to determine the effect of *game-based agility* training on the improvement of students' agility in the football extracurricular activity at MTsN 5 Tanah Laut. It was hypothesised that game-based agility training would significantly improve the students' agility.

METHOD

Research Design

This study used a quantitative experimental approach with a *pre-experimental* one group pretest-posttest design. A single group received a pretest, then the treatment, and finally a posttest, so that the change could be examined by comparing the two measurements. The pattern is expressed as $O_1 \rightarrow X \rightarrow O_2$, where O_1 is the agility pretest, X is the game-based agility treatment, and O_2 is the agility posttest. Because this design does not include a control group, potential threats to internal validity such as maturation, the testing effect, and history were considered when interpreting the results, and the four-week duration was kept short to limit the influence of maturation. These threats are acknowledged as limitations rather than being fully controlled.

Participants

The population comprised all students who took part in the football extracurricular activity at MTsN 5 Tanah Laut, totalling 18 students. Because the population was small and accessible, the entire population was used as the sample through *total sampling*, so that no separate sampling error was introduced. It should be noted that a sample of 18 provides limited statistical power for detecting small effects; the study was therefore powered to detect only moderate to large within-subject changes, which is consistent with the magnitude typically reported for agility interventions in youth football (Neag et al., 2024). Participation was voluntary, the activity followed the regular school schedule, and the students together with the school gave their consent to take part.

Training Programme

The treatment was delivered for four weeks at a frequency of three sessions per week, on Tuesday, Thursday, and Saturday, with each session lasting 60 to 90 minutes at the Beringin Football Field, Panyipatan. The pretest was administered in May 2026 and the posttest in June 2026. Every session followed the same structure of a warm-up, a game-based agility core, and a cool-down, as summarised in Table 1. To make the protocol reproducible, the training load was defined in terms of

the number of sets and the work-to-rest ratio, and it was increased progressively across the four weeks following the principles of overload and variation, as detailed in Table 2.

Table 1. Structure of Each Training Session

Stage	Activity	Duration
Warm-up	Light jogging, dynamic stretching, and coordination movements	10–15 min
Core	Game-based agility games (tag game, mirror game, capture the cone, reaction game, and small-sided games with direction cues)	40–60 min
Cool-down	Static stretching and breathing recovery	10–15 min

Table 2. Weekly Progression of the Game-Based Agility Programme

Week	Emphasis and games	Sets × work:rest	Intensity
1	Familiarisation; tag and mirror games; basic direction changes	2 × 15 s : 45 s	Low
2	Reaction games and 3v3 small-sided games with visual cues	3 × 20 s : 40 s	Moderate
3	Capture the cone and 4v4 small-sided games with direction cues	3–4 × 25 s : 35 s	Moderate–high
4	Competitive small-sided games and reactive agility games	4 × 30 s : 30 s	High

Instrument

Agility was measured using the *Illinois Agility Test*, a standardised field test that captures the ability to change direction, accelerate, decelerate, and coordinate movement over a course of cones. The test has been widely used in football and other sports and, in recent Indonesian studies, has demonstrated acceptable validity and reliability for assessing agility in athletes (Ilham et al., 2025; Baja et al., 2022), and it is commonly applied together with other physical tests in football contexts (Faudji et al., 2023; Yeni et al., 2025). The result was recorded in seconds, where a shorter completion time indicates better agility. To support measurement consistency, each participant first completed a familiarisation attempt and then performed two recorded trials with the fastest time retained; the two trials were highly consistent for each participant, and the same tester, course, and stopwatch were used at pretest and posttest. Prior Indonesian work has likewise adopted the Illinois Agility Test as the agility instrument in football and futsal settings (Mappaompo, 2024).

Procedure

The study proceeded in three phases. In the first week, the pretest was administered after a standardised warm-up, with the course, the instructions, and the scoring explained uniformly to all students. Over the next four weeks, the game-based agility programme was delivered according to Tables 1 and 2 and supervised by the same coach to keep the delivery consistent. In the final week, the posttest was administered under conditions identical to the pretest, at the same time of day and on the same surface, to minimise measurement variation. Attendance was monitored, and any student who missed a session completed an equivalent make-up task so that the training dose remained comparable across the group.

Data Analysis

The data were analysed in stages. Descriptive statistics (mean, standard deviation, minimum, and maximum) summarised the pretest and posttest scores. The normality of the data was examined with the *Shapiro-Wilk* test, chosen because the sample was fewer than 50, and the homogeneity of

variance with the *Levene* test. Hypothesis testing then used a *paired sample t-test* with a significance criterion of 0.05. Following current reporting recommendations, the analysis was complemented by the effect size using Cohen's d for paired samples and by the 95% confidence interval of the mean difference, so that the practical magnitude of the change could be interpreted alongside statistical significance. All computations were performed with SPSS.

The effect size was computed as the mean difference divided by the standard deviation of the differences and interpreted with conventional thresholds, where values near 0.2, 0.5, and 0.8 denote small, medium, and large effects, respectively. Reporting the confidence interval together with the effect size follows current recommendations to communicate the precision and the practical importance of the change, and not only its statistical significance.

RESULTS AND DISCUSSION

This study examined the agility of 18 football extracurricular players at MTsN 5 Tanah Laut before and after the game-based agility training. The descriptive results show an improvement in agility, reflected in a lower mean completion time at the posttest, as presented in Table 3.

Table 3. Descriptive Statistics of the Agility Test

Data	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	18	15.83	18.58	16.9506	0.77697
Posttest	18	14.70	17.85	15.6633	0.87545

Table 3 shows that the mean completion time decreased from 16.95 seconds at the pretest to 15.66 seconds at the posttest, an improvement of 1.29 seconds. Because a shorter time in the *Illinois Agility Test* reflects better agility, this decrease indicates a meaningful improvement. The fastest pretest time was 15.83 seconds and the slowest 18.58 seconds, whereas at the posttest the fastest time improved to 14.70 seconds and the slowest to 17.85 seconds, showing that gains occurred across the group rather than being driven by a few individuals. Before hypothesis testing, the analysis prerequisites were checked. The normality results are presented in Table 4.

Table 4. Normality Test Results (Shapiro-Wilk)

Data	Statistic	df	Sig.
Pretest	0.949	18	0.412
Posttest	0.897	18	0.050

The significance values were greater than or equal to 0.05, so the pretest and posttest data were normally distributed and eligible for parametric analysis. The homogeneity of variance was then examined, with the results shown in Table 5.

Table 5. Homogeneity Test Results (Levene's Test)

Basis	Levene Statistic	df1	df2	Sig.
Based on Mean	1.815	1	34	0.187
Based on Median	0.930	1	34	0.342

Because the significance value exceeded 0.05, the variances were homogeneous. With the normality and homogeneity assumptions satisfied, the paired sample t-test was applied; the results, together with the effect size and confidence interval, are presented in Table 6.

Table 6. Paired Sample t-Test, Effect Size, and Confidence Interval

Pair	Mean	Std. Dev.	t	df	Sig. (2-tailed)	95% CI of mean
Pretest – Posttest	1.28722	0.44315	12.324	17	0.000	1.07 – 1.51

The paired sample t-test produced a mean difference of 1.28722 seconds, t = 12.324, and a significance of 0.000. Since the significance was below 0.05, the null hypothesis was rejected and the alternative hypothesis accepted. The 95% confidence interval of the mean difference ranged from 1.07 to 1.51 seconds, which does not include zero and therefore confirms a consistent improvement, while the effect size was very large (Cohen's d = 2.90). Thus, game-based agility training had a statistically significant and practically large effect on the agility of the football extracurricular players at MTsN 5 Tanah Laut.

Inspection of the individual scores indicated that every participant improved from pretest to posttest, and the relatively small standard deviation of the differences (0.44 seconds) shows that the response to the programme was consistent across the group. This uniformity, together with the progressive weekly load summarised in Table 2, is compatible with a training-induced adaptation rather than a change driven by a few outliers.

This improvement can be explained by the demands that game-based agility training places on the players. The games required repeated acceleration, deceleration, and rapid change of direction while responding to a moving stimulus, which are the core elements of agility. Training that resembles match conditions therefore provides a richer stimulus than isolated drills, and the finding is consistent with reviews and experimental studies reporting that small-sided games and game-based interventions are more effective than purely pre-planned drills for developing agility and COD in youth football (Neag et al., 2025; Suryadi et al., 2023; Neag et al., 2024).

Physiologically, the gains are linked to *neuromuscular* adaptation from systematic and progressive training, which allows the nervous and muscular systems to produce faster, better-coordinated movements and thus shorter completion times. Similar adaptations in change-of-direction ability have been reported after plyometric, combined, and speed-agility-quickness programmes in youth players (Michailidis et al., 2023; Sun et al., 2025), and small-sided games have produced change-of-direction adaptations comparable to other high-intensity methods (Wen et al., 2024). Beyond the mechanical side, the reactive nature of the games also trains the perceptual and decision-making component that distinguishes true agility from pre-planned COD (Sinkovic et al., 2023; Morral-Yepes et al., 2023; Young et al., 2022).

An additional advantage of the game-based approach is its motivational quality. Because the training is framed as play and competition, students remained active, engaged, and less prone to boredom, which suits the characteristics of junior high school learners. This is in line with evidence that speed-agility-quickness and game-based work can improve physical and cognitive outcomes while sustaining engagement (Trecroci et al., 2022). The present results also agree with a range of Indonesian studies in which structured agility training, including zig-zag, ladder, cone, hexagon, circuit, and ball-feeling combined with agility, improved the agility and dribbling of students and club players (Alrizal & Muhafid, 2024; Santoso et al., 2023; Shabih et al., 2021; Khoironi et al., 2025; Hermansyah & Wardani, 2022; Ilahi & Badri, 2021), as well as with work using complementary methods such as side jump sprint and shuttle-run based models to enhance agility (Rachman et al., 2024; Nurhasan, 2022).

From a practical standpoint, the findings suggest that agility should be trained with representative, enjoyable, game-based designs rather than isolated drills alone, since the perceptual and decision-making demands of the game are central to agility performance (Young et al., 2022). They also reinforce the value of monitoring the physical condition and agility of school football players through regular, standardised testing (Saputra et al., 2023; Purnomo & Irawan, 2021), and of attending to the situational patterns in which change of direction occurs (Alanen et al., 2023). For

coaches at the school level, brief weekly blocks of game-based agility can be integrated into ordinary sessions without special equipment.

The magnitude of the change deserves comment. A reduction of about 1.3 seconds on the Illinois Agility Test, accompanied by a very large standardised effect, is larger than the improvements typically reported over comparable periods in controlled youth-football studies. Part of this difference is probably genuine, reflecting the representative and intensive nature of the games, but part may be inflated by the absence of a control group and by familiarisation with the test, which is why the effect is best read as an upper-bound estimate rather than a precise treatment effect (Neag et al., 2024; Sun et al., 2025). Interpreting the result against these benchmarks keeps the practical claim realistic.

The perceptual-cognitive dimension also merits attention. In open games, players must read cues, anticipate, and select responses under time pressure, so that gains in agility reflect faster and more accurate decisions as well as faster movement. Reactive tasks that preserve this stimulus-driven element tend to transfer better to game agility than pre-planned drills (Sinkovic et al., 2023; Morral-Yepes et al., 2023), and position statements on agility in invasion sports recommend training the coupling of perception and action rather than isolated footwork (Young et al., 2022). The games used here, which required responses to opponents, cues, and the ball, were designed with this principle in mind.

For physical education and school extracurricular programmes, these findings carry practical value. Game-based agility can be delivered with minimal equipment, fits within a normal session, and develops fitness, skill, and enjoyment at the same time, which supports both the physical and the character-building aims of extracurricular sport (Arifudin, 2022; Saputra et al., 2023). Comparable Indonesian studies across football and futsal settings report agility gains from a variety of structured methods (Mirpana & Mahfud, 2024; Khoironi et al., 2025; Mappaompo, 2024; Purnomo & Irawan, 2021), suggesting that the key is not a single drill but a progressive, engaging, and representative design that teachers and coaches can adapt to their own context.

It is instructive to compare this single-group result with controlled studies. In volume-matched trials, both reactive and planned agility training improve physical performance in youth players, and reviews of small-sided games confirm robust change-of-direction gains (Neag et al., 2025; Sun et al., 2025). The direction of the present findings is consistent with this literature; however, because no control group was used here, the size of the effect cannot be attributed to the game-based method alone and should be confirmed in controlled designs.

Several limitations temper these conclusions. The one group pretest-posttest design lacks a control group, so the improvement cannot be fully separated from maturation, the testing or familiarisation effect, and other external factors; part of the gain may reflect greater familiarity with the test at the posttest. The sample was small and drawn from a single school, the intervention lasted only four weeks, and agility was captured by a single field test without measuring the perceptual component directly. These constraints limit the generalisability of the results. Future research should use a randomised controlled design with a larger, multi-school sample, a longer intervention, and reactive agility measures that separate the physical and decision-making components, so that the specific contribution of the game-based method can be isolated.

CONCLUSION

In line with its objective, this study found that game-based agility training significantly improved the agility of students in the football extracurricular activity at MTsN 5 Tanah Laut. The mean *Illinois Agility Test* time decreased from 16.95 seconds at the pretest to 15.66 seconds at the posttest, and the paired sample t-test was significant ($t = 12.324$; $p = 0.000$), with a very large effect

size (Cohen's d = 2.90) and a 95% confidence interval of the mean difference of 1.07 to 1.51 seconds. Within the limits of a single-group design applied to one school, game-based agility training can therefore be regarded as an effective and enjoyable option for improving the agility of school-age football players, and this conclusion should not be over-generalised beyond comparable settings without further controlled study. Coaches are encouraged to use the method as a training variation, schools to support adequate facilities, and future researchers to employ a controlled design with a larger sample and a longer duration.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

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