Research Article

Effects of An Eight-Week Differential Training Program on Tactical Efficiency in Under-18 Football Players: A Controlled Experimental Study

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Abstract

This study examined the effects of an eight-week differential training program on tactical efficiency in under-18 football players. A controlled experimental design with pre- and post-intervention measurements was adopted. Twenty-four male youth players were allocated into two equivalent groups, with 12 players in the experimental group and 12 in the control group. The experimental group completed a differential training program three times per week for eight weeks, resulting in 24 training sessions, while the control group continued the conventional training program prescribed by the team coach. Each differential training session included three exercises, with five varied situations per exercise. Training variability was introduced through systematic changes in speed, distance, movement direction, pressure intensity, number of ball touches, player positioning, playing space, direction of attack, and type of finishing. Tactical efficiency was assessed using three football-specific tests: the Tactical Linking and Scoring Test, the Complex Tactical Performance and Scoring Test, and the Tactical Performance with Change of Direction and Scoring Test. The results showed significant pre- to post-intervention improvements in the experimental group across all tactical efficiency measures ($p < 0.001$). Post-test comparisons also revealed significant differences between the experimental and control groups in all six outcomes, favoring the experimental group. The largest between-group differences were observed in the Tactical Linking and Scoring Test for completion time ($t = 7.865$, $p < 0.001$) and performance score ($t = 12.725$, $p < 0.001$). These findings indicate that differential training can effectively enhance tactical efficiency, decision-making, and adaptive tactical performance in youth football players by exposing them to continuously changing and representative game-related conditions.

Keywords: Differential Training; Tactical Efficiency; Youth Football; Decision-Making; Tactical Performance; Motor Adaptation; Under-18 Players.

1. Introduction

Modern football requires players to operate effectively in an environment characterized by continuous changes in space, time, opponent behavior, and tactical demands. Consequently, training methods based primarily on reproducing the same movement pattern may not fully reflect the variability encountered during competitive play. Differential training offers an alternative approach by deliberately introducing continuous variations into practice, allowing players to explore multiple movement solutions rather than repeatedly reproducing an identical technique. Such variability may enhance motor learning, adaptability, and retention by encouraging players to reorganize their actions in response to changing task and environmental constraints [1,2]. Within football, this approach is particularly relevant because technical and tactical actions rarely occur under identical conditions, and players are continually required to adjust their responses according to the evolving context of the game [3].

Tactical efficiency represents a central component of effective football performance because it reflects the player's ability to select and execute appropriate attacking and defensive actions according to the positions of the ball, teammates, and opponents. It involves not only the execution of predefined tactical principles but also the ability to coordinate movement, maintain spatial organization, and respond efficiently to changing game conditions [4]. Tactical behavior is therefore shaped by the interaction between individual perception and collective organization, while coaching instructions and task constraints may influence how players coordinate their movements and perform tactical roles during play [5]. Clear tactical information can direct players' attention toward relevant environmental cues, but effective tactical performance ultimately depends on the capacity to continuously adjust behavior rather than merely reproduce fixed solutions [6].

This adaptive process is closely related to motor adaptability. With repeated exposure to variable practice conditions, players become more capable of modifying movement patterns while preserving the intended

performance outcome [7]. Motor variability should therefore not be interpreted simply as inconsistency, as controlled variations in movement can provide functional solutions to changing task demands [8]. When players encounter unfamiliar or perturbed conditions, gradual adjustments in movement allow errors to be reduced and more appropriate responses to emerge, indicating that adaptation is an essential mechanism underlying successful performance in dynamic sporting environments [9].

Decision-making provides the link between perception and tactical execution. Football players must continuously interpret information from the surrounding environment, evaluate available alternatives, and select an appropriate response under temporal and spatial pressure [10]. These decisions depend on the interaction between perceptual-cognitive processing and motor execution, meaning that decision-making develops most effectively in representative training environments that preserve the complexity of competitive play [11]. In open-skill situations, the appropriate action cannot be fully predetermined because the positions and movements of teammates and opponents are constantly changing; therefore, tactical success depends on accurately reading the game and selecting an action that fits the immediate situation [12].

The preparation of youth football players should consequently integrate technical, physical, tactical, perceptual, and psychological demands rather than developing these components in isolation [13]. Competitive football places substantial demands on acceleration, deceleration, sprinting, directional changes, and repeated high-intensity actions, all of which occur simultaneously with technical and tactical decision-making [14]. Moreover, these demands differ according to playing position and tactical role, reinforcing the need for training environments that allow players to adapt to diverse and unpredictable performance situations [15].

Despite growing interest in variable and game-based training approaches, an important issue remains regarding the extent to which a structured differential training program can specifically improve tactical efficiency in under-18 football players. The present study therefore aimed to examine the effects of an eight-week differential training program on tactical efficiency in under-18 football players. The main problem addressed was the limited ability of conventional, relatively repetitive training environments to reproduce the variability and decision-making demands of actual match play. The study contributes by applying systematic variations in speed, distance, direction, pressure, and tactical conditions within a controlled experimental design and by evaluating their effects through three football-specific tactical efficiency tests.

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2. Previous Studies

Recent research has increasingly emphasized the importance of variability, representative task design, and decision-making demands in developing tactical performance in youth football. Hamaidi et al. [16] examined the integration of differential learning with small-sided games in under-20 amateur players and reported greater improvements in possession, successful passing, defensive interventions, and decision-making compared with small-sided games alone. Their findings are particularly relevant because the intervention lasted eight weeks and demonstrated that introducing variability into game-based training can enhance both technical and tactical responses without requiring an entirely separate training structure.

A similar emphasis on tactical problem-solving was reported by Gaviria Alzate et al. [17], who applied an eight-week critical tactical thinking program to under-14 players. Tactical efficiency increased by 41%, whereas changes in declarative and procedural knowledge were comparatively limited. These findings suggest that tactical development may respond strongly to training environments that require players to analyse game situations and generate solutions rather than simply receive predetermined instructions. Dalbudak et al. [18] also reported improvements in decision-making and offensive and defensive tactical skills after an eight-week psychological skills intervention in under-19 players, indicating that tactical performance is influenced not only by physical and technical preparation but also by cognitive and perceptual processes involved in recognizing and responding to game situations.

Evidence from cognitive-motor approaches further supports this relationship. Salih et al. [19] found that an eight-week cognitive-motor modelling program produced substantial improvements in situational awareness and tactical behavior accuracy in players aged 15–17 years, with gains of 23.8% and 19.6%, respectively, compared with much smaller improvements in the control group. These results reinforce the value of training designs that combine perceptual demands with movement execution and indicate that tactical behavior may be

enhanced when players are repeatedly exposed to tasks requiring continuous interpretation of changing information.

The structure of the training task itself also appears to influence tactical behavior. O'Brien-Smith et al. [20] demonstrated that modifying instructions and game design during 5v5 small-sided games altered dribbling involvement, scoring behavior, and passing-network organization among youth players. Likewise, Gonzalez-Artetxe et al. [21] showed that artificial rules and training constraints produced individualized changes in tactical behavior among U14 and U16 players, particularly in exploratory movement and spatial use. Importantly, their findings highlighted that players do not necessarily respond uniformly to the same constraints, which supports the principle of individualized adaptation inherent in differential training.

The relationship between decision-making quality and tactical efficiency has also been demonstrated under demanding match-like conditions. Dambroz and Teoldo [22] found that players with higher decision-making ability were able to maintain tactical efficiency under acute physical fatigue, whereas players with lower decision-making ability showed significant reductions in defensive and overall tactical efficiency. This result suggests that tactical effectiveness is closely associated with the player's capacity to identify relevant information and select appropriate actions even when physical resources are reduced.

Game-based interventions also provide evidence for the value of variable practice environments. Seyhan et al. [23] reported that an eight-week small-sided games program significantly improved passing performance and aerobic endurance in adolescent players. Although tactical efficiency was not directly measured, the intervention systematically manipulated player numbers, pitch dimensions, and task constraints, thereby increasing perceptual and decision-making demands. Similarly, the systematic review and meta-analysis conducted by Clemente et al. [24] confirmed beneficial effects of small-sided game interventions on technical execution in young team-sport players. However, the review identified a notable lack of eligible controlled studies that directly assessed tactical behavior, highlighting an important gap in the literature.

Taken together, previous studies indicate that tactical behavior and decision-making can be improved through game-based, cognitively demanding, and variable training environments. Nevertheless, much of the available literature has focused on small-sided games, tactical instruction, cognitive-motor interventions, or technical outcomes, while relatively fewer controlled studies have examined differential training as the primary intervention and tactical efficiency as the principal dependent variable in under-18 football players. This gap provides the rationale for evaluating a structured eight-week differential training program in which movement and tactical conditions are systematically varied and tactical efficiency is assessed through football-specific pre- and post-intervention tests.

3. Materials and Methods

3.1 Study Design and Participants

The practical component of the present study was derived from a master's thesis examining the effects of differential training on tactical efficiency in under-18 football players, with the present paper focusing specifically on the experimental design, differential training intervention, tactical efficiency assessments, and the related pre- and post-intervention outcomes [25]. A controlled experimental design with pre- and post-tests was employed. The study population consisted of 30 male youth football players registered at the Football Training Center affiliated with the Department of Sports and Scout Activities, Dhi Qar Education Directorate, Iraq, during the 2025–2026 season. Twenty-four players were selected for the main experiment and randomly allocated into two equivalent groups, with 12 players in the experimental group and 12 in the control group, while six additional players participated in the pilot procedures. The participants had a mean age of 17.5 ± 0.50 years and a mean training age of 4.1 ± 0.80 years, and baseline comparisons confirmed the equivalence of the two groups in the tactical efficiency variables before the intervention.

3.2 Pre-Intervention Testing

Pre-intervention testing was conducted on 14 February 2026 at Al-Hay Al-Askari football field in Dhi Qar Governorate before the beginning of the training program. Both groups completed the same tactical efficiency assessments under standardized conditions regarding timing, field environment, equipment, and testing procedures. These baseline measurements were used to establish the initial tactical efficiency level and to ensure valid comparison with the post-intervention results. No significant baseline differences were found

between the experimental and control groups in the three tactical efficiency tests, confirming that the groups were comparable before the intervention.

3.3 Differential Training Intervention

The experimental group completed an eight-week differential training program from 15 February to 12 April 2026, with three training sessions per week on Saturday, Monday, and Wednesday, resulting in a total of 24 sessions. The differential exercises were incorporated into the main part of each session, lasting approximately 25–40 min. Each session included three differential exercises, and each exercise consisted of five varied performance situations. The intervention was based on continuous changes in speed, distance, direction, pressure intensity, number of ball touches, player positioning, playing space, direction of attack, and type of finishing. Training intensity ranged from approximately 75% to 100%, a work-to-rest ratio of approximately 1:2 was used between repetitions, and a 240-s recovery period was provided between sets. The control group continued the conventional football training program prescribed by the team coach.

3.4 Tactical Efficiency Assessment

Tactical efficiency was the principal dependent variable and was assessed using three football-specific field tests: the Tactical Linking and Scoring Test, the Complex Tactical Performance and Scoring Test, and the Tactical Performance with Change of Direction and Scoring Test. Each test incorporated coordinated tactical actions involving receiving, passing, movement, positional adjustment, directional change, and finishing. Two primary outcomes were recorded for each test: completion time in seconds and performance score in points. Better tactical efficiency was represented by shorter completion time together with a higher performance score. The first test assessed sequential tactical linking and finishing, the second involved a more complex multi-player tactical sequence, and the third emphasized tactical execution under directional changes before finishing on goal.

3.5 Post-Intervention Testing

Post-intervention testing was conducted on 17 April 2026 after completion of the eight-week training program. Both the experimental and control groups were reassessed using the same tactical efficiency tests and under the same field, equipment, timing, and procedural conditions used during the pre-test. Maintaining identical testing conditions was intended to reduce procedural variability and ensure that changes between pre- and post-intervention measurements reflected the effects of the respective training programs.

3.6 Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 23. Descriptive statistics included arithmetic means and standard deviations. Paired-samples t-tests were used to examine pre- to post-intervention differences within each group, while independent-samples t-tests were used to compare the experimental and control groups. Baseline equivalence between groups was examined before the intervention, and statistical significance was accepted at $p < 0.05$.

4. Results

Baseline analysis showed no statistically significant differences between the experimental and control groups in any of the tactical efficiency measures, indicating that both groups started from comparable levels before the intervention.

Table 1. Pre- and post-test tactical efficiency results in the control group

Tactical efficiency test	Variable	Pre-test Mean ± SD	Post-test Mean ± SD	t	p
Tactical Linking and Scoring	Time (s)	26.432 ± 0.614	25.658 ± 0.620	3.254	0.004
	Score (points)	9.167 ± 0.464	10.100 ± 0.000	5.333	<0.001
Complex Tactical Performance and Scoring	Time (s)	39.508 ± 0.793	38.611 ± 1.311	2.747	0.012
	Score (points)	10.817 ± 1.099	11.383 ± 0.501	2.274	0.033

Tactical Performance with Change of Direction and Scoring	Time (s)	27.912 ± 0.665	26.521 ± 1.044	3.237	0.004
	Score (points)	9.883 ± 0.515	10.550 ± 0.224	5.101	<0.001

The control group demonstrated statistically significant pre-to-post improvements across all tactical efficiency variables. However, the magnitude of these changes was relatively limited, with modest reductions in completion time and smaller increases in performance scores compared with the experimental group.

Table 2. Pre- and post-test tactical efficiency results in the experimental group

Tactical efficiency test	Variable	Pre-test Mean ± SD	Post-test Mean ± SD	t	p
Tactical Linking and Scoring	Time (s)	26.025 ± 0.800	23.240 ± 0.866	5.048	<0.001
	Score (points)	8.825 ± 0.705	13.167 ± 0.835	9.078	<0.001
Complex Tactical Performance and Scoring	Time (s)	39.032 ± 0.656	36.270 ± 1.044	6.565	<0.001
	Score (points)	11.250 ± 0.866	13.533 ± 1.030	7.608	<0.001
Tactical Performance with Change of Direction and Scoring	Time (s)	27.401 ± 0.787	24.643 ± 1.030	4.563	<0.001
	Score (points)	10.167 ± 0.986	13.367 ± 0.888	5.791	<0.001

The experimental group showed statistically significant improvements in all six tactical efficiency outcomes. In the Tactical Linking and Scoring Test, completion time decreased from 26.025 ± 0.800 s to 23.240 ± 0.866 s, while the score increased from 8.825 ± 0.705 to 13.167 ± 0.835 points. In the Complex Tactical Performance and Scoring Test, time decreased from 39.032 ± 0.656 s to 36.270 ± 1.044 s, while the score increased from 11.250 ± 0.866 to 13.533 ± 1.030 points. In the Tactical Performance with Change of Direction and Scoring Test, completion time decreased from 27.401 ± 0.787 s to 24.643 ± 1.030 s, while the score increased from 10.167 ± 0.986 to 13.367 ± 0.888 points.

Table 3. Post-test comparison between the experimental and control groups

Tactical efficiency test	Variable	Experimental Mean ± SD	Control Mean ± SD	t	p
Tactical Linking and Scoring	Time (s)	23.240 ± 0.866	25.658 ± 0.620	7.865	<0.001
	Score (points)	13.167 ± 0.835	10.100 ± 0.000	12.725	<0.001
Complex Tactical Performance and Scoring	Time (s)	36.270 ± 1.044	38.611 ± 1.311	4.838	<0.001
	Score (points)	13.533 ± 1.030	11.383 ± 0.501	6.504	<0.001
Tactical Performance with Change of Direction and Scoring	Time (s)	24.643 ± 1.030	26.521 ± 1.044	4.436	<0.001
	Score (points)	13.367 ± 0.888	10.550 ± 0.224	10.659	<0.001

The post-test comparison revealed statistically significant differences between the experimental and control groups in all tactical efficiency outcomes, consistently favoring the experimental group. In the Tactical Linking and Scoring Test, the experimental group recorded a significantly faster completion time than the control group,

with t = 7.865 and p < 0.001, as well as a significantly higher score, with t = 12.725 and p < 0.001. Significant between-group differences were also observed in the Complex Tactical Performance and Scoring Test for both time (t = 4.838, p < 0.001) and score (t = 6.504, p < 0.001). Similarly, the experimental group performed significantly better in the Tactical Performance with Change of Direction and Scoring Test for both time (t = 4.436, p < 0.001) and score (t = 10.659, p < 0.001). These findings demonstrate a clear advantage of differential training over conventional training in improving tactical efficiency.

5. Conclusions

1. he eight-week differential training program significantly improved tactical efficiency in under-18 football players, as reflected by faster completion times and higher tactical performance scores across all three tactical tests.
2. Continuous variation in speed, distance, direction, pressure intensity, playing space, and tactical conditions enhanced the players' ability to adapt their actions and respond effectively to changing game situations.
3. The experimental group achieved significantly better post-intervention results than the control group in all tactical efficiency measures, with all between-group comparisons reaching p < 0.001.
4. Differential training can be considered an effective approach for developing tactical decision-making, tactical awareness, and adaptive performance in youth football players, particularly when training tasks reproduce the variability and unpredictability of competitive match situations.

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