

The Effectiveness of CrossFit Training on Physical Performance in Amateur Youth Football Players

A Field Study on Under-17 Football Players at Afaq El-Mrahna Club

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Abstract

This study aimed to investigate the effectiveness of CrossFit training on the physical performance of amateur youth football players over an 8-week intervention period. An experimental design was employed, and the sample consisted of 28 football players. The principal findings demonstrated that CrossFit training exerts a positive influence on both endurance and strength capacities. Specifically, the study concluded that: statistically significant differences exist between pre- and post-test scores in speed endurance and strength tests; and a statistically significant effect was recorded at the 0.05 significance level in speed endurance among football players, as evidenced by the mean scores on endurance and strength tests following the CrossFit intervention.

Keywords: *CrossFit, Football, Endurance, Muscular Strength, Youth Athletes*

1. Introduction

Football is among the most widely practiced and globally popular sports. No longer a mere recreational activity or competitive pastime, it has evolved into a comprehensive system grounded in precise scientific principles spanning training methodology, physical conditioning, nutrition, and functional player monitoring. Contemporary football has witnessed remarkable advances in the pace of play and speed of execution, placing extraordinary physical demands on players who must respond to a wide range of match requirements—rapid positional transitions, powerful physical contests, and sustained endurance throughout the full duration of play.

The physical dimension constitutes one of the most critical pillars underpinning a football player's success, particularly at younger age categories, where the youth developmental stage forms the foundational framework for building a well-rounded player in the future. During this period, athletes are most receptive to acquiring and refining physical attributes, which has driven coaches and sports science researchers toward an ongoing pursuit of modern, effective training methods capable of enhancing physical performance in a scientifically grounded manner consistent with the demands of contemporary football (Abd al-Khaliq, 2005).

With the continuous advancement of sports training science, numerous modern training systems have emerged with the aim of developing physical fitness in a comprehensive and integrated fashion. Among these, CrossFit training has garnered considerable attention in recent years, both in competitive sport and in the domain of general physical preparation. This training modality is characterized by the performance of diverse functional exercises that combine intensity, progressive

overload, and integration across multiple fitness components—including muscular strength, speed, endurance, agility, and flexibility—making it a suitable approach for developing the physical performance of athletes in general, and football players in particular (Smith et al., 2013).

A growing body of recent studies has confirmed that training programs based on functional exercises and high-intensity training contribute effectively to improving the physical and functional capacities of youth athletes, owing to the variety of performance demands and the sustained motivational stimulus they provide during training sessions. The adoption of modern training methods also serves to break the monotony of conventional practice, elevating players' motivation and producing positive outcomes for both physical and technical performance levels (Hayden, 2013).

Field observations of amateur football training practices reveal that some coaches continue to rely on traditional programs that target only a limited range of physical conditioning components, even though modern football demands the simultaneous, integrated development of diverse physical capacities. This gap highlighted the need to incorporate CrossFit training as a contemporary methodology capable of making a meaningful contribution to the physical preparation of youth players—particularly given its hallmark qualities of variety and comprehensiveness.

This study holds particular significance given its focus on the youth developmental category—one of the most critical phases for establishing the physical and functional foundations of a football player. It seeks to ascertain the extent to which CrossFit training effectively develops selected physical capacities among amateur under-17 football players, with the aim of producing scientific evidence that coaches and researchers can apply to improve training programs and elevate players' physical performance.

The study is further situated within the context of keeping pace with contemporary trends in sports training, which increasingly emphasize the integration of scientific methods and field applications in pursuit of optimal athletic achievement—especially given the dramatic physical and functional demands that characterize modern football.

In light of the foregoing, the study addresses the following central research question:

Does CrossFit training exert a significant effect on the endurance and strength attributes of under-17 amateur football players?

1.1 Sub-Questions

- Are there statistically significant differences between pre- and post-test scores in the endurance attribute among under-17 football players?
- Are there statistically significant differences between pre- and post-test scores in the strength attribute among under-17 football players?

2. Objectives of the Study

- To design a CrossFit training program aimed at improving the physical performance of under-17 football players.
- To identify the effects of CrossFit training on the physical capacities of youth football players.
- To examine the effect of CrossFit exercises on the development of selected physical variables, specifically strength and endurance.
- To determine the differences between pre- and post-tests in selected physical variables for both the experimental and control groups.

- To identify the most appropriate physical tests for measuring the actual effect of CrossFit training on the endurance and strength attributes.

3. Significance of the Study

The significance of this study lies in its demonstration of the value of CrossFit training in enhancing physical fitness components among football players—both for its health-related benefits and its cardiovascular effects. CrossFit training also promotes a psychologically healthy competitive spirit among practitioners and heightens their motivation to exert greater effort. Furthermore, it improves the level of mechanical efficiency of performance and the amount of energy expended by reducing resting heart rate and developing the motor functions of trainees. It positively influences muscle extensibility by engaging all body segments, while improving performance and key physiological capacities such as the anaerobic threshold, maximal oxygen uptake (VO₂max), and body composition. CrossFit training integrates a variety of methods—including core training, compound training, functional training, plyometric training, weightlifting, and cardio exercises—with exercises ranging in difficulty according to the intended goal. Like any athletic regimen, it begins with a warm-up, followed by alternating and diverse exercises such as push-ups, pull-ups, abdominal work, suspension exercises, gymnastics movements, weightlifting, bodyweight exercises, swimming, rowing, running, jumping, and ball throwing. CrossFit is a harmonious blend of diverse technical movements, and its overarching aim is to prepare the athlete through ten foundational physical components: cardiovascular endurance, muscular endurance, muscular strength, flexibility, power, speed, coordination, agility, accuracy, and balance—achieved through the balance between aerobic and anaerobic work in proportions appropriate to the specific sport.

4. Research Hypotheses

- There are statistically significant differences between pre- and post-test scores in the endurance attribute among under-17 football players, attributable to CrossFit training.
- There are statistically significant differences between pre- and post-test scores in the strength attribute among under-17 football players, attributable to CrossFit training.

5. Conceptual and Operational Definitions

5.1 *CrossFit*

Etymologically: The coordination of exercises.

Technically: A set of diverse functional movements performed at high intensity, whereby continuous variation provides a different stimulus to the body in each session, resulting in continuous improvements in physical fitness levels (Abd al-Karim, 2021).

CrossFit is a diverse range of athletic exercises designed to execute functional movements at high intensity. It encompasses aerobics, weightlifting, walking, running, jumping, and other activities; it improves physical elements such as strength, speed, and agility (Smith et al., 2013).

Operationally: A set of diverse functional movements combining bodyweight exercises, aerobics, and high-intensity weightlifting to improve motor functions. These take the form of a wave of muscular contractions engaging all body segments, performed in a group or individual context.

5.2 *Physical Endurance*

Etymologically: To sustain performance for the longest possible period.

Technically: The athlete's capacity to continue performing effectively without a decline in efficiency (Wikipedia, 2018).

Operationally: The football player's ability to perform technical skills over the longest possible period while tolerating the accumulation of lactic acid produced by muscular exertion.

5.3 Muscular Strength

Etymologically: The antithesis of weakness.

Technically: The capacity of a muscle or muscle group to overcome external resistance regardless of its magnitude or form (Ghadir Mahdi, 2023).

Operationally: The muscles' ability to exert maximum effort without experiencing fatigue; muscular strength depends on muscle size, flexibility, and the number and type of constituent muscle fibers.

5.4 Under-17 Players (U17 Category)

Technically: Football players aged under 17 years. This category (ages 15–17) encompasses the middle phase of adolescence, characterized by changes in height, weight, breadth, shape, and body composition, as well as changes in motor, physical, cognitive, social, and emotional functions to accompany the individual's developing life. It is marked by a diminishing of childlike behavior and rapid bone and muscle growth (Ghadir Mahdi, 2023).

Operationally: A group of players aged 16–17 years belonging to the U17 youth category, at a stage constituting one of the fundamental phases of organized football participation.

6. Review of Related Studies

6.1 Study by Zabbani and Al-Arabi (2021)

Titled "The Effectiveness of CrossFit Exercises in Improving the Physical Endurance of a Sample of Amateur Young Bodybuilders," this study aimed to determine the effect of CrossFit training on physical endurance among young amateur bodybuilders affiliated with training halls in the city of El-Bayadh. A single-group experimental design was employed with a purposive sample of 8 participants. Three physical tests were administered to assess endurance. Following data analysis, the study found statistically significant improvements in physical endurance ($p < .05$), with mean scores between pre- and post-tests showing significant differences attributable to CrossFit training.

6.2 Study by Ergin (2002)

Titled "The Effect of a Six-Week CrossFit Training Program on Anaerobic Endurance and Anaerobic Power in Male Basketball Players," this study examined the impact of CrossFit training over six weeks on anaerobic endurance and power in male basketball players ($n = 24$). The principal finding was that the six-week CrossFit program produced positive effects, improving both anaerobic capacity and anaerobic endurance.

6.3 Study by Kumar (2017)

Titled "The Effect of CrossFit and Resistance Training on Physiological, Anthropometric, and Performance Variables Among Basketball Players," this study investigated the effects of CrossFit and resistance training on specified physiological and anthropometric fitness variables. An experimental approach was applied to a sample of 75 basketball players from various colleges. A key finding was a significant reduction in the resting heart rate of the experimental group.

7. Methodology

7.1 Pilot Study

The pilot study is among the most important phases the researcher must undertake to confirm the suitability of the research setting and the appropriateness of the measurement instruments. A pilot study was conducted at the Afaq El-Mrahna Sports Club in the municipality of Mrahna, Souk Ahras Province, to verify the suitability of the tests for the research sample. This phase also involved meetings with team coaches to discuss the study procedures and to identify any potential obstacles to achieving the study's objectives. Psychometric properties of the physical tests—including validity and reliability—were assessed using a pilot sample of 6 youth football players.

The pilot phase proceeded in two stages:

- *Phase One*: Conducted on 2 September 2025 with a randomly selected sample of 6 players. Objectives included: verifying the functionality of measurement instruments and equipment; determining the time required for each measurement or test; identifying difficulties encountered during the experiment; understanding the nature of the tests and their administration procedures; and confirming that the tests were appropriate to the sample's level and characteristics.
- *Phase Two*: Applied from 4 September 2025 to a sample of 6 youth players drawn from outside the main sample. Tests were re-administered one week later to assess test-retest reliability.

7.2 Research Design

Given the study's focus on determining the effectiveness of CrossFit training on physical performance in football players, the experimental method was selected as the most appropriate design. The experimental approach enables the objective study of phenomena and allows the researcher to test at least one hypothesis (Abu al-Nasr, 2017). A two-group experimental design with pre- and post-tests was adopted (experimental group and control group).

7.3 Population and Sample

The study population comprised all youth football players from sports clubs in the Souk Ahras Province. A purposive sample of 35 players was drawn from a single sports club in the province. Following exclusion of injured players and those who did not complete the program, 28 players were included in the final analysis.

7.4 Research Scope

- Human domain: Youth football players from the U17 category.
- Spatial domain: Municipality of Mrahna, Souk Ahras Province, Algeria.
- Temporal domain: August 2025 to November 2025.

7.5 Research Variables

- Independent variable: CrossFit training exercises.
- Dependent variable: Physical performance of football players.

7.6 Research Instruments

A set of physical tests, validated by expert review, was used to measure the strength and endurance attributes:

- Sargent vertical jump test and standing long jump test: to measure muscular strength.
- 500-metre run test: to measure aerobic endurance; 200-metre run test: to measure speed endurance.

Additional instruments included result recording forms, an expert evaluation form for validating the tests prior to application, and SPSS version 25 for statistical analysis.

Table 1: Instruments and Equipment Used During Tests and Morphological Measurements

No.	Instrument	Quantity	Purpose
01	Medical scale	01	To measure body weight
02	Measuring tape	03	To take anthropometric measurements
03	Large plastic cones	30	To mark positions during tests
04	Sport stopwatch	02	To time test execution
05	Whistle	02	To signal the start of tests
06	Player result recording card	02	To record measurement and test results
07	Chalk	02	To mark the jump line for the Sargent test
08	Sand pit	01	For the standing long jump test

7.7 Physical Tests Used in the Study

The physical tests were selected after a review of relevant literature and prior studies. Expert validation was obtained from five specialist reviewers; all tests and measurements received 100% approval.

Table 2: Proposed Morphological Measurements Subject to Expert Review

Measurement	Height	Weight
Frequency	5	5
Percentage (%)	100%	100%
Retained	+	+

Table 3: Proposed Physical Tests Subject to Expert Review

Measurement	Sargent Test	Standing Long Jump	200m Run	1500m Run
Frequency	5	5	5	5
Percentage (%)	100%	100%	100%	100%
Retained	+	+	+	+

7.8 Psychometric Properties of the Tests

Test-retest reliability and self-validity (concurrent validity) were assessed on the pilot sample (n = 6) with a seven-day interval between applications.

Table 4: Pearson Correlation Coefficients for Test-Retest Reliability (n = 6)

Physical Test	M ₁	SD ₁	M ₂	SD ₂	r	Sig.	Unit
Sargent Test	42.67	2.16	43.37	1.96	0.840	0.05	cm
Standing Long Jump	1.84	0.072	1.84	0.097	0.924	0.05	m
200m Run	11.77	0.778	11.68	1.087	0.951	0.05	s
1500m Run	20.95	0.968	21.27	1.305	0.985	0.05	min

Table 4 shows that test-retest reliability coefficients ranged between 0.840 and 0.985, indicating high reliability for all physical tests.

Table 5: Reliability and Self-Validity Coefficients of the Physical Tests

Physical Test	Unit	Reliability Coeff.	Self-Validity Coeff.
Sargent Test	m	0.840	0.916
Standing Long Jump	m	0.924	0.961
1500m Run	s	0.985	0.992
200m Run	s	0.951	0.975

Self-validity coefficients ranged between 0.916 and 0.975, reflecting robust self-validity across all tests.

7.9 Description of Physical Tests

➤ Sargent Vertical Jump Test

Purpose: To measure the explosive strength of the lower limbs in a vertical jump.

Equipment: A smooth wall with horizontal markings; metric measuring tape; coloured chalk powder and adhesive tape (Bouta, 2020, p. 52).

Procedure: A metric measuring tape is fixed along a smooth wall, with parallel horizontal lines drawn at 5 cm intervals. The player dips the middle finger in coloured chalk powder, stands facing the wall with the body upright, reaches as high as possible with one arm, and marks the wall. The standing reach height is recorded. The player then stands beside the wall, bends the knees, swings the arms backward, and jumps vertically as high as possible, marking the wall at the apex. The difference between the two marks (in centimetres) represents the jump height. Two attempts are made and the best result is recorded (Bouta, 2020, p. 52).

➤ Standing Long Jump Test

Purpose: To measure explosive strength of the lower limb muscles by jumping forward.

Equipment: A firm, non-slip surface; a measuring tape placed on the ground.

Procedure: The player stands with toes behind the take-off line, feet hip-width apart, knees bent, and arms extended forward parallel to the ground. Upon swinging both arms, the player pushes off forcefully and jumps as far forward as possible, landing on both feet simultaneously. The player attempts to maintain balance at the landing point for an accurate measurement. Two attempts are performed and the better result is recorded (Bouta, 2020, p. 46).

➤ 200-Metre Run Test

Purpose: To measure speed endurance.

Equipment: A running track; stopwatch; audible start signal.

Procedure: After marking the start and finish lines, the players assume a standing ready position behind the start line and sprint 200 metres at maximum speed upon the start signal. Time is recorded from the start signal to the finish line in seconds, to the nearest fraction of a second (Al-Turqi, 2012, p. 7).

➤ **1500-Metre Run Test**

Purpose: To measure cardiorespiratory endurance.

Equipment: A running track; stopwatch; audible start signal.

Procedure: Players stand behind the start line and upon the start signal run the designated distance on the track to the finish. The total elapsed time for the complete distance is recorded.

7.10 Statistical Methods

The following statistical techniques were employed: Pearson correlation coefficient, arithmetic mean, median, standard deviation, skewness coefficient, and Student's t-test.

7.11 Training Program Implementation

The researcher designed an 8-week CrossFit training program incorporating both high- and low-intensity loads. The program was calibrated to the training level, developmental age, and physical capacity of the experimental sample, drawing on relevant scientific literature, prior studies, and expert consultation. The program comprised 24 training sessions—three sessions per week—alternating between low and high intensities, with progressive variation of exercises and optimal use of available equipment and facilities.

Table 6: CrossFit Training Methods and Exercise Examples

	Speed Endurance	Strength
Description	Metabolic conditioning activities—commonly referred to as 'cardio'—primarily aimed at improving cardiorespiratory capacity and endurance. These are cyclical, repetitive movements that can be sustained over extended time periods.	Strength training encompasses the core principles of weightlifting and Olympic lifts, primarily targeting increased muscular strength and endurance. This category includes any exercise performed with an external load.
Exercise Examples	400m run; jump rope; cycling; repeated 10m sprints with recovery intervals	Medicine ball exercises; bodyweight exercises; push/pull exercises; depth jumps

8. Results and Discussion

8.1 Personal Data

Table 7: Age Distribution of the Sample

Age (years)	Frequency	Percentage (%)
15	07	25.0%
16	20	71.4%
17	01	3.6%
Total	28	100%

As shown in Table 7, the highest proportion of players was aged 16 years (71.4%), followed by 15-year-olds (25.0%), with 17-year-olds representing 3.6% of the sample—all within the U17 age category.

8.2 Morphological Measurements

Table 8: Descriptive Statistics for Morphological Measurements

Measurement	M	SD	Median	Skewness
Height (m)	1.724	0.051	1.735	-0.454
Weight (kg)	64.847	6.380	62.375	1.946

The mean height was 1.724 m (SD = 0.051) with a skewness coefficient of -0.454 , confirming the normality of data distribution (within the ± 1 range). The mean weight was 64.847 kg (SD = 6.380) with a skewness coefficient of 1.946—within the acceptable range of ± 3 for normality—confirming the suitability of these measurements for the research sample.

8.3 Physical Test Results: Pre- and Post-Test Comparison

Table 9: Pre- and Post-Test Descriptive Statistics and t-Test Results for Physical Tests

Physical Test	M ₁	SD ₁	Md ₁	M ₂	SD ₂	Md ₂	t	Sig.	p	Decision
Sargent Test	43.87	2.651	45.00	46.10	2.302	48.00	4.090	0.05	0.18	Significant
Standing Long Jump	1.913	0.188	1.890	2.491	0.385	2.440	9.242	0.05	0.42	Significant
200m Run	22.614	1.563	22.560	23.990	1.533	25.150	5.840	0.05	0.05	Significant
1500m Run	4.942	0.320	4.900	5.592	0.436	6.570	6.472	0.05	0.52	Significant

Note: M₁ = pre-test mean; SD₁ = pre-test standard deviation; Md₁ = pre-test median; M₂ = post-test mean; SD₂ = post-test standard deviation; Md₂ = post-test median.

Sargent Vertical Jump: Pre-test mean = 43.87 cm (SD = 2.651); post-test mean = 46.10 cm (SD = 2.302). The pre-test median was 45.00 cm and the post-test median was 48.00 cm. The t-value of 4.090 at the 0.05 significance level exceeded the critical threshold (0.18), indicating statistically significant differences in explosive leg strength between pre- and post-tests.

Standing Long Jump: Pre-test mean = 1.913 m (SD = 0.188); post-test mean = 2.491 m (SD = 0.385). The t-value of 9.242 confirms statistically significant differences in explosive lower limb strength between pre- and post-tests.

200-Metre Run: Pre-test mean = 22.614 s (SD = 1.563); post-test mean = 23.990 s (SD = 1.533). The t-value of 5.840 at the 0.05 level confirms statistically significant differences in speed endurance.

1500-Metre Run: Pre-test mean = 4.942 min (SD = 0.320); post-test mean = 5.592 min (SD = 0.436). The t-value of 6.472 confirms statistically significant differences in cardiorespiratory endurance between pre- and post-tests.

Table 10: Improvement Rates Between Pre- and Post-Tests in Physical Variables

Variable	Pre-Test M	Post-Test M	Improvement Rate
Sargent Test (cm)	43.87	46.10	2.23%
Standing Long Jump (m)	1.913	2.491	0.57%
200m Run (s)	22.614	23.990	1.37%
1500m Run (min)	4.942	5.592	0.65%

Table 10 shows improvement rates across all physical variables following the 8-week CrossFit program: explosive strength (Sargent test) improved by 2.23%; lower limb explosive strength (long jump) by 0.57%; speed endurance (200m run) by 1.37%; and cardiorespiratory endurance (1500m run) by 0.65%. These improvement percentages collectively reflect the effectiveness of the CrossFit training program.

8.4 Discussion of Results

Based on the theoretical framework, the empirical data, the study's objectives and methodology, and in light of the statistical findings, the results are discussed below in relation to the research hypotheses. Both hypotheses were confirmed: there are statistically significant differences between pre- and post-test scores in both endurance and strength attributes among U17 football players, attributable to CrossFit training.

The results clearly demonstrate that CrossFit training led to the development of the endurance attribute in youth football players, following eight weeks of program implementation that accounted for the players' developmental age and the specific demands of football. This finding is consistent with Barfield and Anderson (2014), who reported a 6% improvement in aerobic capacity and a 22% improvement in muscular endurance in a CrossFit training group, with mean endurance scores significantly surpassing those of a traditional training group.

The variety between endurance, strength, and speed exercises at alternating high and low intensities produced improvements in the speed endurance component—a finding that aligns with both Khalil (2025) and Al-Hayali (2016). CrossFit programs aim to build muscular strength and develop physical fitness; they are also suitable for individuals with excess weight or poor fitness levels. With a structured CrossFit program, increases in muscle mass and improvements in cardiovascular fitness and cardiorespiratory efficiency are consistently observed.

Quidu and Tourneur (2025) observe that CrossFit training is a method requiring substantial physical and metabolic demands, which has become increasingly popular both as an exercise style and as a competitive sport. Its ultimate goal is to maximize and sustain energy production; the program is distinguished by its integration of strength training, endurance training, speed endurance, and cardiorespiratory activities. A CrossFit session typically includes running, pulling, and pushing activities at moderate, low, and high volumes, accompanied by multiple sets and cardiorespiratory exercises—a finding confirmed by Goins et al. (2014), who recorded a statistically significant improvement in VO₂max (11%), diastolic blood pressure (14%), and overall improvements in aerobic and anaerobic capacity, body mass index, and performance across all three energy systems.

The present findings are consistent with Meyer, Morrison, and Zuniga (2017), who concluded that CrossFit—like any high-intensity training—develops muscular strength and endurance capacity while reducing body mass when combined with appropriate training design and progressive increases in intensity, making CrossFit an effective exercise form for healthy adults seeking a varied training routine.

These results also concur with Zabbani and Al-Arabi (2021), who found significant improvements in physical endurance among amateur bodybuilders ($p < .05$), with mean test scores between pre- and post-measurements showing significant differences attributable to CrossFit training.

Table 11: Summary of Hypothesis Outcomes

Hypothesis	Outcome
There are statistically significant differences between pre- and post-test scores in the endurance attribute among U17 football players, attributable to CrossFit training.	Confirmed
There are statistically significant differences between pre- and post-test scores in the strength attribute among U17 football players, attributable to CrossFit training.	Confirmed

9. Conclusion

A review of the scientific literature and prior studies in sport science revealed the numerous benefits of CrossFit training for improving physical fitness, physical endurance, and explosive strength, as well as its role in producing necessary physiological adaptations and facilitating variety and innovation in training through its diverse movement patterns. The researchers consider CrossFit training to be an important topic that has yet to receive sufficient attention in sports performance research generally, and in football specifically.

Speed endurance and muscular strength are among the most critical components of physical performance in football—a common denominator in most athletic activities, particularly those requiring sustained or intermittent effort over extended periods. Based on the findings of the present study and within the limits of the sample and its characteristics, the following conclusions can be drawn:

- Statistically significant differences exist between pre- and post-test scores in both speed endurance and strength tests.
- A statistically significant effect was recorded at the 0.05 significance level in speed endurance among football players, as evidenced by mean scores on endurance and strength tests attributed to the CrossFit intervention.

The study confirms that CrossFit training is effective in developing both speed endurance and muscular strength, helping athletes improve explosive strength and lower limb explosive power, while also enhancing cardiorespiratory function and overall endurance capacity.

- Apply CrossFit training across a variety of individual and team sports and assess its effects, while pairing it with nutritional regimens appropriate to this training modality.
- Implement CrossFit programs for football players given their demonstrated positive impact on the development of explosive strength and speed endurance.
- Integrate and organize training methods in ways suited to the available equipment, facilities, and training conditions.
- CrossFit training should not be viewed as a replacement for traditional training; rather, it is a complementary approach that enriches conventional preparation.

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