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SHAPING MOTOR ACTIVITIES OF YOUNG FOOTBALL PLAYERS IN COMPREHENSIVE TRAINING USING THE FITLIGHT SYSTEM

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Authors' contribution:

A. Study design/planning
B. Data collection/entry
C. Data analysis/statistics
D. Data interpretation
E. Preparation of manuscript
F. Literature analysis/search
G. Funds collection

Abstract:

Introduction. In the actions of football players, due to the dynamics of the playing field, the ability of perception is of great importance for game effectiveness. This instruction not only determines good orientation in the game, but also significantly facilitates perception in action. Therefore, considering its importance for an effective game, apt methods are being sought out to improve the level of this disposition among football players.

Aim of the work and research questions. This study is of utilitarian nature. The main research objective is aimed at modifying the current concept of teaching methodology in sports games on the example of football, which involves activation of a player's orientational and spatial spheres. The following research questions were posed:

- Will the implementation of the Fitlight system for teaching football techniques improve the spatial orientation of young football players?
- Will the use of the Fitlight system in training increase the level of action in the game among young footballers?
- Can football training be improved by introducing the Fitlight system?

Materials and test methods. The method of pedagogical experiment was used to study the effectiveness (learning and teaching) of special motor skills. The technique of parallel groups was used: experimental (E) and control (C).

In experimental research, the independent variable was the method of developing and transmitting information using the Fitlight system based on the mental action of the player, c considering the development of spatial orientation in the process of teaching movement activities (special techniques).

The dependent variables were measurable results concerning development of the spatial orientation level in practical activities and the players' mastery of technical activities in game conditions.

Research was conducted on an annual basis (in 2018-2019) among young football players of RKS Garbarnia Kraków - junior class C1 - age of the respondents: 14-15 years. The study participants comprised 30 young players, divided into 2 subgroups: experimental (E) and control (C), each consisting of 15 players.

The experimental group participated in the experimental training unit twice a week; practical classes lasting 90 minutes. A total of 60 training units were conducted. These classes were carried out using the Fitlight system to teach technical activities that were characterised by a greater pool of exercises in the field of spatial orientation and also including greater mentalisation (concentration, divisibility of attention).

Results. Analysis of the research results allowed to confirm the significance of training using the Fitlight system. The experimental group, in relation to the control, demonstrated higher values in the level of spatial orientation and, above all, higher parameters in the simulated game.

Intoduction

In the actions of football players, due to the content and dynamics of field situations, not only the ability to act in a comprehensive manner plays an important role in game effectiveness, but also the skill to perceive an optimal number of events in a game. Therefore, it seems that effective technical training should take into account comprehensive - multi-movement activities, with the goal of performing a task taking place in the event space, with the need to shape spatial orientation of a footballer. Such comprehensive training (in practice as well as the game) is based on thinking and the properties of visual perception. According to Duda [1], these dispositions not only determine good orientation in the game, but also significantly facilitate perception in action (evaluation of events in the "wide field of action"). Perceptiveness is based on the high quality and accuracy of perception processes, understood as a reflection of objects or phenomena of the world around us in the consciousness, acting on our sense organs at a given moment [2].

Perception may be defined differently as a complex system of processes, thanks to which, a subjective image of reality is created in man, called perception [3]. This disposition is related to the development of certain properties of visual perception and thought processes, as well as the ability to choose the most advantageous place on the pitch to achieve the objectives of the game. Two factors influence spatial orientation [4]:

1- anatomical structure (properties of the structure regarding the nose and eye socket, location of cones and pillars on the retina of the eyes);
2- physiological structure (level of stimulation concerning nerve endings, stimulus sensitisation of the peripheral part of the retina).

We have no influence over the first of them in sports training, while the second factor, through training in "field vision" exercises, can help significantly improve spatial orientation [4]. This thesis was previously confirmed by Dziąsło and Naglak [5], who, in numerous studies, proved that the field of vision increases with age (more received stimuli) and as a result of specialisation in observation (e.g. spatial orientation training).

Shaping spatial orientation in football player training is significant, because the player's activity during the game requires a large range of the field of view (development of central, peripheral and deep vision) [6]. During the game, a player perceives important moments of the game through central vision, while that secondary, controls peripheral vision (e.g. leading the ball, the players sees an opponent to whom s/he wants to pass the ball, but also sees partners with whom s/he can cooperate) - Fig. 1.

To a great extent, these properties allow perception of the game and, above all, facilitate making decisions, significantly increasing player efficiency. The above information indicates that shaping spatial orientation in comprehensive training (performing multi-movement activities in space), especially among young players, is significant for the game, therefore, the training of such activities should be shaped in a unique way. Thus, the use of targeted means and teaching methods are required- for example, the Fitlight training system, which is based on a set of light disks connected to the software control panel [http://czasreakcji.pl/fitlight-trainer/].

The above information is significant for the research purposes of this study, as it indicates the possibility of developing specific dispositions for playing in specialised training, while for sports practice, it allows to indicate a new didactic direction which can significantly increase the process of teaching the game in organised training.

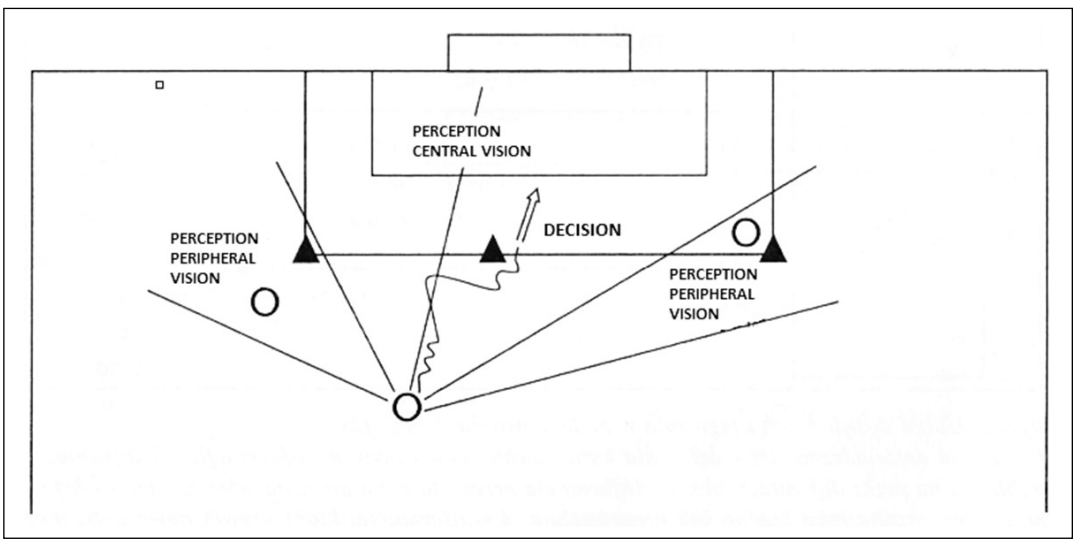

Fig. 1. Pitch situation, in which the athlete leading the ball uses central and peripheral vision.

Study aim, research questions and hypotheses

The research presented in the work is of utilitarian nature, because in the main objectives, it is aimed at modifying the current concept of teaching methodology in sports games on the example of football, which is associated not only with movement (technical) impact, but also with mental activation of the spatial-orientation sphere of a player.

The following questions were posed in the research procedure:

- Will the implementation of the Fitlight training system to teach football techniques increase the level of spatial orientation among young football players?
- Will the use of the Fitlight training system in training increase performance level in the game of young footballers?

Positive demonstration of these relationships will allow looking for reserves in other areas influencing a player's training. Solving this problem, great benefits may be expected in terms of didactics, because the effectiveness of such teaching will increase the efficacy of a player's actions.

Taking the above into account, the following research hypotheses were formulated:

- Organised training within the aspect of shaping spatial orientation will increase its level.
- Improving the training process by introducing the Fitlight system to football technique training will have a positive effect on increasing efficacy of the game.

Research materials and methods:

The method of pedagogical experiment was used to assess effectiveness (learning and teaching) of special motor skills. The technique of parallel groups was used: experimental (E) and control (C) [7].

In the experimental study, the independent variable was the way of developing and transferring information using the Fitlight training system based on the mental action of a player, taking the development of spatial orientation (comprehensive activities in space) in the process of teaching motor activities (special technique) into account.

The dependent variables were measurable results concerning the development of the spatial orientation level in practical activities and the players' mastery of technical activities in game conditions.

Confirmation of the research hypotheses was sought out at institutions training young talented players (football adepts). Research was carried out on an annual basis (in 2018-2019) among young footballers from RKS Garbarnia Kraków, C1 junior category - participants aged 14-15 years, whose coach was Tomasz Liput.

The study comprised 30 young players who were divided into 2 subgroups based on organised selection: experimental (E) and control (C), each group consisting of 15 players.

The **Fitlight training system** was used in the research process. The Fitlight system is a modern technical training programme based on shaping movement habits with high activity of the nervous system - mainly the athlete's mind, who consciously uses movement acts in the space of activity, while developing spatial orientation [http://czasreakcji.pl/fitlight-trainer /].

This system includes sets of light disks - lamps (Fig. 1) connected to a programmed control panel.

In the training concept, properly programmed disks send light signals, which are distributed in space depending on the training content. By performing a specific technical exercise in various forms of teaching, the player's task during the exercise is to quickly react by carrying out a specific movement task in response to the light signal - e.g. coordination in the movement activity of the lower limbs, agility run with choice, leading a ball through a "labyrinth of poles" and quick response to light signals at specific markers (Fig. 3).

In such exercises - of comprehensive content, the player not only improves coordination of the lower limbs, but also specific runs, ball handling, while engaging mental processes and shaping spatial orientation by perceiving the signal and consciously performing the task.

Throughout the study, the experimental group participated in the organisation of the research training twice

Fig. 2. Set of light disks with instrumentation in the Fitlight system (as at: http://czasreakcji.pl/fitlight-trainer/)

Fig. 3. Example of reacting to light signals in movement action (as at: http://czasreakcji.pl/fitlight-trainer/)

a week in the experimental training unit; practical classes lasting 90 minutes. These classes, conducted with the Fitlight training system in teaching technical activities, were characterised by a greater range of exercises in the area of spatial orientation, also taking greater mentalisation into account (concentration, split attention) - examples of exercises in Fig. 4-5.

Example of exercise in strict form

The player with the ball is in the middle of 4 boards. The task is to put out (by bouncing the ball off the board) as many lights as possible within a certain time. The lights flash randomly (Fig. 4).

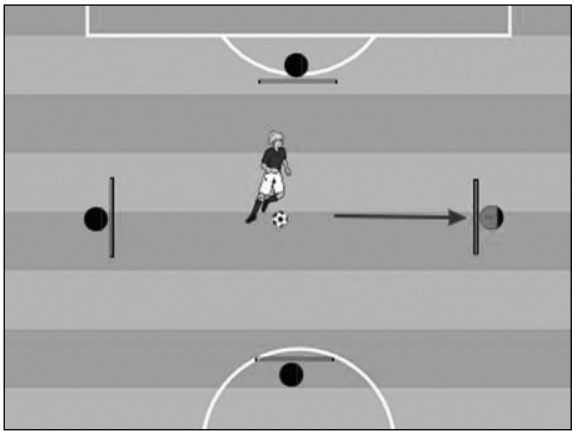

Fig. 4. Organisational structure of exercises in strict form.

By performing this exercise, the competitor not only improves spatial orientation, but also the quick kicking technique and mental processes through a conscious choice of actions in motor activity.

Example of exercise in game form

A 3-on-3 game towards 3 small goal posts. The Fitlight system is programmed so that the lights (disks) light up randomly for both teams, and each time, one of the lights is lit behind the goal of a given team. The sensor changes every 15 seconds and the players have to place the ball in the goal post, behind which the light is lit at the given moment (Fig. 5).

By performing this exercise, players not only perfect their technique in game conditions, but also their spatial orientation (observation of goals) and action (the concept of achieving the game objective - scoring a goal).

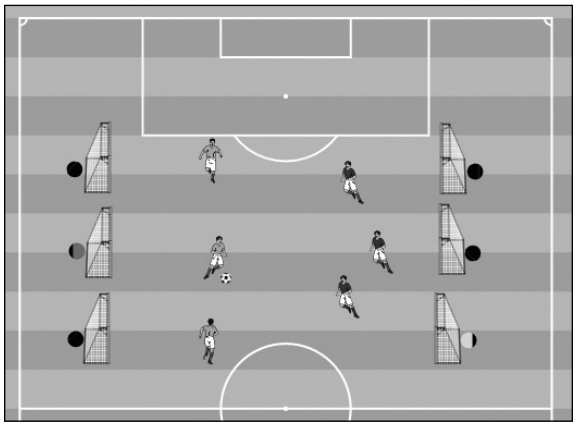

Fig. 5. Organisational structure of exercise in the form of game fragment.

In total, 60 training lessons with the Fitlight system were conducted for the experimental group in the annual training cycle.

In the second group - the control, the teaching process was carried out using traditional methods. In this group, the same programme was implemented in teaching the technique of the game, but without the Fitlight system accent.

The study was conducted in 0 stages. In the first one - preliminary tests (pre-test) were carried out in order to determine the base values and to select 2, possibly "identical" research subgroups (statistically insignificant difference) due to the motor and movement efficacy in simulated game conditions. The choice of groups was based on organised selection [6]. The players were classified using a table of ranking numbers. In the second stage, repeated tests (post-tests) were carried out in the area of the level of motor skills and the efficiency of technical activities in game conditions.

The teaching activities used in the experimental and control groups were based on the following assumptions:

1. The learning objectives carried out in the training lessons were identical.
2. The number of training lessons in the E and C groups was the same.
3. The duration of the training unit was the same in both groups and totalled to 90 minutes.
4. The selection of players for training groups included similar age as well as the level of motor and technical skills (statistically insignificant differences).
5. The difference in the didactic procedure between the experimental and control group was the manner of teaching motor activities, taking the Fitlight system into account (experimental group).
6. In the control groups, in the annual training cycle for practical teaching (without the Fitlight system), 60 more training units were allocated than in the experimental groups.
7. In the experimental groups, in the annual training cycle, 60 more training units using the Fitlight system were allocated than in the control groups.

During the experiment, both groups (E and K) assumed:

1. Carrying out teaching content according to the assumed programme.
2. Classes are conducted by the same trainers.
3. Participation in a group of the same students - players in training activities. In both groups, people with the same attendance records were taken into account to calculate the test results (the overall attendance in the groups was 88%).
4. The intensity of teaching in both groups was the same (teaching individual and group activities in strict form - oxygen transformation zone, mixed transformation zone; teaching in game form - mixed transformation zone, anaerobic transformation zone).
5. Teaching technical activities in both groups was consistent with the training programme at RKS Garbarnia Kraków.

In the experimental training, teaching motor activities (special technique) was implemented with emphasis on shaping the ability of spatial orientation - the use of the Fitlight system.

The aim of this teaching was to shape specific game actions (technical actions) - conscious complex actions in space.

To assess spatial orientation (reliability: $r = 0.81$, accuracy: $r = 0.84$), test according to Duda's concept [8] - Fig. 5.

In this test, to assess spatial orientation, the player led the ball over a distance of 3 m - with his back turned

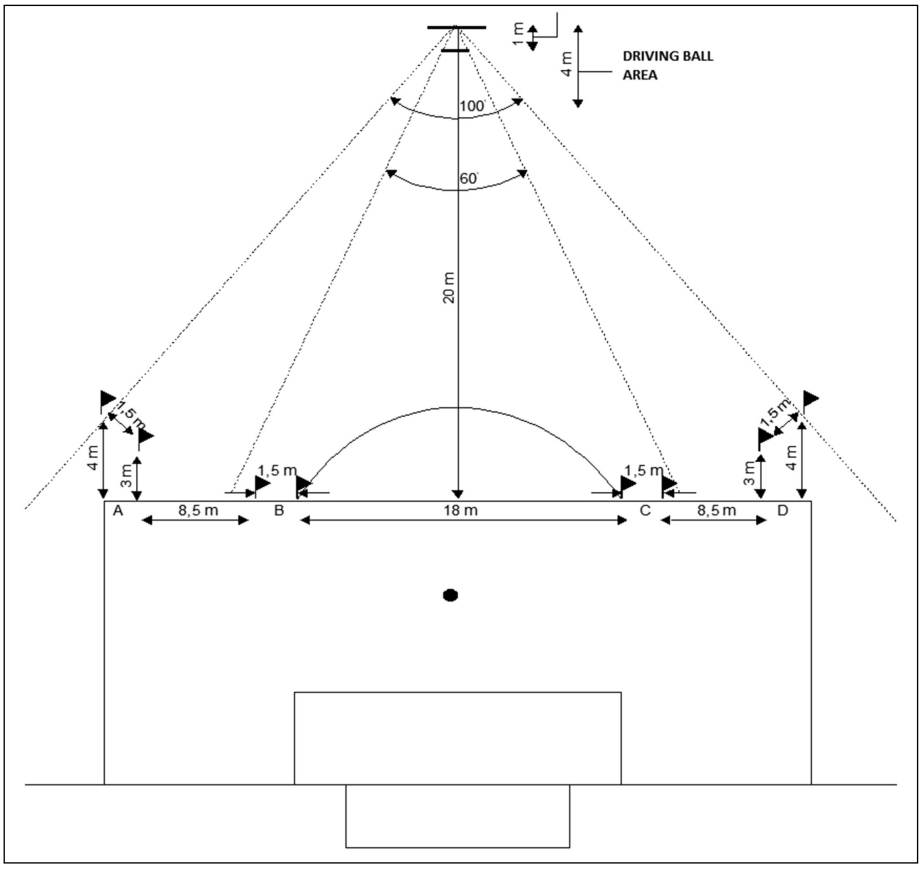

Fig. 6. Test scheme to evaluate spatial orientation.

to the goal posts with disks placed all over the area of the football pitch and marked using the Fitlight system software (Fig. 5). Then, when introducing the ball into the shooting zone (1 m), the player had to react quickly at the moment of the light signal (the light disk in front of the player at a distance of 6 m from the impact zone) and perform a kick towards the signalling goal. The reaction time and the speed of orientation to the light signal were determined, and the time was counted from the moment of kicking the ball to the moment of crossing the light markers 10 m away from the place of impact. The measured value is the average time of making a shot towards the designated goals according to order A, C, B, D.

To determine the tested players' level of motor fitness, selected skills were measured using the INKF test. The test trials included:

a) speed - (30-m run),
b) the ability to adapt and change movement activities - coordination skills while running - (zigzag running, the so-called "envelope"),
c) power - (vertical jump),
d) endurance - (300-m run).

Motor efficiency was determined on the basis of a standardised point scale [9].

To assess motor fitness of the young players, a standardised ($t = 0.88, r = 0.87$), technical (special) fitness test was used [6]. Selected technical fitness tests were used in the trial, which took the following into account: feeling of the ball (juggling with legs and head), speed of leading ball through slalom, hitting the ball with the head and kicking with leg from a distance, accuracy of passing the ball from a distance, accuracy of shooting - shot towards designated sectors of the goal.

Evaluation of the players' actions in the game (defensive and offensive) was conducted via objectified observation sheets ($t = 0.93, r = 0.86$) during 3x3 simulation games, in which players allocated to selected teams in an organised manner (according to ranking from special fitness) were assessed by competent judges [6].

The evaluation of technical efficiency tests in isolated conditions and during a simulation game was converted to a standardised 100-point scale (point tables) [6]. Experimental teaching was carried out by trainers from RKS Garbarnia in Kraków, with the participation and control of employees from the Football Theory and Methodology Team of the University of Physical Education (AWF) in Kraków.

Descriptive statistics methods were used in the analysis of results. To identify differences in the level of spatial orientation between groups (E and C), the Mann-Whitney U test for evaluating significance of differences was used, while for intra-group differences, the Wilcoxon test was applied. The correlation between the level of spatial orientation and performance in the game was defined via Spearman's correlation coefficient [10].

Research results

In the research, it was assumed that players subjected to experimental learning (Fitlight system) - in teaching technical activities, will achieve better values in terms of the level of spatial orientation and game actions. Therefore, in order to verify these assumptions, detailed evaluation of the mentioned parameters was carried out in 2 groups: experimental and control.

At the initial stage of the research (as a potential base), the level of motor skills was also assessed.

In Tables 1-4, the test results are shown for: motor level, technical skills, the level of spatial orientation and efficacy of activities in conditions of sports competition (simulated games). These test results concern the abovementioned groups in 2 phases of research - initial and final.

When analysing the results of the research on selected dispositions of effective player performance, it should be noted that before the experiment, as a result of organised player selection, neither of the groups (experimental and control) showed any significant differences for motor skills or movement abilities ($p > 0.05$) - Tab. 1-2. However, with regard for technical actions among the experimental group (Tab. 2), better parameters were shown between the first and second tests, thus, it may be "hypothetically" stated that technical training with accents of comprehensive activities and spatial orientation could cause better changes in motor skills (higher reactivity of receptors for complex tasks including spatial orientation).

Interesting results can already be seen when determining the level of spatial orientation for the studied groups. At the initial stage of the study (as a result of organised selection), no significant differences are noted ($p > 0.05$); however, in the second test, these parameters vary in value, especially when considering the increase between Tests 1 and 2, and particularly in the experimental group (Tab. 3). Based on these tests, it may be assumed that the training of technical activities, with parameters for the development of spatial orientation, significantly improved this disposition in the experimental group.

Determining the increase in the level of efficacy regarding the simulated game for the studied groups was of significance for the purpose of research within the utilitarian aspect. The level of spatial orientation may significantly affect efficiency of the game, because this disposition improves speed of decision-making [11, 8] and perception of the game in sports competition. From the data analysis (Tab. 4), it may be deduced that performance in the game indicates better parameters in the experimental group, which confirms the research hypothesis determining this disposition for game efficacy.

In the final stage of research, confirming the essence of the significance of spatial orientation for game performance, determination regarding the dependence of this

Tab. 1. Characteristics of motor ability levels among groups in Tests 1 and 2

Test 1	Experimental group (pts.)	Control group (pts.)
Arithmetic mean	45.81	46.28
Standard deviation	6.18	6.48
Arithmetic mean	13.45	14.01
Significance of differences between groups	0.468	
Test 2		
Arithmetic mean	47.75	48.39
Standard deviation	6.43	6.46
Arithmetic mean	13.45	13.38
Significance of differences between groups	0.445	
Level of significance of differences between Tests 1 and 2 in given group	0.346	0.324

Table 2. Level of significance of differences while assessing motor activities in isolated conditions (technical test) among tested groups

Test 1	Experimental group (pts.)	Control group (pts.)
Arithmetic mean	53.11	53.60
Standard deviation	4.63	4.22
Coefficient of variation	8.74	7.91
Significance of differences between groups	0.386	
Test 2		
Arithmetic mean	57.07	54.35
Standard deviation	5.63	3.94
Coefficient of variation	9.86	7.30
Significance of differences between groups	0.117	
Level of significance of differences between Tests 1 and 2 in given group	0.067	0.305

Table 3. Significance level of differences in evaluating parameters regarding spatial orientation in tested groups

Test 1	Experiment group (s.)	Control group
Arithmetic mean	1.94	1.96
Standard deviation	0.22	0.18
Coefficient of variation	12.21	8.48
Significance of differences between groups	0.462	
Test 2		
Arithmetic mean	1.47	1.76
Standard deviation	0.19	0.21
Coefficient of variation	14.24	11.40
Significance of differences between groups	0.0012*	
Level of significance of differences between Tests 1 and 2 in given group	0.001*	0.02*

*$p<0.05$

disposition for game performance was evaluated. For data analysis, it may be indicated that both in the control and experimental groups, this disposition is of great importance for efficacy in the game (Tab. 5). Therefore, assuming that progression related to the level of spatial orientation was higher in the experimental group (Tab. 3), it can be concluded that the use of the Fitlight system in organised training (which largely shapes spatial orientation) may positively affect efficiency of technical operation in competitive sports conditions.

Discussion

The above-presented analysis of the obtained research results allows to conclude that the applied experimental teaching of motor activities based on comprehensive actions performed in space (development of the visual field) deserves special attention, because shaping visual perception can significantly increase the effectiveness of teaching and training players [12]. This position is significant, as the Fitlight training system not only aids the development of specific game dispositions (multi-movement action in space), but also makes training more attractive (multi-movement - activating actions). It also seems that through complex exercises (multitasking), with emphasis on visual perception, mental processes are activated and the player's perception of the game is increased, improving the strategy of perceiving actions during the game [13, 12]. Furthermore, the creation of complex situations (the specificity of comprehensive exercises), with emphasis on visual perception, shape anticipatory processes in the player, thanks to which s/he can more accurately predict the actions of opponents and partners in the game [14]. This direction of teaching the game results from its specificity, which, according to Duda [6], [15] and Panfil [16], is characterised by high mentalisation in action and variability of spatial events. This is related to situational actions of a player (decision alternatives) based on the efficiency of thought processes in an alternative choice [17]. When defining such requirements for training in sports games (variability of tasks in spatial perception), it may be considered that the Fitlight system meets these conditions, because the applied and programmed light disks force a task-based reaction to the situation in the space of action, shaping a player's perception.

Therefore, taking into account the fact of shaping mental efficiency (shaping special abilities to act) in the Fitlight system, it seems that using this system in train-

Table 4. Significance level of differences regarding evaluation of simulated game efficacy among tested groups

Test 1	Experimental group (pts.)	Control group (pts.)
Arithmetic mean	52.44	52.85
Standard deviation	3.33	2.51
Coefficient of variation	6.37	4.81
Significance of differences between groups	0.366	
Test 2		
Arithmetic mean	56.81	54.40
Standard deviation	3.73	2.76
Coefficient of variation	6.58	5.12
Significance of differences between groups	0.043*	
Level of significance of differences between Tests 1 and 2 in given group	0.003*	0.082

*$p<0.05$

Table 5. Evaluating influence of spatial orientation level on action efficacy in the game

Test 1	Experimental group (pts.)		Control group (pts.)	
	Level of spatial orientation	**Action efficacy in game**	**Level of spatial orientation**	**Action efficacy in game**
Arithmetic mean	1.47	56.81	1.76	54.40
Standard deviation	0.19	3.73	0.21	2.76
Coefficient of variation	14.24	6.58	11.40	5.12
Correlation	- 0.670*		-0.571*	

*$p< 0.05$

ing football players can significantly accelerate the process of learning the game.

In conclusion, it should be stated that the above information confirmed by the research results requires special reflection on the specificity of learning the game (technique with an alternative choice of actions in space). This direction (complexity of activities) is consistent with teaching the game in specific conditions required in a competitive sports environment (variability of events in space - the principle of "in training, as in a game") which is opposed to the traditional – less effective – manner of teaching team sports [18, 19]. Thus, a new paradigm in teaching sports games is introduced.

Conclusions:

1. Proceedings in training with the use of the Fitlight system, based on the specificity of a sports game (complexity of activities in space), may accelerate teaching technical and tactical activities.
2. On the basis of the obtained research results and the significance of decision-making processes in spatial conditions of a sports game, it may be concluded that this direction of research is an important source of progress in achieving sports championship among football players.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Ethics Committee

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