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ORIGINAL

The assessment of intellectualisation of the movement techniques teaching in terms of effective and pro-health training in young football players

Henryk Duda [ABCDEF], **Dariusz Mucha** [ABCDEF], **Tadeusz Ambroży** [ABCDEF], **Jarosław Omorczyk** [ABCDEF], **Ewa Dybińska** [ABCDEF], **Dawid Mucha** [ABDE]

Faculty of Physical Education and Sport, University of Physical Education in Krakow, Poland

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B Data Collection
C Statistical Analysis
D Data Interpretation
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abstract

Background Sporting success puts high requirements in terms of physical stress; it causes a major threat to an athlete's health. Therefore, there is a need for effective training methods in order to reduce the number of contusions and sports injuries. For this purpose a method of intellectual training in the mastery of motor actions (playing technique) of young football players is recommended.

Material/Methods The influence of intellectualization on the training process and the state of health was studied in young football players (16 years old), students of the Sports School in Cracow. Continuous research was conducted from 1996 to 2001. A group of 92 players were examined in two groups: 46-experimental group and 46-control group.

Results Research has shown that the intellectualization of training, which reduced the volume of the body load by 14%, has a positive impact on the effectiveness of training and helps to reduce the number of injuries during sports training.

Conclusions Intellectual training is beneficial to the effectiveness of young football players' technical actions. The intellectualization of the training process reduces the physical burden, and exposing the aware action affects the condition of lower limb injuries in young players.

Key words Intellectualization, training, effectiveness of teaching, sports injuries

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Corresponding author: Dr hab. Dariusz Mucha prof. nadzw., Faculty of Physical Education and Sport, University of Physical Education in Krakow; Al. Jana Pawła II 78 Krakow 31-571, Poland; e-mail: nauka.autograf@gmail.com

INTRODUCTION

Professional sport enforces fitness so that championship can be reached only after many years of tiring and systematic physical work. This fact requires a systematic pursuit of physical exercise from the early age. In the period of intensive growth, which occurs at the age of development, the organism is particularly sensitive to any unilateral physical effort.

The development and formation of locomotor apparatus (including bones, tendons and joints) is subject to biological laws, among which particular importance is assigned to pressing and extending forces, influencing the skeletal system during its intensive growth.

Long-lasting and unilateral overload of young players' skeletal system causes intensification of accommodation changes, which in its different parts can be characterized by pathological changes. They include, among others, bone fractures, bone spurs, involution of other Osgood-Schlater disorders, aseptic inflammation of secondary testicles, necrosis of long bones ossification as well as tiny bones of hands and feet [1, 2]. This has an important practical meaning, since disregarding these biological laws may lead to heavy damage of the organs of motion, causing negative effects, and sometimes permanent disability.

Also the above considerations are aimed at making trainers and club instructors aware of the possible risks for the young, developing organism, resulting from the application of unilateral, too exhausting training. Instructors or coaches of athletes in the age of development are particularly responsible, as appropriate organization, programming and usage (leading) of sports training has a decisive influence on the further career of a young player. So understood and implemented training process is also the most effective prevention of sports injuries. In the age of development, the concept of serious sports injuries should not be a major problem, since the rational training which is required at this stage of training should decrease the risk. However, overloading and injuries of lower extremities are still accumulating in the environment of professional sport, mainly among athletes of sports games.

The treatment of these injuries is increasingly difficult, as requirements for the organism are growing, which surpasses its adaptability, while coaches as well as players expect from doctors rapid and effective help in removing a number of conditions, hindering or impeding the implementation of intensive effort. Meanwhile, sporting conditions are continuously changing. External conditions make the athlete's organism fulfill more difficult adaptive tasks, which he finds difficult to do because of lack of time. These lesions occur as a result of the application of the excessive workload in sports training. Damage to the movement apparatus because of overtraining is, in most cases, considered as the overload of the organism. It can be assumed from the above information that sports training characterized by great intensity and content of exercises already exploiting organism from an early age can unfortunately endanger their health especially if led unreasonably. This assumption is confirmed in numerous studies of sports medicine and sports theory [2, 3, 4, 5]. So the question arises: how to increase the efficiency of a player's training process at the expense of reducing the training burden.

It seems that an effective way of such proceedings is to find solutions in the appropriate intellectual preparation, that is an appropriate transmission of information, which would be received by the player in the conscious and active way. For the implementation of the objectives of the sports game, such preparation involves learning about the theoretical principles of the efficient motor activity (game technique), taking into account the biomechanical rules accompanying motor actions [6]. It was proven that the more the sportsman knows the action and the way of application of these operations, the easier these actions in the game situations are seen and its objectives effectively implemented [7, 8, 9]. Starting from the assumption that the effective development of motion habits in sports games takes place at the semantic-motor level [10], it is believed that intellectual teaching compensates the excessive time spent on practical training, while the time effort (load) much exploits the organism, especially of a young player. It can be claimed that the player's conscious participation in the training process will mark out efficient and healthy sports training.

In view of the above, the present research has a utilitarian character. Its aim was to evaluate the effect of intellectual technique teaching on the effectiveness of actions performed by football players during matches and on reduction in the lower limb injury rate.

Confirmation of this evidence was looked for in institutions training young football players (football adepts). Taking into consideration the fact that young players (footballers) in Sports Schools are exposed to a large volume and intensity of sports training (20 lessons in micro-cycle – programmatic requirements), teaching methods were searched for which would lead to a rational impact (intellectualization of the learning process). The following research questions were posed:

1. Does intellectual teaching of football players have a favorable effect on the effectiveness of technical tasks during matches?

2. Does intellectualization in the process of football training reduce physical load in individual training sessions?

3. Does the process of intellectual training have an effect on reduction in lower limb injury rates in young football players?

Positive demonstration of these dependencies will help to look for reserves in other fields of impact on the player's training. If this problem is resolved, large benefits can be expected in terms of teaching and health, since the effectiveness of such a curriculum will help to increase the efficiency and to reduce the burden in sports training, and this will alleviate the risk of exploitation of the organism. Taking all the above into consideration the research hypothesis was stated as follows:

1. Focus on the development of intellectual abilities of football players leads to a reduction in physical load in individual training sessions.

2. Intellectual training improves abilities of taking technical actions during matches and reduces lower limb injury rates.

MATERIAL AND METHODS

To assess the effectiveness of (learning and teaching) special motor skills, the method of pedagogical experiment was used with the help of the technique of parallel experimental groups: experimental (E) and control (C) [2].

In the experimental research, an operand was the way of elaborating and transferring information with the help of the method based on intellectualization of the teaching process of the footballer's motor activities.

The dependent variables were the measurable results concerning:

- Specialist knowledge of motor activities of the tested players.
- Practical mastery of technical activities by the players in isolated conditions andin a game.
- Determination of the state of the players' lower limbs muscles and joints.

Continuous research was conducted in annual cycles (1996–2001) among students of the Sports Mastery School of Football in Cracow. A group of younger Juniors at the age of 16 were the subjects of the research. Continuous research was carried out on 92 young players, who were divided after selection into 2 subgroups: experimental (E) and control (C), each with 46 players. The experimental group, throughout the entire time, took part in experimental training classes, theoretical-practical lessons – lasting 45 min once a week. These activities based on mental teaching, in a global meaning, were characterized by much less intensity and volume of practical sessions. In general, 80 training lessons of the intellectual character were conducted in each experimental group. In the global load (700 lessons), this number makes up about 14% of the annual training volume.

In the control group, traditional teaching methods were used. In this group, the knowledge of the technique of the game was transferred to the player in the course of practical exercises in the form of a briefing.

Research was conducted in two stages. In the first stage, preliminary studies (pretest) were carried out to determine the base value and select possibly "identical" two subgroups (the difference statistically irrelevant) concerning the level of expertise and efficiency of motor and motive skills. The choice was based on the organized selection of groups [11], where players were classified by using a table of rank numbers. In the second stage (posttest) the level of specialist knowledge and mobility was tested again. In teaching activities used in the experimental and control groups, the following principles were taken into consideration:

The objectives of the curriculum implemented at the training lessons were identical.

The number of training lessons in both groups E and C was the same.

The duration of the training lessons in both groups was the same – 45 min.

The difference in didactic proceedings between the experimental group was a way of transferring the knowledge about the operation of locomotive system.

In the control groups during the annual training cycle, in the area of practical training there were 80 training lessons more than in the experimental groups.

In the experimental groups during the annual training cycle, in the area of theoretical training (intellectualization of the teaching process) there were 80 training lessons more than in the control groups.

In the course of the experiment in both groups (E and C) we expected:

- implementation of learning content according to the established program;
- leading trainings by the same trainers;
- participation of the same students-players in training classes. In both groups to calculate test results, persons of equal attendance were considered (general attendance in groups was 92%);
- the intensity of conducted classes in both groups was the same (teaching of individual and group activities in a close form (the zone of aerobic alteration, the zone of mixed alteration), teaching in the form of the game (the zone of mixed alteration, the zone of anaerobic alteration).

In the experimental training, mental-intellectual teaching was applied, whose aim was to shape the level of motor image of the taught movement technique. In the process of intellectual teaching, verbal and visual methods were used as strengthening teaching materials. In the author's method of teaching, stages of football teaching techniques included [8]:

Stage I: introductory knowledge about the structure of the movement of a given activity, the principles of biomechanics occurring in a given mobility task (presentation of drawings and graphic schemes);

Stage II: presentation of the isolated technical element with the help of a video material (didactic film) at a normal pace, and then in order to analyze a repeated fragment of an action and to remember it better, in slow motion;

Stage III: exemplary practical presentation as well as an attempt at individual work of a taught technical element by the player;

Stage IV: practical mastering (methodology of teaching mobility activities), the analytical teaching with the help of visual aids (e.g. programmed learning or a series of photos showing particular motion sequences while performing a technical element;

Stage V: showing the film material (work with a camera) how to perform a technical element which is being taught by a practicing player (observation of movements of one's body on the film material);

Stage VI: the correct description of the technical element (motor image) – mental training;

Stage VII: creative teaching, with the help of creative methods: task methods, for example, in which the trainer formulates a problem and players try to solve it by using different movements (technique). Independent performance of the motor task in the form of a fragment of a game;

Stage VIII: common assessment of the performed task by both the student and the coach.

To check the level of football players' knowledge about operation of the locomotive system, a standardized (t – test validity = 0.95, r – test reliability = 0.87) test of technical acknowledge [8, 12] was applied, containing closed, open and illustrative questions of a problem character which, similarly to the action during the game, concerns an alternative choice for the solution of a given motion activity. The questions concerned the regularity of motion activities (technical) taking into account the analysis of motion, biomechanical rules and the policy of effective implementation of action in the game. To evaluate the young players mobility, a standardized (t – test validity = 0.88, test reliability = 0.87) technical agility test was applied [8, 12]. The test uses selected trials of technical performance, which include: feeling the ball (juggling the ball with legs, juggling the ball with the head), speed, leading the ball in a slalom, hitting the ball with the head and a leg from distance, the accuracy of administration of the ball from distance, the accuracy of impact-shot in designated sectors. Evaluation of the players' activities in the game was done with the help of an objectified observation sheet (t – test validity = 0.93, test reliability = 0.86) during simulation games 4 x 4 [8, 12], where the players in teams selected in an organized manner (according to rank assessments for special performance) were evaluated in four games: experimental groups players against the control ones. Selected individual defensive (body movement, knocking out and receiving the ball through overtaking) and offensive actions (keeping, feints, dribbling and hitting the ball) were examined. Effective and ineffective actions were taken into consideration, which allowed calculating reliability indicators [13]. The evaluation of technical efficiency trials in isolated conditions and in a simulation game was converted to standardized 10-point scale (point tables). Experimental teaching was carried out with the participation and control of the Establishment of Football Theory and Methodology of Physical Education School staff in Cracow. To assess the tested groups, the level of knowledge about player's motor actions and mobility was tested.

To evaluate the state of health in the field of training loads, the players' health records(student health information card) were analyzed. This included a detailed analysis of the muscles and joints of the lower limbs injuries in the annual training cycle. The injuries of muscles and joints of the lower limbs which did not allow players to do any physical activities for more than three days were considered [14]. In the calculation of the research results, the basic statistical operations have been applied: arithmetic mean, standard deviation, t-Student test, which specified the level of the significance of differences. The relationships between the measured traits were defined using Pearson's correlation coefficient [15].

RESULTS

It was assumed in the research assumptions that the players subjected to experimental interaction (intellectual support in the teaching of the process of motion) will achieved a better value in terms of expertise, mobility and action in the game. Intellectual teaching relationships in health aspects were also tried to be found. Therefore, the implemented research objective was to answer the questions, firstly, whether experimental teaching will bring tangible benefits in the player's performance, and secondly, whether experimental teaching based on intellectual learning of the game compensating for the volume of the physical load will lower the usage of the ligamentous-muscular apparatus of lower limbs.

For the purpose of the research, as a result of the organized selection in the tested groups (experimental and control), no significant differences in the measured parameters or in motor skills had been shown before the experiment; hence it can be assumed that both groups were homogeneous (Tab. 1-3). Analyzing the research results it can be seen that during a 10-month training there was significant progress in both groups in the terms of the tested parameters. However, for the research and practical objectives of the implemented method, the dynamics of results growth in the experimental and the control groups was important. That is why the difference between the experimental and control groups was studied in the study – after completion of the experiment (annual research cycle). Analyzing the specificity of football, it can be claimed that expertise constitutes the basis for player's mobility action [7, 13]. It is knowledge that determines the efficiency of action in changeable situations of the game, where a player basing on his experience anticipates, sees and takes decisions concerning a way of doing a motion task [7, 8]. Taking all into account, an attitude towards this predisposition was primarily examined. In the experimental groups higher values and diversity of the progress of knowledge assimilation (Tab. 1) were noted in comparison to the control groups, which reached the statistically significant level ($p < 0.01$).

Table 1. Mean values of the knowledge of movement activities in the tested groups

Tested groups / Tests order	Experimental groups (E – points)	Control groups (C – points)	The significance of the differences t-Student's
I test	38.31 ±4.82	38.53 ±4.65	0.82
II test	48.49 ±7.64	41.99 ±5.76	4.67*

* Significantly different ($p < 0.001$) in comparison with control groups

Interesting results were noticed in analysis of the progress in mastering technical activities by the players in isolated conditions. Table 2 shows that the level of technical development of the players in the experimental groups was more beneficial and demonstrated the diversity at the level of the statistical significance $p < 0.05$. It means that subjects who underwent experimental teaching made bigger progress in the training process. The best form of verifying the progress is a game which in the environment of direct competition marks out parameters of effective action.

Table 2. Evaluation of motor activities in isolated conditions (technical test) in the treated groups

Tested groups / Tests order	Experimental groups (E – points)	Control groups (C – points)	Significance of differences t-Student's
1st test	57.16 ±4.17	58.2 ±4.54	1.51
2nd test	62.78 ±5.0	60.93 ±4.24	2.19*

* Significantly different ($p < 0.05$) in comparison with control groups

Although the analysis of the calculated reliability indicators defining the efficiency of the player's actions (Tab. 3) did not confirm significant diversification in the tested groups in the second study, the growth of this value in the experimental group was significantly higher.

Table 3. Evaluation of motor activities in simulation games in the tested groups

Tested groups / Tests order	Experimental groups (E – points)	Control groups (C – points)	Significance of differences for groups E and C
1sttest	56.06 ±3.4	57.38 ±4.18	1.96
2ndtest	60.66 ± 3.94	59.57 ±4.04	1.67
Significance of differences – for the 1st and the 2nd test	6.48***	2.79*	

Significantly different *($p < 0.05$), *** ($p < 0.001$) in comparison with the 1st and the 2nd test

The differentiation between the 1st and the 2nd research in the experimental groups was at the level of statistical significance of $p < 0.001$, while in the control group at $p < 0.05$.These values may prove that the experimental teaching based on intellectualization shaped dispositions to play more effectively. This is confirmed by a high level of the main factor correlation in the intellectual teaching, that is the level of expertise with the efficiency of actions in isolated conditions and in the game (Tab. 4).

Table 4. The dependence between chosen mobility activities and the level of expertise in the tested groups

The level of values in a group / Type of attempt	The level of values in the given group		The level of expertise in the given group		The level of correlation	
	Tested group (points)		Tested group (points)		Tested group (points)	
	E (δ)	C(δ)	E (δ)	C(δ)	E (δ)	C(δ)
Test – technical efficiency	62.78 ±5.0	60.93 ±4.24	48.49 ±7.64	41.99 ± 5.76	0.57***	0.55***
Game – technical efficiency	60.66 ±3.94	59.57 ±4.04	48.49 ±7.64	41.99 ± 5.76	0.335*	0.439**

Correlation - statistical significance level: * p < 0.05, ** p < 0.01, *** p ≤ 0.001

The obtained results confirming the values of didactic mental training gave rise to further research analysis with the aim to check whether mental training which resulted in a reduction in the volume of the training load will also positively influence the young players' state of health (injuries of lower limbs). In this aspect it was shown that the number of training lessons with physical interaction (at the level of statistical significance ($p < 0.001$) differentiated the tested groups.

Table 5. The level of diversity of training loads in the annual training cycle of the tested players

Group / Tested parameters	Experimental group (n – the number of training lessons)	Control group (n – the number of training lessons)
Arithmetic mean	564.22	656.67
Standard deviation	16.58	17.19
Significance of differences	8.47*	

*Significant ($p < 0.001$) difference in comparison with the control group

This means that players from control groups had more practical sessions, so it can be considered that they were more exploited in the process of training. A further aspect of the research demonstrated how the state of intense practical training affects the joint and muscle injuries of lower limbs. As the data in Table 6 show, in the experimental groups, in which mental training dominated, there were much less injuries than in the control groups– research data difference at the level of statistical significance for the lower limbs injuries – $p < 0.01$ and for the joints of lower limbs $p < 0.05$. In measurable values, Tables 7–8 present this condition in the annual training cycles.

Table 6. Measurable average value of the joints and muscles injuries of the examined players

Group / Tested parameters	Group E (number of injuries)		Group C (number of injuries)	
	muscles	joints	muscles	joints
Arithmetic mean	0.80	0.54	1.10	0.71
Standard deviation	0.63	0.62	0.85	0.81
Correlation			2.66**	2.09*

Significantly different: * ($p < 0.05$), ** ($p < 0.01$)in comparison with the control group

Table 7. The number of lower limbs injuries of the SMS players in the annual training cycle

The location of an injury	Experimental group (n – the number of cases)	Control group (n – the number of cases)
Muscles	37	51
Joints	25	33
Both	62	84

Table 8. Quantitative characteristics of the injury spot

The injury spot	Experimental group (n – the number of cases)	Control group (n – the number of cases)
Knee joint	14	18
Ankle joint	11	15
Quadriceps of the thigh	16	23
Biceps of the thigh	12	17
Triceps of the calf	9	11

As it was mentioned, the efficiency in the process of transferring the expertise is the essence of intellectualization of the learning process. According to professional literature [7, 8, 9, 13, 16], this knowledge decides what and how a player has to do a certain activity. In the practice of sports action, this means that the player pursues the objective in a conscious way [16], preserving e.g. tactical and motor rules based on the correctness of biomechanical performance [6].

Taking this into account in the further research proceedings, we attempted to estimate the dependence of the expertise on the traumatism of the lower limbs muscles and joints. In both groups E and C the results of the applied statistical calculations showed a close correlation of the level of expertise with the state of the muscle injury – $p < 0.01$ and of the joints of the lower limbs $p < 0.05$ (Tab. 9).

Table 9. The influence of expertise on the lower limbs injuries in the examined players

Group / Tested parameters	Experimental group			Control group		
	expertise (points)	muscles (n)	joints (n)	expertise (points)	muscles (n)	joints (n)
Arithmetic mean	48.49	0.80	0.54	41.99	1.10	0.71
Standard deviation	7.64	0.63	0.63	5.76	0.85	0.81
Correlation		0.447**	0.316*		0.392**	0.301*

Significantly different: * ($p < 0.05$), ** ($p < 0.01$) in comparison with the control group

DISCUSSION

The aim of the present study was to evaluate the effect of intellectual technique teaching on the effectiveness of actions performed by football players during matches and on a reduction in the lower limb injury rate.

Contemporary training of young football players is often based on excessive training loads, leading to a variety of risks [17]. Consequently, football players are more prone to numerous injuries which not only affect athletes' health but also their careers and the future of the entire team [18]. Therefore, searching for more effective methods of sports training has to be focused on the improvement in the effectiveness of various tasks during the game (e.g. technical motor tasks) and an increase in the health status [19].

With regards to the problem addressed in the first research question, it should be emphasized that the experimental group had the highest levels of the parameters of football training evaluated in the study. This concerns in

particular the expert knowledge, which translates into substantial playing effectiveness [7, 8, 9] and motor skills alone [8]. These findings are consistent with those documented by Duda [8], Panfil [9], Henninger et al. [7]. The above researchers found e.g. a significant effect of intellectual training on athlete creativity. According to Memmert [16] and Light [19], this ability has an essential effect on making accurate decisions that ensure the effectiveness of playing (i.e. playing with understanding [20]).

As for the second research question, which was essentially focused on the health aspects, the attempts were made to find whether the intellectualization process in football training helps reduce the load in individual training sessions. The results obtained in the research are important to the young players' health. They indicate a reduction in the impact in the physical and motor sphere in the player's preparation. This was confirmed in studies where the experimental group had about 14% less time on practical training (3600 min. in the annual cycle).

This value is of great importance for the size of the load on the ligamentous-motor apparatus in the players' football training [21]. The intellectual training, which optimized the training process, interacted in two directions. In the first one, the capacity of the load decreased, and in the second, the time of restitution in the training micro-cycle increased [10]. These factors could greatly determine the efficiency of the tested players' movement apparatus [14, 22].

Further research also referred to health aspects, and the injuries which the football players suffered over the studied training period were evaluated quantitatively. Data analysis revealed that the experimental groups achieved statistically significantly better parameters of the health status. Therefore, one should examine the cause of this phenomenon. According to Duda [8] and Henninger et al. [7], this was caused by a player's expert knowledge in the field of motor tasks. As argued by Panfil [9], this knowledge, being an essential aptitude, has an effect on the purposiveness of the movement structure but also on the perception of various conflict situations during a match. It determines the purposive actions taken by a player who, due to the goal of their actions, makes right decisions and, through a reflexive situation (various levels of conflict), acts safely in the conditions of the game [19].

In conclusion, the hypotheses proposed in the study were supported, while examinations of these factors could greatly determine the efficiency of the tested players' movement apparatus [22]. A great influence of trainings in the aspect of intellectual teaching on the effectiveness of technical activities in isolated conditions and in games was also shown (Tab. 4). This means that in intense sports training the methods which will reduce the exploitation of the body can be used (in the optimal proportions).

A confirmation of the importance of expertise for the effectiveness of the game can also mean the preventive-health impact in training. The knowledge of biomechanical principles in the structure of motor skills can be an example (optimal figure and optimal dynamics of motion) which can significantly reduce the number of sports injuries [6]. Taking into account the fact that the problem of the volume and exploitation of the organism especially of young players

has a significant meaning [3, 4] for their state of health, such a direction in the process of training is of humanitarian importance. Intellectual training has an impact on the player's mental sphere as well. This fact has also a health meaning as it meets the requirements of holistic training [18]. It fully recognizes the problem of training for health of especially young players, which means looking for reserves in all the spheres of the athlete's action, which would make up lost time intended for physical effort.

CONCLUSIONS

1. Intellectual training positively influences the effectiveness of technical actions of young football players.

2. Intellectualization of the teaching process decreasing the physical load on a player and exposing the conscious action positively influences the state of lower limbs injuries in young players.

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