Development of Mental Representation of Movements in Children as a Means of Forming Sports Skills and Reflexivity

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Abstract

The article presents the theoretical generalization of the need to use mental imaginary representation of movements in teaching children sports skills in football. The aim of the study is to investigate the characteristics of the sensory-perceptual information processing by children 7-12 years old (mastering motor skills in football), depending on the level of their imagination development and the use of mental motor images. To determine the most effective and often used mental images by young athletes and the ways of representing them we used the "Movement Imagery Questionnaire for Children". This study involved 35 boys from Kyiv football sports section aged 7 to 12 years old. Based on the adapted methodology "Movement Imagery Questionnaire for Children", data were obtained that indicate the performance of the applied method of mental representation of movements in the formation of motor skills. The study contributed to a more complete understanding of the mechanisms of mental representation of movement, including such parameters as the physical reaction of athletes to mental representation of a situation; features of the environment in which they are performing exercises; pace; remembering the mental image; related emotions and the way of image representation. Knowing the ability of children to represent mentally the movements they perform can help sports psychologists and coaches develop mental representation in young athletes, which will help improve motor skills when performing real exercises during the training process and competitions.

Keywords: sensory-perceptual activity, mental representation, mental image, motor skills, reflection.

1. Introduction

In psychological science the problem of the development of sensory-perceptual activity is considered as one of the urgent. Sensory-perceptual processes as regulators of human interaction with objects and environmental phenomena and the main forms of cognition are the basis of mental development and an important condition for human life. The concept of "sensory-perceptual activity" encompasses sensory perception and perceptual actions that provide conscious sensory allocation of certain properties of the

objects being examined with the subsequent transformation of sensory information into a reflection of reality in the form of constructing an image adequate to the objective world and purpose of the activity.

This concept emerges from scientific studies of psychomotor processes that connect the external world of people's physical body with their inner world – needs, mental processes and conditions, and originates from the experimental work of the outstanding Russian scientist I. M. Sechenov, who was the first to introduce these terms into scientific circulation. These studies arose as an important direction, a necessary degree of transition to the study of the most important and popular subject of psychological research – human cognitive processes.

Depending on the complexity, it is customary to name three levels of the psyche or mental reflection of reality: these are sensory and perception, mental representation and the higher level – the verbal-logical level. The transition from the sensory to the perceptual reflection level is a further development of sensory – a significant increase in the number of cumulative sensations, the complexity of the analyzer systems (synesthesia). The increase in sensitivity as a result of the interaction of analyzers and training exercises is called "sensitization." In the latter case, we are talking about sensory education – a system of pedagogical influences aimed at the formation of sensory cognition ways and sensations and perceptions' improvement. We do not just hear, see, etc., but we pass it all through an individual prism.

Today, most models and training programs are focused on cognitive development. Therefore, for psychological and pedagogical science and practice it is an immediate need to study all the factors that can affect the formation of the human intellectual potential. Based on this, the study of the mechanisms of mental representation development in children of primary school age and adolescence, the use of such knowledge in the educational process, including learning motor skills in sports, is of particular relevance.

2. Literature Review

I. P. Pavlov explained the cortical mechanisms of voluntary movements as "a consequence of afferent irritation from our subjective presentation, a consequence of our thought." That is why movement as a functional organ possesses not only biodynamic, but also sensory tissue. The first is the external form of living movement, and the second is the internal one. These two forms of motor action are in constant interaction, the mutual transition of the biodynamic and sensory sides [1]. J. Piaget also associated simpler forms of memory with movements, the obligatory presence of sensations and mental representations in their implementation. He linked movements with foresight and search [2].

An important place in understanding the processes of awareness and mental representation of movements belongs to the researches of M. O. Bernshtein, O. V. Zaporozhets, P. K. Anokhin [3, 4, 5]. In his works M. O. Bernshtein for the first time presented the movement as a multi-level mental influence. The regulating mechanism for constructing movement is the "closed loop of interaction" [6]. M. O. Bernshtein showed that a system of reverse afferentations is needed for successful regulation of movements. The system of reverse afferentations includes a constant assessment of the trajectory of the real motion and the given one. In fact, we are talking about feedback in the regulation of movements (reflexive ring regulation).

The methods of biodynamic analysis of movements developed by him indicated the essential importance of the latter in the study of higher nervous activity and behaviour. This is, first of all, his idea of "living movement" as a living organism – a dynamic functional organ of an individual, possessing, like the anatomical and physiological organs, the qualities of evolution, involution, and reactivity [7, 8]. This also covers the role of the motor image, which was understood as the "leading directive", "model of the required future", the programs, and feedbacks in the construction and regulation of movements. These are ideas about the uniqueness and originality of movements (movements are not repeated, but are built anew each time), therefore exercises are "repetition without repetition".

Following M. O. Bernshtein, O. V. Zaporozhets called living movement as "the movement of a living body, reproducing the shape of another body, which is intrinsically connected with the search that includes orientation to the future" [5]. It was noted that the essence of their origin was at the same time the essence of the origin of sensuality, feeling, psyche. A living movement was considered by O. V. Zaporozhets in this sense as "a genetic derivative unit of mental activity analysis". It is no coincidence that M. O. Bernshtein noted that "human motility can and should become a wonderful indicator for studying the processes that take place in the central nervous system" [6]. He wrote that this motor indicator of higher nervous activity is able to reflect the fleeting processes of the brain.

Further studies of M. O. Bernshtein showed that these inexhaustible phenomenological aspects of movement can serve as indicators of not only the processes occurring in the central nervous system, but also higher mental functions. It was proved that afferent stimulation of the motor system with the help of physical exercises accelerates the development of the motor analyzer, which serves as an apparatus for integrating the results of the entire cerebral cortex, and also contributes to the development and improvement of afferent acts [4]. To the same extent that people feel the qualities of the objective world surrounding them, there is a need for a sense of one's own movements. That is, motor actions can act as conditions for the emergence and development of sensuality, feeling. The sensation, in turn, creates the necessary conditions for the further development and improvement of the movements themselves.

Regarding this, O.V. Zaporozhets emphasized that the sense of movement is not only an obligatory companion of their arbitrariness, but also a prerequisite for them. He said "before turning into arbitrarily regulated, the movement must become tangible" [5]. So, sensation, from this point of view, "is as much the basis of movement as its result". It is no coincidence that the concept of "sensory tissue" was introduced into the psychological theory of movements' construction, which was understood as the motor experience that persists after the movement is completed, and together with the biodynamic tissue of living movement is the material of the formation and construction of motor actions' images. This motor experience acquired in practical activity is crucial for the process of future motor images formation, because on its basis the construction of new movements is carried out. It should be noted that sensations, mental representations of a living movement here are understood not only in relation to the external conditions of its flow, but also to oneself, internally.

The research papers of P. K. Anokhin on the physiology of functional systems are of exceptional interest in terms of the problems we are considering. Without setting ourselves the task of completely covering this direction, we dwell only on two components of the physiological functional system: the acceptor of the results of an action and reverse afferentation. According to P. K. Anokhin, "an acceptor of the results of actions ..."provides" the afferent properties of that result, which should be obtained in accordance with the decision, and, therefore, is ahead of the course of events in the relationship between the human body and the outside world" [3]. The acceptor of the results of actions allows one to "predict the signs of the result necessary at the moment and compare them with the parameters of the real result, information about which comes to the acceptor of the actions' results due to reverse afferentation". The presence of an acceptor of the actions' results and a system of inverse afferentation in a functional system of behaviour shows theoretically the need to evaluate current and quantitative results of behaviour. These mechanisms can become the basis of reflection, awareness of activity and oneself.

Studying the role of children's motility in the regulation of their mental state, we proceeded from the fact that during voluntary movements there is a relationship between internal (mental) and external (physical) activity. Intentions arising in the child's consciousness are realized in external motor acts, which in turn contribute to the development of mental functions, motor experience. Internal and external activities have the same structure and are interconnected. The external activity is internalized and takes the form of mental activity, and the internal activity is externalized, acquiring the objective form [1]. Usually, speaking of mental representation and imagination, mental representation of memory and mental representation of imagination are distinguished. The concept of memory refers to the reproduction of previously experienced perceptions in the consciousness. The mental representation of memory is the mental representation of what was. But the reproduction of what was is not identical to what was perceived. After all, the image is always perceived subjectively, it acts as a unit of individual consciousness. It maintains its stability for a fairly short time, and even while in present, the image of the object, ensuring the adequacy of the perceiving object, is constantly in dynamics, dictated by the situation of the problem being solved and personal values. A permanent thing, but the image of this thing as a subjective image is changeable. In this case, we understand the subjective variability of the image with its objective stability (invariance) in order to understand the relationship of the image-perception and the way of presentation. To understand this relationship, we note that the image-representation, like the image-perception, is functional.

We always reproduce the image for solving any problem, guided by certain needs that are directed by certain experiences. The image-perception is a thing of the past. The image-representation is reproduced in the present to solve the problems faced by the subject "here and now". This means that the image-representation is under the control of the whole inner world of a person and acts as a part of the

consciousness of the subject. Therefore, new ideas can be introduced into the image-representation, which were not in the process of perception, but at the same time the image-representation provides the objectivity of the mental representation, as applied to the specific motor action. The image-representation is the image-perception, refracted through the inner world of a person, related to the problem and situation being solved. This is where the productivity of mental representations lies. No wonder it is mentioned in folk tales: "Morning is wiser than evening." The images of movement and ideas about movement have different content of thoughts, but at the same time they retain their objectivity. Therefore, the expression of the image in individual thoughts shows their relationship and simultaneously the difference due to time, situation and tasks that are solved by the subject.

Today there are many scientific papers on the effectiveness of using mental representation in athletes' diverse training. There are many synonyms of terms in the literature on sports psychology: motor image, mental image, motive image, imaginary training, ideomotor training, figurative repetition, visualization, kinaesthetic image, visual-motor repetition of behaviour, etc. We adhere to the definition according to which mental images include the types of quasi-sensory and quasi-perceptual experiences that exist in our minds in the absence of stimulating conditions that generate primary sensory-perceptual reflections of reality.

It is important to distinguish between athletes' imaginary training and the usual process of a person's mental representation: an imaginary training involves a thorough and focused study and repetition of a specific motor image in a series of mental representations. The usual process of mental representations differs from such a procedure in the spontaneity of its course, the absence of an analysis of the most significant details. Mental representation is a conscious process; it is conducted and controlled by our needs, interests, feelings and desires. Of course, imagination uses the material of thoughts, feelings, images and can transform them, acting together with them or free them from the power of memory. The unity of feelings and imagination is an opinion.

Studies on the mental representation of movements (MRM) in adult and young athletes are carried out both in the territory of the former Soviet Union [9-15] and abroad [16-18]. In studies performed on adult athletes, it is proved that the use of mental images can increase the efficiency of learning new motor skills and improving the technique of performing familiar exercises. Motor skills include the process of self-training in various sports, as well as the ability to predict the actions of a partner in a game in team types, for example in football [19]. In addition, in a number of works it was shown that the combination of physical activity and MRM is more conducive to the effective performance of movements than the simple muscle training, as well as the fact that MRM can increase the strength of the muscles of the lower leg, press, arms, legs, etc. [20].

There are also foreign studies that prove the importance of MRM for the training process of young athletes. For example, the research of M. Guerrero, D. Tobin, K. Munroe-Chandler, and her colleagues conducted with children aged 8 to 14 years old showed that due to mental images it is possible not only to improve the performance of sports tasks, but also to increase the collaborative effectiveness of a team [21]. The research of M. Afrouzeh and his colleagues, conducted on 36 young volleyball players (average age 13 years old), was aimed at elucidating the effect of the 7-week use of the PETTLEP-1 model on them when studying the delivery technique. The results of this study showed that those athletes who trained in a pitch, using the model of mental representation of their movements, learned that skill better than athletes who did not use mental images of movements before training [22].

The study of the imaginary processing specifics – the systematic and purposeful speculative repetition of motor elements by young athletes-skiers in order to improve the coordination of movements performed this way and increase the general level of technical readiness – also confirms the effectiveness of this approach. It is assumed that when working on movements, depending on their mastering and the features of mental representation, athletes will have higher rates of sportsmanship. It was noted that the specifics of movement pattern is related to its perspective, in particular, while representing mentally 11 elements of ski equipment, the children noted the most familiar perspective of mental representation of each of them [11].

The aim of the study is to investigate the characteristics of the sensory-perceptual information processing by children 7-12 years old (mastering motor skills in football), depending on the level of their imagination development and the use of mental motor images. The main objectives of the work were to conduct the primary adaptation of the methodology to the Ukrainian sample, the main stage of the study on the use of imaginary motor representations and analysis of the obtained data.

3. Method

To determine the most effective and often used mental images by young athletes and the ways of representing them we used the "Movement Imagery Questionnaire for Children" (MIQ-C) [18]. The MIQ-C technique is the modification of the third version of the movement mental representation questionnaire for examining children aged 7 to 12 years old. It was during this period that a child begins to develop such cognitive ability as mental manipulation of images, which is involved in the mental representation of movements [13, 15]. Due to the lack of reliable methods for assessing children's ability to visualize movements in Ukraine currently, we considered it relevant to test MIQ-C methodology on the Ukrainian sample of young athletes.

Based on the model of using mental images in sports [18], today the model is based on two functions of athletes' figurative representations: cognitive and motivational, each of which in turn is realized at two levels – general and special. The authors distinguish five different types of mental images used by athletes:

1. cognitive general images (CI);
2. cognitive special images (CS);
3. motivational special (MS);
4. motivational general activating (MO-A);
5. motivational general regulatory (MO-R).

According to this model the images used by an athlete in various sports situations should correspond to the desired result. So, if athletes want to increase the self-efficacy of a sports exercise, they need to use images of the MO-R type, and if the question arises of the intellectual component formation of the motor action, then – images like CS, etc.

At the preliminary stage, the MIQ-C methodology was translated into Ukrainian and its primary adaptation was made for 5 children under test aged 7 to 12 years old who were involved in football. As a result, some words were replaced by more understandable for the Ukrainian sample, but did not distort the contents of the task: for example, the expression "a glass of mud" was replaced by "a glass with dirty water"; a more detailed description of what "kinaesthetic performances" mean was also added. At the main stage, young athletes performed the tasks of the methodology. The technique consists of 4 exercises. Each exercise was aimed at the work of a specific muscle group.

Standing in the starting position (in four exercises the starting positions are different), the child must imagine some kind of movement without actually making it, and then assess the complexity of mental representation of this movement on a 7-point scale (from 1 – "very difficult" to 7 – "very easy"). Each movement had to be represented in three different ways: from the first person (perception of the movement from the position of "I-subject" which actualizes the result of direct interaction with specific properties of the environment, from the third person (perception of the movement from the position of "I-object", which is the reflection in the individual's consciousness of oneself as the part of objective reality; and kinaesthetic (perception of the features of muscle work when performing movement) [14].

Before starting work with each child, a detailed discussion of instructions and clarification of terminology was held, as well as a training session, during which athletes answered questions about their ways of representing this movement using the mental representation of a hit on a soccer ball. Also at this stage there was an explanation of the rules for scaling sensations using pictures with glasses filled with various liquids, the visibility through which was accordingly different: for example, if the children present an image of hitting the ball as if they were looking through a glass with dirty water, then they should choose a value from 1 up to 3 (that is, from "very difficult" to "a little difficult").

The study involved 35 boys from Kyiv football sports section aged 7 to 12 years old. To check the reliability-consistency of the questionnaire's questions, the Cronbach's alpha coefficient was calculated. The resulting indicator 0.852 indicated good consistency of questions. The processing of empirical data was carried out on the basis of the SPSS Statistics.

4. Results and Discussion

The results obtained in the study are shown in Table 1.

Table 1. *Indicators of mental representation of movement by children*

Number of children	Age	Indicators			
		Min.	Max.	Average value	Standard deviation
The first-person mental representation of movement					
11	7 - 8	3,25	7.00	6.41	0.07
12	9 - 10	3.75	7.00	6.41	0.82
12	11 - 12	4.00	7.00	6.31	0.68
The third-person mental representation of movement					
11	7 - 8	3.25	7.00	6.11	1.56
12	9 - 10	4.00	7.00	6.26	0.79
12	11 - 12	1.00	6.80	6.00	0.31
Kinaesthetic representation					
11	7 - 8	1.00	7.00	5.59	2.06
12	9 - 10	3.75	7.00	5.94	0.88
12	11 - 12	1.00	7.00	5.66	1.23

In the process of recognizing kinaesthetic images, 70% of children reported that they were not able to enter into kinaesthetic images, saying that they "could not feel anything". Four children said that they justified their answers by how easy it was to feel the actual movement than the mental representation of the movement. Three children reported that they required a visual image when they were asked to generate the kinaesthetic image. Instructions have been changed. During this assignment we asked the children first to name the muscles that will be used to complete the task and which parts of the human body will be involved. Then they focused on the mental image of how this action will be felt without really doing it. After that they appreciated the easiness / complexity of the image, the feeling of hitting the ball.

When completing the third task, children's answers often indicated a lack of understanding of the concept of "kinaesthetic representations", visualization, and its relation to Likert scale. To solve this, photographs of three different glasses: one filled with dirty water, the other one – with muddy water, and the third one was empty and transparent, were placed at various points on Likert scale. The glass with dirty water and the clear glass were fixed to the very easy / difficult ends of the scale, and the image with muddy water was placed in the center. The children were again sent to the idea of kicking the ball and were asked questions about how easy / difficult it was to see their skill if they had to do it through glass. Due to this question and photographs of various glasses, we have provided a more complete understanding of the use of the scale and the concept of easiness / difficulty of visualization by children.

The mental actions and operations created by a child begin to be realized from the perspective of another person who is initially real, and later conditionally present in the ideas of a particular child. That is, the child's action is built from the very beginning as reflective, since it includes the conditional position of another person. Moreover, the conditional position of another person may be present in action spontaneously or maybe realized. Conscious forms of reflection are possible only in the presence of language mediation.

Reflexivity is necessary: a) when carrying out actions or committing acts requiring arbitrary self-control; b) in actions aimed at transforming oneself (for example, self-education, development of one's knowledge, skills, abilities, etc.). Thus, the subject is aware of its external objectively substantive or internal mentally constructed position in relation to a specific action or act, object or person. These two indicated criteria of reflexivity correspond to such characteristics of actions as their awareness and self-awareness. According to the first criterion, reflection is considered as an objective expression of some knowledge through other knowledge (expression of one value in a system of other values) – organization, construction and control of one orientational basis of actions using another orientational (metaorientational) basis of actions. The subject does not include orientation on oneself in the conscious system of orientational actions. The second criterion defines reflection as such a conscious system of orientational actions, in which the subject's orientation, aimed at oneself, is necessary.

So, the sensation of movements is directly related to the person's self-knowledge, occurs on the basis of reflection, which is carried out by the same mental processes as cognition of the surrounding world. These

processes are addressed to the basic constructs of the psychological system of activity. But how is reflection realized when it is addressed to the subject of activity? How is self-knowledge realized? To begin with, we pose the question this way: how can external observers recognize us? They can do this either by observing our daily behaviour, or using special tests. But in this case, what should these tests consist of? They should represent standardized types of activities, which, according to our assumption, allow us to conclude on the basis of the tests' results about the essential qualities that they seek to learn about. Otherwise, how do we judge real personalities? Of course, we should take into account the behaviour of these individuals.

Thus, we are talking about the knowledge of certain entities that are not directly observed. They are not observed both by an external observer and by the subject oneself. Therefore, both the external observer who wants to know us (as an object of knowledge), and when we ourselves want to know ourselves (as an object of self-knowledge) we are in the same situation. And so, in order to know ourselves, we must turn to the results of our activities and behaviour. Thus, subjects for the purpose of knowing themselves include themselves in an activity in which certain qualities are likely to appear, and based on the results of this activity (behaviour), they draw conclusions about their qualities.

So, in the act of reflection there are two points:

- targeted inclusion of oneself in activity;
- analysis of the results from the standpoint of their conditioning by their essential qualities.

Targeted inclusion, in turn, involves:

- the motivation to know oneself;
- knowledge of the essential qualities that determine behaviour;
- knowledge of the types of vital activity in which the essential qualities of oneself can manifest and become clear.

Thus, we see that the determinant of self-knowledge is the motivation for self-knowledge. The whole process of self-knowledge is realized by the same mental processes as the knowledge of the external world. Developed reflection determines self-awareness, and developing a sense of movement – we develop reflectivity and vice versa.

The results obtained complement and extend the findings of many studies [23-30].

5. Conclusions

The highest MRM indices for all modalities (the first-person, the third-person and kinaesthetic representations) are observed in children of the middle group (9-10 years old). This may be due to the greater tendency of children of this age to form cognitive patterns and the beginning of their use, as well as the development of the mechanism for the interaction of sensory-perceptual and motor modularities of the central motor analyzer, that is, the development of the intellectual component of motor action. But this assumption requires further verification. Despite the fact that, in general, the idea of the human body is less developed in children than in adults, however, the age of 7 to 12 years old is just the most sensitive for a more complete understanding of the structure of the human body.

In the process of studying the relationship between athletes using mental images of movement (motivational, cognitive) and the general development of their imagination, it turned out that there is a significant relationship between the use of mental images by athletes and the level of their imagination's development. When answering the question, which images: motivational or cognitive are used by athletes with a more developed imagination, we note that this depends on the age of people under test. If according to the results of 8-year-old athletes significant correlations of indicators in one or another way reflect the use of motivational images by the athletes, and then according to the results of 11-12-year-old athletes, it turned out that

In our opinion, this fact can be explained as follows. Firstly, in 8-year-old athletes real motor skills are still insufficiently formed, which causes difficulties when trying to mentally process them (cognitive function of images). Probably the mechanism for adjusting imaginary action can be effectively applied only if the skills of real motor programs (the intellectual component of motor actions) are available, while with regard to motivational images such restrictions should not be made. Secondly, it is known that in most children at the age of 8 the formation of formal logical thinking is only beginning, that is, the level of development of imagination in athletes of this age is higher than the level of intellectual development. So, for younger

athletes there are rather more productive applications than motivational images, which are characterized by greater emotionality than the cognitive ones.

The analysis of variance also confirmed our assumption that the mental representation of muscle movements is more difficult for children than the representation from the first or third person. Despite this we can assume that as a result of the regular use of mental images of the movements performed children-athletes will begin to analyze in more detail the sensations received from their body, and the indicators of the kinaesthetic representation of their movements in them will increase. We noted the following feature: despite the rather successful completion of the MRM from the first and third persons by young athletes, they still needed an explanation of the difference between these two types of representations. It is possible to assume that the internal visual, external visual and kinaesthetic images are separate constructions in primary school children.

The study contributed to a more complete understanding of the mechanisms of MRM, including such parameters as the physical reaction of athletes to mental representation of a situation; features of the environment in which they are performing exercises; pace; remembering the mental image; related emotions and the way of image representation. Knowing the ability of children to represent mentally the movements they perform can help sports psychologists and coaches develop mental representation in young athletes, which will help improve motor skills when performing real exercises during the training process and competitions.

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References

1. Pavlov, I. P. (1952). Izbrannye proizvedeniia [*Selected papers*]. Moscow. [in Russian].
2. Piazhe, Zh. (1994). Izbrannye psikhologicheskie trudy: Psikhologiia intelekta. Genezis chisla u rebenka. Logika i psikhologiia [*Selected psychological papers: Psychology of intelligence. Genesis of the number in a child. Logic and psychology*]. Moscow. [in Russian].
3. Anokhin, P. K. (1975). Printsipialnye voprosy obshchei teorii funktsionalnykh sistem [*Fundamental questions of the general theory of functional systems*]. Moscow. [in Russian].
4. Bernshtein, N. A. (1966). Ocherki po fiziologii dvizhenii i fiziologii aktivnosti [*Essays on physiology of movements and physiology of activity*]. Moscow. [in Russian].
5. Zaporozhets, A. V. (1986). Psikhicheskoe razvitie rebenka [*Mental development of a child*]. Izbrannye psikhologicheskiie trudy, 1, 320. [in Russian].
6. Bernshtein, N. A. (1990). Fiziologiia dvizhenii i aktivnost [*Physiology of movement and activity*]. Moscow. [in Russian].
7. Bernshtein, N. A. (1947). O postroenii dvizhenii [*About movement building*]. Moscow. [in Russian].
8. Bernshtein, N. A. (1997). Biomekhanika i fiziologiia dvizhenii [*Biomechanics and physiology of movements*]. Voronezh. [in Russian].
9. Veraksa, A. N., & Gorovaia, A. Ye. (2010). Vliianie voobrazheniia na rezultaty sportivnoi deiatelnosti nachinaiushchikh futbolistov [*The influence of imagination on the results of sports activities of novice football players*]. Natsionalnyi psikhologicheskii zhurnal, 2, 131-135. [in Russian].
10. Veraksa, A. N., Gorovaia, A. Ye., Grushko, A. I., & Leonov, S. V. (2016). Myslennaia trenirovka v psikhologicheskoi podgotovke spotsmena [*Mental training in the psychological preparation of an athlete*]. Moscow. [in Russian].
11. Kaminskii, I. V., & Veraksa, A. N. (2016). Rakurs psikhicheskogo obraza i ego rol v myslennoi prorabotke dvigatelnykh navykov [*Perspective of the mental image and its role in the mental study of motor skills*]. Vestnik Sankt-Peterburgskogo universiteta: Psikhologiia. Pedagogika, 2, 27-37. [in Russian].
12. Shmargun, V. M. (2016). Sensorno-pertseptyvna reguliatsiia protsesu myslennia [*Sensory-perceptual regulation of the thinking process*]. Visnyk Kyivskogo natsionalnogo universytetu imeni Tarasa Shevchenka, 1, 45-60. [in Ukrainian].
13. Aristova, I. L., Yesipenko, Ye. A., Sharaiieva, K. R. et al. (2018). Prostranstvennye sposobnosti: struktura i etiologiia [*Spatial abilities: structure and etiology*]. Voprosy psikhologii, 1, 118-126 [in Russian].
14. Kaminskii, I. V., Almazova, A.V., & Veraksa, A. N. (2017). Vzaimosviaz rakursov obrazov s osvoennostiu

i spetsifikoi predstavleniia dvizheniia [*The relationship of the perspectives of images with the development and specificity of the mental representation of movements*]. Psikhologicheskii zhurnal, 4, 76-92. [in Russian].
15. Shmargun, V. M. (2009). Psykhosomatychni osoblyvosti v intelektualnomu rozvytku ditei: monografiia [*Psychosomatic features in children's intellectual development: monograph*]. Kyiv. [in Ukrainian].
16. Björkstand, S., & Jern, P. (2013). Evaluation of an imagery intervention to improve penalty taking ability in soccer: A study of two junior girls teams. *Nordic Psychology*, 65 (4), 290-305.
17. Cooke, L., Munroe-Chandler, K., Hall, C. et al. (2014). Development of the children's active play imagery questionnaire. *Journal of Sports Sciences*, 32 (9), 860-869.
18. Martini, R., Carter, M., Yoxon, E. et al. (2016). Development and validation of the movement imagery questionnaire for children (MIQ-C). *Psychology of Sport and Exercise*, 22, 190-201.
19. Robin, N., Dominique, L., Toussaint, L. et al. (2007). Effects of motor imagery training on service return in tennis: The role of imagery ability. *International Journal of Sport & Exercise Psychology*, 2, 175-186.
20. Malouin, F., Richards, C., Duran, A., & Doyon, J. (2009). Added value of mental practice combined with a small amount of physical practice on the relearning of rising and sitting post-stroke: A pilot study. *Journal of Neurologic Physical Therapy*, 33, 195-202.
21. Guerrero, M., Tobin, D., Munroe-Chandler, K. (2015). Tigers and lions, oh my! Effect of a guided imagery intervention on children's active play. *Journal of Applied Sport Psychology*, 27, 412-429.
22. Afrouzeh, M., Sohrabi, M., Torbati, H. R. T. et al. (2013). Effect of PETTLEP imagery training on learning of new skills in novice volleyball players. *Life Science Journal*, 10 (1), 231-238.
23. Reiser, M., Büsch, D., & Munzert, J. (2011). Strength gains by motor imagery with different ratios of physical to mental practice. *Frontiers in Psychology*, 2, 194.
24. Arefiev, V., Tymoshenko, O., Malechko, T., Domina, Zh., Bezkopylny, O., Dutchak, Yu., et al. (2020). Methodology of differentiation of health-improving classes in physical education for primary school students.
25. Shkola, O., Griban, G., Prontenko, K., Fomenko, O., Zhamardiy, V., Bondarenko, V., et al. (2019). Formation of valuable orientations in youth during physical training.
26. Tymoshenko, O., Arefiev, V., Griban, G., Domina, Zh., Bublei, T., Bondar, T., et al. (2019). Characteristics of the motivational value-based attitude of students towards physical education. *Revista Dilemas Contemporáneos: Educación, Política y Valores*. Año: VII, Número: Edición Especial, Artículo no.: 11, Período: Octubre, 2019.
27. Prontenko, K., Griban, G., Medvedeva, I., Aloshyna, A., Bloshchynskyi, I., Bezpaliy, S. et al. (2019). Interrelation of students' motivation for physical education and their physical fitness level..
28. Griban, G., Prontenko, K., Yavorska, T., Bezpaliy, S., Bublei, T., Marushchak, M., et al. (2019). Non-traditional means of physical training in middle school physical education classes
29. Zhamardiy, V., Griban, G., Shkola, O., Fomenko, O., Khrystenko, D., Dikhtiarenko, Z., et al. (2020). Methodical system of using fitness technologies in physical education of students.
30. Prontenko, K., Bublei, T., Marushchak, M., & Bondar, T. (2020). A computer program for evaluation of children's fitness at football classes. *Information Technologies and Learning Tools*, 77 (3), 90-100. doi: https://doi.org/10.33407/itlt.v77i3.3277.