Available online www.ijpras.com

International Journal of Pharmaceutical Research & Allied Sciences, 2023, 12(2):99-107
https://doi.org/10.51847/OuY8gDu25Lh

Original Article

ISSN : 2277-3657
CODEN(USA) : IJPRPM

The Relationship of Mental Processes with the Technical Fitness of Basketball Players Aged 15-16

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ABSTRACT

In basketball, reaction speed is important: how quickly a player reacts to an external stimulus, finds the right solution and implements it on the playground, often determines the outcome of the match. The aim of the study is to analyze the peculiarities of the course of mental processes and to identify their relationship with the technical readiness of basketball players at the training stage of preparation. To assess mental processes, we used: a proofreading test, a test with a school ruler, an individual minute, and a tapping test. Standards were used to check technical readiness: the number of hits from 10 free throws, the time of the throw-in motion, and the total number of hits in the ring, shuttle running with ball driving (5x10). The study involved girls aged 15-16 years who had been playing basketball for at least 5 years and had sports grades. The basketball players were examined in September 2021 and May 2022. In this study we found statistical differences between the initial and final levels in terms of the number of errors in the proofreading test (27.91%, $p<0.05$), the reaction rate to a moving object (27.57%, $p<0.05$), the duration of the individual minute (13.59%, $p<0.05$), the result of the tapping test with the right and left hands (the differences were 21.82%, 15.46%, respectively, $p<0.05$), as well as the coefficient of functional asymmetry (35.67%, $p<0.05$). The data obtained require a deeper study of ways to increase the effectiveness of training activities that allow influencing traditional training.

Key words: *Basketball, Mental processes, Technical readiness, Basketball players, Correlation dependence*

INTRODUCTION

The effectiveness of competitive activity in basketball is determined by external and internal factors occurring during the game and competitions in general. Each player performs many actions during the competition: it takes into account the location of the players on the court, and the location of the ball, while it must correctly and promptly respond to the behavior of the opponent, "anticipate" possible difficulties and promptly find solutions to emerging problems, since the game takes place in conditions of time shortage [1]. At the same time, mental processes are actively involved: players are forced to concentrate and often switch attention from one type of activity to another, quickly and adequately responding to changing game situations [2, 3]. This is evidenced by several studies, which note that along with traditional types of sports training – physical and technical, the concretization and quality of the ongoing mental processes and cognitive behavioral strategies have a significant impact on the performance structure of motor action [4, 5]. In a study it is shown that value of the ratio of the value of the end diastolic volume of the heart to the index of myocardial mass on the background of regular basketball training significantly decreased due to an increase in the volume of the heart muscle, especially in the posterior part of the left cardiac ventricle [6].

The success of a basketball player determines attention, perception, foresight, creativity, and other cognitive processes. The speed of thinking will catch up with the speed of movement for many more years [7]. Nevertheless, deficiencies in cognitive processes reduce the personal potential of the player, because the processes of learning and technical improvement, decision-making, and acquisition of new technical and cognitive skills are largely determined by the nature of stimulation of the central nervous system, and training (repeated repetition of actions). However, in modern practice aimed at achieving quick results in competitive activity, the training of young players is dominated by the template execution of technical actions based on the endless repetition of the same actions, the absence of creative tasks, avoiding labeling the actions performed with words, which do not contribute to the accumulation and breadth of motor experience in the training process and competitive activity. The superficial attitude of many coaches towards the activation of mental activity in the improvement of technical actions, their component structure, and training methodology, put the individual training of a basketball player in several tasks that require its resolution [8, 9]. Therefore, in assessing the effectiveness of the competitive activity, it is necessary to include indicators and dynamics of mental processes, and analytical and voluntary motor activity of basketball players, contributing to the growth of technical and tactical readiness, which will allow placing the necessary emphasis in the development of training programs.

The purpose of the study: is to identify the relationship between mental processes and with technical readiness of basketball players at the training stage of preparation.

Research objectives:

1. To identify the peculiarities of the course of mental processes and the level of technical preparedness of basketball players aged 15-16 in the annual training cycle.
2. To carry out a correlation analysis and identify the relationship between mental processes and technical readiness of basketball players in the annual training cycle.

MATERIALS AND METHODS

To assess the peculiarities of the course of mental processes in basketball players, testing was conducted on the following indicators:

- correction test (diagnostics of concentration, stability, attention switching). Respondents were asked to review the proposed form for 4 minutes and delete certain characters from it (every minute the subject made a mark (dash) in the form);
- a test with a school ruler (an assessment of the reaction to a moving object was diagnosed). Respondents were asked to catch the ruler in free fall;
- individual minute (assessment of the peculiarities of time perception). The respondent was asked to count aloud from 1 to 60 (the experimenter turned on the stopwatch in parallel). Individual seconds were compared in duration with seconds of physical time.
- tapping test (assessment of the properties of the nervous system according to psychomotor indicators). The respondent was asked to put dots in the form, moving from rectangle to rectangle on command, without changing the rhythm every 5 seconds (each form has 8 squares arranged in a row of 4). The experiment was carried out sequentially, first with the right and then with the left hand.

To check technical readiness, the following tests were selected: the number of hits from 10 free throws; the time of the throw-in motion, and the total number of hits in the ring; shuttle running with ball driving (5x10).

The estimation of the time of the throw-in motion and the number of hits was carried out as follows: a basketball player from square A ran closer to the shield, 2-3 meters from the shield received a transfer from a partner standing at the top of the semicircle of the free throw area, performed two steps and threw the ball into the basket, then picked up the ball, passed it to his partner and ran into the square "B", where he repeated the same actions, only threw the ball into the basket with his other hand **(Figure 1)**. A total of 10 throws were made.

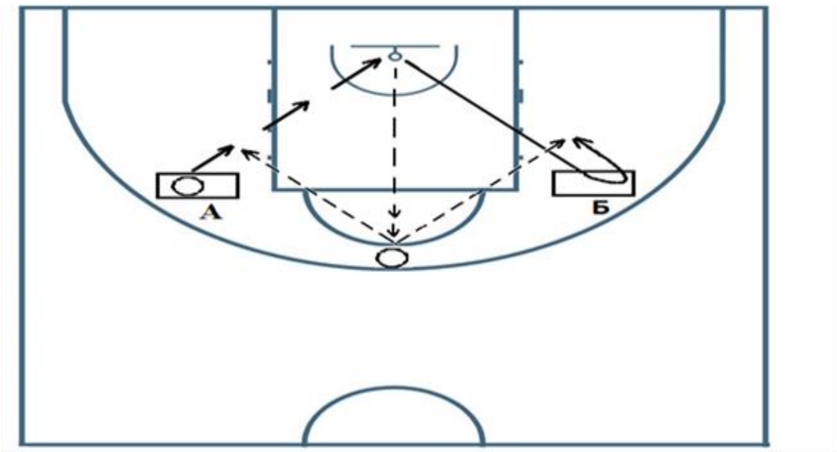

Figure 1. Diagram of the "Throw in motion" test

The study involved a group of respondents, numbering 20 people in each group (girls aged 15-16 years), all had sports grades and were engaged in basketball for at least 5 years. The basketball players were examined in September 2021 and May 2022.

The control group was engaged in the usual training program, and the Experimental group additionally performed a program that focused on the perception of information coming from the outside; awareness of the actions performed; performing basic technical actions with conscious control of individual components of the action to obtain new sensations and perception of information, collectively determining the improvement of the work of various sensory organs and the development of kinesthetic sensations of various directions (visual, motor, auditory, tactile, etc.); the decision-making process of the player, including expectation, perception, memory, attention with the simultaneous formation of technical skills. During the training sessions, special attention was paid to the implementation of technical actions in the presence of interference for their implementation. The following changes were included: the size of the playground (increasing the playing field to the handball court and vice versa - reducing the size to the volleyball court); strong noise with negative speech stuffing; exercises to maintain balance on unstable support, on tactile and proprioceptive sensitivity, audio and visual information.

To improve the processes of information processing and improve mental processes, games, and exercises were included to recognize poses, gestures, gait, and behavior of players; objects with tactile perception, distances in relation to markings, a shield, a player, a ball, landmarks; sound signals at different tempos and different intensities; to support the balance of the body, to coordinate movements, not inherent in basketball. The development of operational thinking was carried out in the process of developing the ability to properly assess the competitive situation and timely adjust the program of further actions; change the risks in an unfavorable game situation.

RESULTS AND DISCUSSION

Table 1 presents the results of assessing the mental processes of basketball players from the Experimental group at the initial and final stages of the experiment.

Table 1. Results of evaluation of mental processes of basketball players of the experimental group

Assessment of mental processes	Before	After	Difference
Proof-reading test (attention span)	2092,6 ± 465,03	2247,9 ± 375,56	7,42%
Proof-reading test (number of errors)	4,3 ± 2,4	3,1 ± 2,22	27,91%*
Test with a school ruler (cm)	18,5 ± 5,78	13,4 ± 3,38	27,57%*
Duration of individual minute (s)	56,5 ± 9,53	64,18 ± 3,37	13,59%*
Tapping test right hand (number of points)	184,45 ± 21,48	224,7 ± 29,07	21,82%*
Tapping test left hand (number of points)	149 ± 14,77	172,05 ± 25,26	15,46%*
Coefficient of functional asymmetry (conl.units)	9,84 ± 3,92	13,35 ± 7,32	35,67%*

* - differences are significant at $p < 0.05$

Table 1 shows that the amount of attention in the "Proof-reading test" is slightly higher compared to the original ones, which may be due to their higher efficiency, however, we found no statistical evidence. The number of errors when performing the test at the final stage of the examination is lower than at the initial stage, the difference is statistically significant (27.91%, p<0.05). The reaction rate to a moving object by the end of the experiment is statistically significantly higher (the "Ruler" test), which may be due to better coordination of movements resulting from the inclusion of experimental techniques in the training process (27.57%, p<0.05). During the periods before the experiment, basketball players were inclined to underestimate, while to by the end of the experiment, some overestimation was noted (13.59%, p<0.05).
Table 2 shows the results of assessing the mental processes of basketball players from the Control group at the initial and final stages of the experiment.

Table 2. Results of the assessment of the mental processes of basketball players of the control group

Assessment of mental processes	Before	After	Difference
Proof-reading test (attention span)	2045,4 ± 532,08	2138,6 ± 445,7	4,54%
Proof-reading test (number of errors)	4,9 ± 2,2	4,3 ± 2,14	12,24%*
Test with a school ruler (cm)	18,1 ± 6,54	16,2 ± 5,24	10,49%*
Duration of individual minute (s)	54,8 ± 8,59	56,9 ± 5,86	3,83%
Tapping test right hand (number of points)	192,55 ± 28,68	201,9 ± 29,93	4,85%
Tapping test left hand (number of points)	154,08 ± 12,45	160,34 ± 20,18	4,06%
Coefficient of functional asymmetry (conl. units)	11,11 ± 3,86	11,5 ± 4,26	3,51%

* - differences are significant at p < 0.05

Table 2 shows that the results of the tapping test of the right and left hands, as well as the coefficient of functional asymmetry, are significantly higher at the end of the study.
In the control group, the percentage differences at the final stage of the study are significantly lower, while only two indicators have significantly changed: the number of errors in the "Proof-reading test" (12.24%, p < 0.05) and the reaction to a moving object (10.49%, p < 0.05).
Table 3 shows the results of tests on the technical readiness of basketball players from the Experimental group at the initial and final stages of the experiment.

Table 3. Results of technical readiness tests of basketball players from the Experimental group

Technical readiness tests	Before	After	Difference
Throws in motion (time, s)	67,05 ± 6,96	61,55 ± 2,7	8,2*
Throws in motion (number)	6,8 ± 2,4	8,9 ± 1,16	30,88**
Free throws (number of hits out of 10)	6 ± 1,09	7,35 ± 0,92	22,5**
Shuttle running with ball driving 5x10 (time, s)	14,27± 1,05	12,95 ± 0,57	9,25*

* - differences are significant at p < 0.05; ** - differences are significant at p < 0.01

Table 3 shows that in all tests for assessing technical readiness, the results obtained at the end of the experiment in athletes are statistically significantly higher, and the spread of values is also less pronounced. The high spread of values at the initial stage of the experiment is due to the imbalance of functions related to age characteristics, which affects the effectiveness of training and is confirmed by the studies of several authors [1, 10, 11]. The time it takes to make throws in motion, the number of throws themselves, completed free throws, as well as the time of the shuttle run with ball driving for girls at the end of the experiment, statistically significantly exceed the values of the initial testing, due to the purposeful improvement of processes more related to awareness of their own thoughts and sensory-motor repetition of motor actions [11, 12].
Table 4 shows the results of tests on the technical readiness of basketball players from the Control group at the initial and final stages of the experiment.

Table 4. Results of technical readiness tests of basketball players from the Control group

Technical readiness tests	Before	After	Difference
Throws in motion (time, s)	68,12 ± 7,24	65,54 ± 4,32	3,78

Throws in motion (number)	6,65 ± 2,82	7,89 ± 2,9	18,64*
Free throws (number of hits out of 10)	6,2 ± 1,31	6,8 ± 1,38	9,68*
Shuttle running with ball driving 5x10 (time, s)	14,3 ± 1,2	13,42 ± 1,1	6,15*

* - differences are significant at p < 0.05

Table 4 shows that in the control group, the results of technical readiness improved at the end of the study, while statistically significant changes were noted in the number of completed throws in motion (18.64%, p<0.01), in the number of effectively completed free throws (9.68%, p < 0.05), the time of shuttle running with the ball (6.15%, p < 0.05). At the same time, the percentage changes are significantly lower than in the experimental group.

Next, we characterize the correlations traced between the mental processes and the technical readiness of the experimental group of girls at the initial stage of the examination **(Figure 2)**.

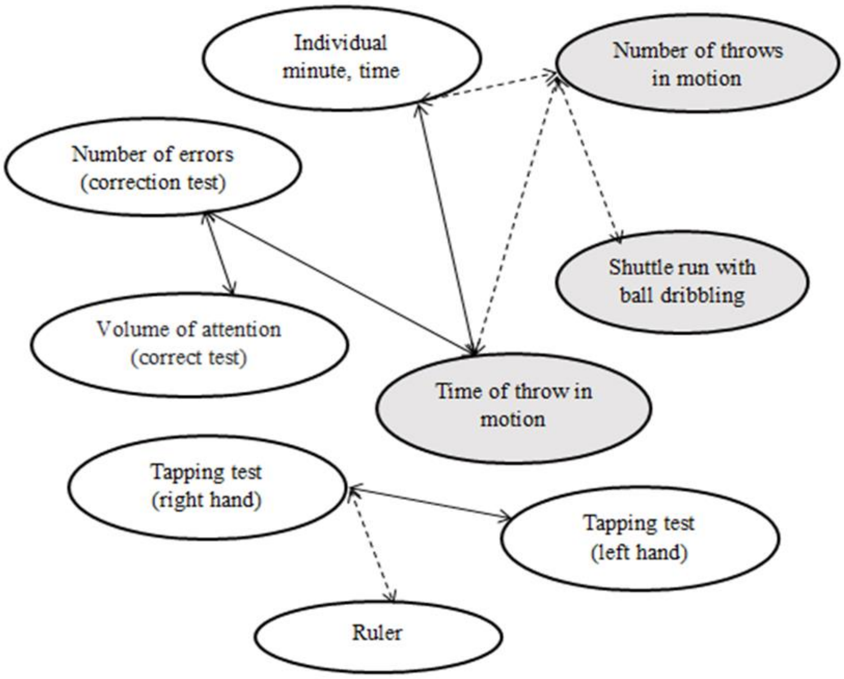

Figure 2. Correlational relationships between mental processes and technical readiness in the basketball players of the experimental group at the initial stage of the examination

Attention volume indicators have a direct correlation with the number of errors (R=0.628, p < 0.01): the greater the number of characters viewed, the greater the number of mistakes made, which indicates a low ability to concentrate attention. Indicators of the volume of attention (the number of characters viewed in the "Proof-reading test") have an inverse correlation with the number of throws in motion (R=-0.460, p < 0.05), which correlates with data from psychology (the greater the amount of attention, the worse the concentration on individual objects or objects).

The results of the tapping test of the right hand (the number of dots placed with the right hand – all participants in the experiment are right-handed) have a direct correlation with the results of the tapping test of the left hand (R=0.670, p < 0.01), as well as an inverse correlation with the time of the throw-in motion (R=-0.465, p < 0.05). The results of the tapping test of both hands have similar dynamics. However, a larger number of dots placed with the right-hand affects the reduction of time to perform the "throw in motion" test.

The results of the shuttle run have an inverse correlation with the number of throws in motion (R=-0.461, p < 0.05): the longer it takes respondents to perform the shuttle run test, the worse the performance of the standard "number of throws in motion".

The interrelations between mental processes and technical readiness of the experimental group of basketball players at the final stage of the experiment are shown in **Figure 3**.

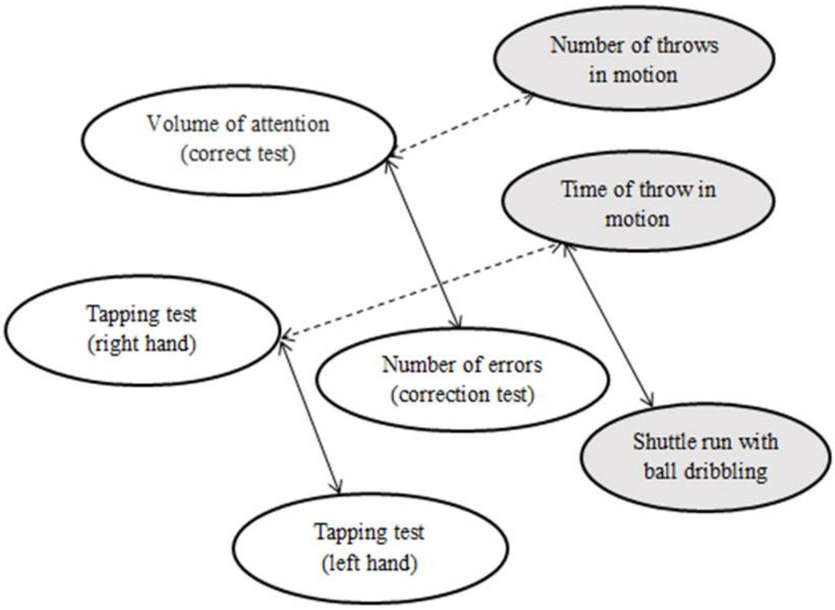

Figure 3. Correlational relationships between mental processes and technical readiness of basketball players of the experimental group at the final stage of the examination

In the study of O. E. Shaikina, such relationships (between mental processes and technical readiness) are designated as "functionally oriented supports", while "... the more connections are found between processes and their development, the more stable the support that allows you to perform a motor action qualitatively" [2]. In general, the data obtained by us confirm the hypothesis that purposeful regulation of mental, perceptual, and motor processes leads to an increase in the number of functional supports compared to the initial data [10, 13, 14].

For example, the execution time of the standard "throw in motion" correlates with the duration of an individual minute ($R= 0.612$, $p < 0.01$): this feature may be associated with the ability to feel time intervals and correlate them with actions on the playground.

The number of throws in motion has an inverse relationship with the time required to perform a shuttle run with driving the ball ($R=-0.498$, $p < 0.05$), as well as with the duration of an individual minute ($R=-0.499$, $p < 0.05$): a greater number of completed throws in motion is associated with the result of the standard "shuttle run with driving the ball" and the accuracy of the "individual minute".

The number of points put down by the right hand in the "tapping test" correlates with the results of the "Ruler" test (better reaction to a moving object) ($R=-0.492$, $p < 0.05$), which may be due to sensory-motor repetition of technical actions with the inclusion of the processes of awareness of "what, how and why" is performed.

The total number of points performed by the right and left hands in the tapping test has a direct correlation ($R=0.758$, $p < 0.01$), and it is somewhat stronger by the end of the experiment.

The execution time of the "throw in motion" test has an inverse relationship with the number of throws ($R=-0.588$, $p < 0.01$): the more time it takes to complete the task, the fewer the number of throws to the basket. This feature can be taken into account when organizing the attacking actions of the team.

The number of errors in the "Proof-reading test", revealing the features of concentration of attention, correlates with the time of the throw-in motion ($R= 0.530$, $p < 0.05$). The duration of the task affects the quantitative characteristics of errors and indicates the athlete's ability to maintain concentration for a long time, which is very necessary when getting a productive game. Considering that the number of errors in the "Proofreading Test" has a direct correlation with the total number of characters viewed ($R=0.736$, $p < 0.01$), it can be stated that an increase in the amount of work performed, leads to errors and, accordingly, the athlete who will be able to perform operational work on tracking one or the other for longer will look better. other information with fewer errors.

If an athlete has more or less complete information about his capabilities, then he can successfully use the spatiotemporal advance of the opponent's actions based on the acquired perceptual and motor components of technical actions. The representation and thought image as a reflection in the athlete's mind of the picture of objective conditions of competitive activity, as well as the subjective experience of the upcoming situation allows you to consciously concentrate on the purpose of the action, and not on the quality of the performance of actions, which is confirmed in a comparative analysis of the performance and information processing of basketball players in comparison with people leading a sedentary lifestyle [3, 14, 15].

The breadth of the range of incoming information due to the influence of various factors is not only directly related to actions in basketball, its effectiveness is based on the analysis and synthesis of the athlete's experience, constant comparison of current events with him, and selective extraction of information from memory. Thoughts are more focused on the consequences of competitive activity, as well as on the future: on what is not yet there, what should appear, in which static, dynamic, functional, and productive parameters of competitive activity are reflected in certain proportions [12, 16]. And depending on the degree of formation of the behavior model on their impact, an arsenal of retaliatory actions is developed, including the technical actions of a basketball player in all their diversity, which is reflected in the specific sports experience in the game. This allows, on the one hand, to overcome narrow functionalism, limited by the rules of the game and a certain arsenal of technical actions. On the other hand, it is considered a significant factor in increasing the capabilities of a basketball player in managing technical actions and competitive activities in general [14, 17].

At the same time, not a single mental judgment, and the thinking associated with it, is built anew every time. They carry information about the past, reflecting current actions and changes in the environment as harbingers of the future. Involuntary imagination complements thinking with independence, depth, breadth, flexibility, criticality, and speed. These effects are found in neuromuscular settings and in movements associated with the upcoming performance of a motor action, which frees the mind to solve more important tasks of sports activity. If the assumption of the need to perform a motor action in the future is based on sufficiently complete and exhaustive and timely information received, then the accuracy and depth of foresight can be increased, refined, and even changed [14, 16].

At the stage of implementation of technical actions in the conditions of real opposition of the opponent, the athlete acts as a "self-controller" of his actions, assessing the degree of their effectiveness, how much they correspond to the adopted operational plan, and the quality of the action performed in the conditions of competitive activity. At the same time, no conscious activity is possible without an explicit presentation of data on the technical actions performed, and their sensory awareness, which is most likely a key property of awareness. While practical activity is the main condition for the emergence and development of thinking, as well as the criterion of the truth of thinking [18].

This is confirmed by the results of the study, which allows us to state significant differences in the rate of mental processes and the increase in the results in the technical readiness of the athletes of the experimental group at the final stage of the experiment compared with the basketball players of the control group. This is also confirmed in the authors' research that the intellectual analysis of the results should be implemented in training to develop the ability of athletes to concentrate, and show fighting qualities and confidence [10, 19]. The practice of organizing training based on a broad and deep inclusion of conscious organization of one's actions, and not only automatic execution of actions, requires significant personal efforts of the athlete, independence, and responsibility, which are very different from the traditional requirements of the twentieth-century sports school, mainly based on reproductive activity [10, 19, 20].

The more perfect mental preparedness of the athletes of the experimental group, associated with special training of mental processes, causes more successful performance of tests on technical readiness associated with a higher reaction speed to a moving object, fewer errors, and the creation of images of motor actions that are close to a specific game situation [12, 14].

The study of correlational relationships revealed a significant increase in their number by the end of the experiment: 2 indicators had 3 relationships (the number of throws in motion and the time of the throw-in motion), 3 indicators had 2 relationships (an individual minute, the number of errors in the proofreading test, tapping test of the right hand), 5 indicators had one relationship (ruler, tapping test of the left hand, the amount of attention in the "proof-reading test", shuttle running with ball driving).

At the same time, at the initial stage of the survey, significantly fewer such correlations were revealed: 3 indicators had 2 correlations each (the amount of attention in the proofreading test, the tapping test of the right hand, the time of the throw-in motion), 4 indicators had 1 relationship each (the number of throws in motion, the number of errors in the proofreading test, tapping-left hand test).

For the initial stage of the experiment, an urgent problem remains the search for ways to comprehensively influence the body in order to improve both physical fitness and the speed of mental processes. The inclusion in the training process of a training program aimed at ensuring the interaction of the mechanisms of sensory-motor repetition, mental processes associated with the processing of information based on improving the processes of concentration and attention volume, allows you to more productively form images of motor action, game situations and behavior within their framework, monitor and change them, creating a mobile and controlled world of creative experience, thereby allowing to explain the nature of a wide range of properties of conscious brain activity [16, 20, 21].

CONCLUSION

The results obtained allow us to conclude that there is a need for a complex effect on the athletes' bodies. To increase the effectiveness of training and competitive activities, it is necessary to influence not only traditional types of training but also to work with mental processes, since they are an important factor influencing the effectiveness of technical actions of basketball players in competitive activities.

ACKNOWLEDGMENTS : None

CONFLICT OF INTEREST : None

FINANCIAL SUPPORT : None

ETHICS STATEMENT : All procedures met the ethical standards of the 1964 Declaration of Helsinki. Informed consent was obtained from all parents of the children included in the study.

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