Artificial intelligence in providing the first and second signal systems with polysensory information for precise coordination of volleyball players actions

UDC 1174.378.4

PhD, Associate Professor **M.Kh. Khaupshev**[1]
PhD, Associate Professor **A.Z. Bazhev**[1]
PhD, Associate Professor **A.A. Khezhev**[1]
A.A. Bazhev1
[1]Kabardino-Balkarian State University named after H.M. Berbekov, Nalchik

Corresponding author: haupshev-m@mail.ru

Received by the editorial office on 26.02.2024

Abstract

Objective of the study was to justify the use of artificial intelligence in managing the process of precise coordination of the actions of volleyball players.

Methods and structure of the study. The scientific work used the technology of planning and monitoring the dynamics of development of the accuracy of coordination of the components of the first and second signal systems, the success of technical and tactical actions of volleyball players in training and competition conditions.

Results and conclusions. It was established that the use of artificial intelligence as a technology for managing the educational process in volleyball made it possible to create conditions for variability and increase the coordination of functional and motor systems; develop coordination abilities in leading sensory systems; stimulate the development of cognitive and intellectual qualities, accompanying the actions with objective and urgent information of the second signaling system; ensure an effective increase in the accuracy of technical and tactical actions and competitive game tension.

Keywords: *artificial intelligence, first and second signaling systems, sensory information, coordination accuracy, useful result.*

Introduction. Perception and reflection of the world, storage of important information, its analysis and control of actions are carried out by the coordination apparatus of sensory systems and the memory function. A feature of sensory systems is the high sensitivity of receptors. Excitation acts on sensory elements, the sensitivity of receptors increases, conditions are created for obtaining information about the accuracy of spatial, temporal and force parameters of actions and their implementation to achieve an important result. Processes in the body are information, and images are elementary, sensory-perceptual, secondary - these are spatio-temporal signals, particular forms of codes. Therefore, human activity is guided by images of special environmental influences. This is the basis for the mechanisms of training sensory systems to environmental influences [1, 2, 4, 6, 9, 11, 12].

To study human activity, it is necessary to understand how information flows in systems, what is the result, how to evaluate behavior that satisfies needs and reflects the mutual influence of the organism and the environment. On this, a model of behavior is built, the leading one for which is the non-change of the sensory system, and the significance of the function in achieving the result of the action, which the body compares with the model of the result and its code is formed, that is, the brain, reflects the output activity of the whole organism, and not individual systems [1, 5 , 7, 8, 10].

It is known that the perception of signals that do not have semantic restrictions depends on the capacity of the learner and on familiarity with the signals. To perform an action, the signal must carry information from the sensory systems, with the mechanisms of their sensitivity and interconnection, and then in verbal form. The level of coordination is determined by: the objectivity of information, the adequacy of its analysis according to the situation, the formation of speech

codes of the second signal system, the timeliness of the implementation of actions, taking into account corrections [1, 3, 5, 6, 7, 10].

Information analysis is the process of comprehending it and incorporating it into the system of knowledge and experience in solving problems. Action coordination training, together with the capabilities of the first and second signal systems, leads to an increase in the accuracy of the result and determines the effectiveness of technical and tactical training. This is the process of formation of knowledge, motor abilities, skills and a hierarchical control system, where each level ensures the implementation of an action of a certain complexity. In this regard, mechanisms of reverse afferentation with the participation of the first signaling system are identified as the basis for reflecting the world in sensory images - visual, auditory, vestibular, muscular, motor, with anticipation of corrections recorded by the human brain [1, 3, 5, 6, 7, 10].

The visual sensory system is a function of activity that provides orientation and behavior of a person in the environment. Its motor components carry the basis of the load in coordinating actions in space, perceiving in a range of speeds, sizes, and relationships. When analyzing the vision system, signals are isolated that lead from the encoding of pulse sequence information to a spatial (typological) code. Describing a signal with a set of features reduces information and facilitates the assessment of the parameters of motor landmarks in space and response actions. This suggests that vision in the coordination of actions leads to the following functions: signaling (environment, target position), direct communication; control (action execution) feedback. The final result of visual perception is a subjective image of a real object [1, 2, 5].

The vestibular sensory system is an organ of balance, plays a role in taking basic postures, positioning the head and body, participates in the formation of the fund of movements, ensures coordination in space, and configures other systems to perform a motor task. This gives the vestibular system a leading role in behavior and in the development of sportsmanship [1, 5, 7].

The auditory sensory system is a meter of movements in time - rhythm, tempo of actions and the «individual minute». Hearing evaluates the accuracy of coordination of actions over time, reducing errors. An effective method for developing a sense of time is to count by ear using precise time references. The athlete plans the technique and tactics of actions, rearranges them, anticipating time points [5, 6, 7].

The musculoskeletal system plays a role in sensory formations that transmit information about movement - joint position, muscle length and tension. The accuracy of muscle efforts is associated with the optimal tone of the nerve centers and the functioning of the motor analyzer. For the central nervous system, the ratio between sensory input and motor output is on average 10:1. Therefore, when managing actions, it is important to use means and methods of reducing the number of effector parameters and simplifying information analysis [1, 10, 12].

The second signaling system is words and speech that replace conditioned stimuli, a means of human self-government. It was formed thanks to the word, as a tool for orientation and general reflection of the world in concepts, symbols, and images. Words are distinguished from the first signals by sound, visual image, and semantic meaning. It is this meaning of the word that refers to the second signal system, which reflects the properties of objects and phenomena. Speech is the ability of a person to communicate using words with their meanings, sounds and signs, based on vocal, auditory, visual and manual skills. The function of external speech is expressed in its translation into internal mental speech that regulates behavior. Perception acquired the qualities of objectivity and meaningfulness; attention has become voluntary; logical memory; thinking verbally and abstractly. Signals are received by the senses and then translated into virtual copies of real objects and phenomena in the mind. The word, being a signal of the first signals, constituted the second system of reality signals. It, as the basis of consciousness and verbal-logical thinking, forms knowledge through words, connecting fragments of information into a whole and regulating human behavior. Training is important when a person thinks about the movement, mentally performs it, tells himself correctly, which helps to comprehend the movement in general and in detail, and master it [6, 8].

The first and second signaling systems are involved in controlling the temporal, spatial and power parameters of actions, and accuracy depends on the perception and specificity of the signals. Systems model objects in the process of perception and reflection, where the word is the name of the object. If we carry out an element-by-element projection of the first system, we get the second, where the image of the object of the first corresponds to the name in the second. The brain reflects the world, creating models, imposing a mastered pattern on the first image, introducing additional information - brief, understandable,

semantic. This creates conditions for solving problems of world perception, where the second model, which is more variable, transforms into the first with a rigid model [1, 2, 3, 6, 7, 8, 10, 12].

Human speech is the brain's reflection of objects and activities in the environment, which is considered as a system of signals in development: the stage of sound, semantic and gestural signals; the stage of forming signs as a means of displaying and understanding the environment.

It is known that signal codes include speech phonemes, realizing their perception and recognition. Words and speech, reflecting the world, form a system that plays a signaling and triggering role, biological and social functions - cognition through actions and regulation of influence on the world. This showed that oral speech is not a collection of words, but a tool of thinking and signals of subject content [1, 2, 3, 6, 7, 8, 10, 12].

The organization of control, in the form of comparison of objective information and subjective assessment of activity, is included in the training of coordination of sensory systems.

Objective of the study was to justify the use of artificial intelligence in managing the process of precise coordination of the actions of volleyball players.

Methods and structure of the study. The scientific work used the technology of planning and monitoring the dynamics of development of the accuracy of coordination of the components of the first and second signal systems, the success of technical and tactical actions of volleyball players in training and competition conditions.

The spatiotemporal environment was designed to be multifunctional, to influence sensory systems, and variable, to ensure coordination of actions. A large database on volleyball has been created (certificate No. 2023616017). During the classes, coordination exercises were performed on types of training at three levels of complexity, accompanied by drawings, videos, audio materials and verbal codes, in the format of visual and auditory signals using simulators with feedback. This provided the sensory systems and the second signal system of volleyball players with important information.

The technology has been introduced into teaching students at the State University named after. HM. Berbekov of the Kabardino-Balkarian Republic. For the work, an experiment was conducted with the participation of 629 1st-3rd year students (251 boys, 378 girls). The effect in preparation was achieved thanks to adequate perception of information and its prompt analysis by sensory systems, which were successfully measured, formulated and presented in conditional codes of the second signaling system, allowing their understanding, comparison and implementation. The work used methods of literature analysis, computer planning and monitoring, feedback simulators, and mathematical statistics.

Results of the study and discussion. Artificial intelligence technology was studied by the reaction of the first and second signaling systems to the developing information space-time environment, by the accuracy of coordination of actions, by the success of mastering techniques and tactics, competitive tension, and by mastering the conceptual apparatus. By controlling the development of the first and second signaling systems, it was possible to mobilize potential capabilities, improve the accuracy of coordination of volleyball players actions by 8,7% at $p<0,05$, and understanding of verbal and speech support by 36,5% at $p<0,001$ (Table 1).

Such stable coordination of the functioning of systems cumulatively increased the indicators of technical and tactical actions of volleyball players by 14,5% ($p<0,05$) and competitive intensity by 11,5% ($p<0,05$) (Table 2).

Table 1. Accuracy of functioning of the leading sensory systems of volleyball players

Contingent / Systems	Students, % (m = 629)						Credibility
	1st course (m=183)		2nd year (m=208)		3rd year (m=238)		
	$M_1 \pm m_1$	$M_2 \pm m_2$	$M_1 \pm m_1$	$M_2 \pm m_2$	$M_1 \pm m_1$	$M_2 \pm m_2$	p1
Visual, 8 parameters	59,3±2,2	67,2±2,3	60,2±2,2	69,3±2,3	62,5±2,2	72,1±2,4	<0,05
Vestibular, 2 parameters	73,3±2,1	81,3±2,1	75,4±2,2	83,6±2,2	77,4±1,6	85,5±1,7	<0,05
Auditory, 2 parameters	76,8±1,7	85,2±1,8	77,4±1,7	87,1±1,8	79,6±1,4	89,0±1,5	<0,05
Muscular, 3 parameters	62,9±2,0	70,9±2,5	63,4±2,1	72,1±2,7	66,6±2,1	75,3±2,5	<0,05
Second signal, 90 terms	31,4±1,2	57,6±1,3	35,9±1,3	66,1±1,6	38,6±1,4	81,8±1,5	<0,001

Table 2. Accuracy of technical and tactical actions and competitive intensity of volleyball players

Contingent /Systems	Students, % (m = 629)						Credibility
	1st course (m=183)		2nd year (m=208)		3rd year (m=238)		
	$M_1 \pm m_1$	$M_2 \pm m_2$	$M_1 \pm m_1$	$M_2 \pm m_2$	$M_1 \pm m_1$	$M_2 \pm m_2$	p1
Technical and tactical	32,1±2,7	43,1±3,3	33,6±2,2	45,3±2,3	34,3±3,1	46,6±3,2	<0,05
Competitive tension	51,4 ± 2,1	58,9 ± 2,2	52,6±2,2	59,3±2,3	54,3 ± 1,6	62,9 ± 1,9	<0,05

Data from the coordination of sensory systems, technical and tactical training and competitive game tension showed a direct connection and a high level of correlation - R = 0,534 < 0,749, which indicates the benefits of artificial intelligence in the pedagogical process of managing volleyball classes.

C**onclusions.** It has been established that the use of artificial intelligence as a technology for managing the educational process in volleyball has made it possible to create conditions for variability and increase the coordination of functional and motor systems; develop coordination abilities in leading sensory systems; stimulate the development of cognitive and intellectual qualities, accompanying actions with objective and urgent information of the second signaling system; ensure an effective increase in the accuracy of technical and tactical actions and competitive game tension.

References

1. Basybekova K.E. O sootnoshenii elementarnykh urovney regulyatsii zritelno-motornoy koordinatsii. PhD diss. abstract. M., 1987. 19 p.
2. Berezhnaya E.K. O roli zritelnoy obratnoy svyazi v tochnykh dvizheniyakh. Upravleniye dvizheniyami. M.: AN SSSR publ., 1970. pp. 142-146.
3. Bratchikov E.Ya. Razvitiye bystroty i tochnosti raspoznaniya situatsiy signalnogo znacheniya s formirovaniyem adekvatnykh deystviy posredstvom tekhnicheskikh ustroystv. PhD diss. abstract. M., 1981. 24 p.
4. Kekhayov A.N. Prostranstvo, vremya, dvizheniye: vestibulyarnyye, zritelnyye i slukhovyye pertseptsii. Sofiya: Meditsina i fizkultura, 1978. 85 p.
5. Kushnikov E.E. Spetsificheskiye dvigatelnyye reaktsii voleybolistov i ikh sovershenstvovaniye metodom srochnoy informatsii. PhD diss. abstract. L., 1978. 27 p.
6. Marmazinskaya P.E. Rol vtorosignalnykh svyazey v differentsiatsii vremeni. PhD diss. abstract. Odessa, 1970. 25 p.
7. Ovsyuk E.A. Tekhnologiya sovershenstvovaniya dvigatelnykh deystviy sportsmenov na osnove kompleksnogo ispolzovaniya sredstv polisensornogo informatsionnogo vozdeystviya. PhD diss. abstract. Khabarovsk, 2003. 185 p.
8. Pavlov I.P. Pervaya i vtoraya signalnyye sistemy cheloveka. Works, vol. 3, book 2, 1951. pp. 215-233.
9. Pidorya A.M., Godik M.A., Voronov A.I. Osnovy koordinatsionnoy podgotovki sportsmenov. Omsk: Uprin. form pechati publ., 1992. 76 p.
10. Sukhoreva N.S. Formirovaniye adekvatnykh ustanovok v protsesse obucheniya dvigatelnym deystviyam. PhD diss. abstract. St. Petersburg. Gosudarstvennaya Akademiya Kultury, 1996. 22 p.
11. Khaupshev M.Kh., Khezhev A.A., Yakhutlova E.B., Panchenko G.A. Tekhnologiya kompyuternogo monitoringa razvitiya tochnosti koordinatsii tekhniko-takticheskikh deystviy voleybolistov. Teoriya i praktika fizicheskoy kultury. 2021. No. 5. pp. 85-87.
12. Khaupshev M.Kh., Tumov A.A., Gurfova R.V. Proyektirovaniye informatsionnoy obrazovatelnoy tekhnologii effektivnogo upravleniya fizicheskim vospitaniyem studentov (elektivnyy vid voleybol). Programma dlya EVM. Svidetelstvo programmy dlya EVM № 2023616017. 21.03.2023.