

**HARMONIZATION PROBLEM OF USED METHODS REGARDING
THE COMPLEXITY OF THE RESEARCH**

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Purpose: systematization of modern scientific ideas on the harmonization problem of methods used in relation to the complexity of the research.

Material and methods: analysis of literary sources, archival materials, methods of historicism, analogies and similarities.

Results: the works and theories of scientists from different fields of scientific knowledge are analyzed, which established the general principles of self-organization of developing systems and are the basis for the construction of special semantic feature spaces. This gave a fundamentally new method of research that provides the necessary level of solution to many practical problems, which was not achieved by methods previously used.

Conclusions: each level of organization of scientific research needs adequate methods that have the necessary level of solving the tasks in scientific works. In the arsenal of used methods are widely used methods of analysis of results, presented in the form of verbal descriptions, tables, graphs, figures, video recording and analytical description of the obtained patterns. Based on the conventional concept, the validity

of which is confirmed by the general theory of self-organization of developing systems and economically sound principles of invariance of the laws of self-organization that they are equally acceptable in inanimate and living systems from biology, anthropology, pedagogy, psychology, including as well as social systems, which has significantly expanded the possibilities of scientific research in these fields of knowledge.

Keywords: method, theory, system, self-organization, semantic space.

Introduction

Physical culture, as an integral part of the holistic culture of society, carries the socially demanded components of interdependent obligations to meet the necessary needs, which include: educational, health and economic components.

The significance of these components does not remain the same in different forms of physical culture components related to the age of those who exercise, their individual physical development, purpose and motives.

Successful implementation of relevant functional responsibilities can be achieved with sufficient awareness of existing needs in society, which, of course, requires a certain level of observation of the qualitative structure of needs, the degree of their demand and the appropriate satisfaction of these needs.

The purpose of the study - is to characterize the systematized structure of modern scientific provisions on the problem of coordination of the methods used in relation to the complexity of the research.

Material and Methods of the research

Each study is aimed at achieving the goal, for which the relevant tasks are formed, which requires the necessary tools to solve them. Appropriate research methods are such a tool. Requirements for the possibility of solving the methods used are completely determined by the complexity of the tasks, which in turn are determined by the level of complexity of the research goal, which determines the construction of the chain "goal - task - methods".

The more complex the purpose of the study, the more important from the whole arsenal of research methods are mathematical descriptions of patterns, based on which a method of computer modeling, which is called "dynamic modeling". The use of this method allowed providing observation of the peculiarities of the dynamics of the studied processes, which cannot be solved by other methods.

It is the method of computer modeling on the basis of established patterns of dynamics of interdependent morphofunctional processes allows in real time to have information about the current state of the organism and on the basis of individual analogy of the established course of these processes to have information used to optimize their construction. In fact, the regularity of the process of external observation of the dynamics of the current state of the organism is manifested, and on this basis the regularity of the formation of the optimal mode of its construction is reflected.

The analogy of the observed patterns determines the validity of the use of computer mathematical modeling as a new research method that has the greatest potential in solving problems of modern research in the field of physical culture and sports. The above, in turn, creates the need to train the necessary specialists for the further development of physical culture and sports.

Results of the research

Throughout the period of development of different branches of scientific knowledge, the same task is set, aimed at understanding the patterns of those processes and phenomena that are observed and represent the object of their study. The division of scientific knowledge into separate branches is connected with the differentiation of social labor, but not with the laws that determine the process of development of self-organizing systems.

In the course of the development of certain branches, interdependent with public activity, scientific knowledge was accumulated as they became in demand. At the same time, the appropriate language of their expression was formed. At each stage of achieving a higher level of development of society there has always been a

desire to systematize knowledge in search of patterns of a single mechanism that would determine the behavior of self-organizing systems.

Speaking of this process, John Bernal (1901 - 1971) emphasized that "in science, more than in other institutions of mankind, it is necessary to study the past to understand the true domination of nature in the future" [19].

In the history of the development of science can not be said about the absolute priority of the discovery of basic laws. In each epoch, they were formed in a clearer form of their time by persons who had encyclopedic knowledge and their deep awareness. In various forms, these laws expressed the position that the like arises from the like and gives rise to the like, or the past gives rise to the present, in which the future arises.

The validity of a unified theory of self-organization was presented by Empidocles and Heraclitus. In their scientific practices, the provisions on the periodicity of the repetition of the process of self-organization, based on the continuous dynamics of the statistical ratio of the results of the struggle of two opposites, united in a single whole in the structure of dichotomous interactions, are set out with deep validity. At each stage of their realization, these statements had a more rigorous representation, expressed in clearer forms, logical justifications of the essence of the content of the process of self-organization of the material world. This reflects the orderly structure, which was established in the Hellenic period of its description and was interpreted as a "norm". The concept of "norm" in this period expressed the orderliness of relations, which are constantly changing the statistical dynamics of the interaction of two opposites.

This position is reached after a millennium by I. Kant, talking about the dynamic effect of inner feeling, which calculates the statistical image of the observed object, highlighting in it each time the basic and variable structure of its formation [11]. In the works of G.W.F. Hegel in the study of the concept of "norm" and the dynamics of its transformation, he comes to identify the universal law of thinking, which is based on the statistical principle of distinguishing a dynamic stereotype of behavior as a stable structure and the mandatory presence of a variable part that

reflects operational adaptive behavior, that ensures the preservation of the equilibrium state of the object with the forming environment of its stay [7].

In an effort to formalize these provisions, A. Quetelet [13] on the basis of the theory of statistics describes the formation of the image of observed phenomena of various natures, highlighting in them the basic structural formation and variable component, which are "strange" constancy. In assessing the human somatotype, he creates the image of the "average person", investing in it the meaning of the most stable structure of the somatotype, which is characteristic of a particular environment as a "whole object" and reflects the variable nature of its morphological and functional components regarding the norm of their interdependence of relations in a single whole that unites them.

Later, the idea expressed by I. Kant, comes from F. Galton in the construction of "collective photography", or the method of multiple layers of the studied image, which shows the statistical method of forming this image. Summarizing the theoretical approaches of I. Kant, G.W. F. Hegel in the study of the law of thought, E.V. Ilyenko comes to the conclusion that the universal method of thinking is inherent not only in man, but in all self-organized systems, no matter what affiliation they have in both animate and inanimate nature [7; 10; 11; 21].

Ya.A. Ponomarev comes to a similar conclusion [14] in the assessment of creativity as an operational process of adaptation to the dynamics of change of the educational environment, as an integral mechanism of operational search, providing interaction of differentiated entities that invest a dynamic stereotype of the norm between the object and the environment of its formation. In this case, there is a holistic system "environment-object-subject", where the subjects are interdependent areas of the whole organism as morphofunctional entities that carry out differentiated activities.

During the XIX and XX centuries, the commonality of the structure of the construction of methods of historicism, or chronological observation, the method of natural pedagogical experiment, developed by A.F. Lazursky, constructing a dynamic stereotype of behavior, revealed by A.A. Ukhtomsky, the phylogenetic process of

natural selection and inheritance of genetically determined traits in the process of ontogenesis. In all cases, the unifying organization is represented by a stable structure of a dynamic stereotype, which reflects the phenomenon under consideration and accompanies its operational adaptive behavior, which ensures the preservation of equilibrium in the relationship "object-environment" [5; 17].

Special contribution to the understanding of the process of self-organization was made by revealing the nature of tolerance and its decisive role in establishing the level of complexity of organizational processes. The degree of tolerance of these processes reflects the level of observation. The process of statistical accumulation and processing of the observed behavior provides an affordable degree of risk avoidance. The formation of the mechanism of observation and systematization of accumulated experience is a reflection of the process of differentiation of the educational environment into an orderly system of reflecting the sustainability of the birth of permanent relationships in interdependent obligations to perform functional activities. The statistical accumulation of the recurrence of this process determines the structure of their most stable recurrence.

This served as a basis for the construction of special semantic spaces with a degree of partial comparison of the degree of participation of their joint interaction in achieving the equifinal end result.

Simultaneous uniform "effort" of dichotomous interacting formations reflects the static voltage of statistical characteristics, which has no pulsation and is drawn in a rectangular coordinate system by a straight line. According to the introduced measure of the law of normal distribution, six sigma zones are distinguished, which form seven boundary points, which act as a measure of static voltage and change from their minimum in the first point to the limit maximum in the seventh. Each voltage measure is a static voltage rank.

If the simultaneous manifestation of effort has a difference, then there is a pulsation. This kind of dynamics of emerging efforts determines the kinematics of jointly conditioned interactions. In this case, we can talk about the pulsations of static voltage, which has a certain range on the scale of its rank characteristics and the

dynamics of changes in the forces reflected on the coordinate axes of dichotomous interacting formations. This technique was developed at the Kharkiv State Academy of Physical Culture and has been tested in many studies [1; 3; 16].

The obtained representations of the results of constancy of birth of permanent relations in the corresponding sign semantic spaces form a statistically accumulative image, which reflects the analytical dependence of these relations, which is a fundamentally new method of analysis of empirical data viability, which reveal the patterns of their interdependent relations of differentiated branches of the whole organism in ensuring the required level of its viability.

The presence of modern computer technology and appropriate software allows to solve the inverse problem according to the established laws, which is that the observed kinematics of the initially known data can restore the dynamic forces that determine the observed kinematics of movement, and the established characteristics of dynamic efforts to judge about the corresponding and determining their manifestation of static voltage, which reflects the potential for viability of the observed system. This research method is the main position of this study.

Conclusions / Discussion

In scientific research, the achievement of the formulated goal is always completely determined by the possible solvability of the tasks and adequate methods. In this case it is a question of comparability of the considered needs and adequate possibilities of their decision. Such an interdependent relationship can be established only if the comparable relationship between demand and satisfaction. Under natural conditions, this problem is solved in a purely empirical way with a certain degree of available trial and error, which has significant economic costs and low quality, which, in turn, limits the possible level of complexity of the organization of these relations.

The true nature of the construction of these relations is related to the definition of "norm" as an average value in explaining the "idea of norm" in aesthetics and was actually expressed by I. Kant in his work "Critique of judgment", in which he talks about the process of formation of clarity of expression of the studied image during his observation. As an example, he considers the process of constructing an image of a

person, pointing out that if “someone saw a thousand adult men and he wants to judge their normal size, determined by comparison, the imagination imposes a huge number of images on each other. And if we apply here the analogy with the optical image, then in the space where most of them meet and inside those outlines where the part is most densely painted, the average value becomes noticeable, which is equally distant in height and width from the extremes of the largest and the smallest figures. And this is the figure of a handsome man, if you measure all this thousand, add the height of all, as well as the width (and thickness) and the sum divided by a thousand. But the imagination does this through a dynamic effect that arises from the repeated grasping of such figures by the internal senses, *calculated statistically*” [11; 12].

In its historical development, the category of "measure" appears as fixing each time on a new basis the contradictions of the abstract and concrete, subjective and objective, and resolving these contradictions that lead to their reproduction at a higher level. With each step of cognition of the category of "measure" led G.W.F. Hegel to formulation a category that covers not only the unity of quantity and quality in a certain range of measurements (i.e. measures), but also the category that describes the process of transition from one type of measure to another. This category is called the "nodal line of measure". Change of measures of development (nodal line of measure) was presented by G.W.F. Hegel as *a universal law of thought* [7].

About the universal method of thinking, but in 1968 says E.V. Ilyenko. He notes that this is not a subjective-psychological technique by which a person "easier to understand" the subject, but the only logical form that allows to express in motion the concepts of "*objective process of self-distinction*" by which it arises, becomes, is formed and diversified within any "*organic whole*", or capitalism, feudalism or socialism, or biological whole (living organism), or any other "*holistic*" system of interacting phenomena. Therefore, the method of ascent from the abstract to the concrete can be considered as *a universal method of thinking* [10, p. 212].

At one time, this idea was almost completely solved by A. Quetelet during mass surveys of various anthropometric indicators, including the level of physical fitness of two thousand recruits during hostilities between the south and north of the

United States [13]. Based on these empirical data, the most common characteristic of the average person as a somatotype structure was established. Based on the revealed regularity, it was found that it is expressed by a binomial distribution. During conduction of the number of obtained materials, its asymptotic approximation was used, which is the law of normal distribution. This allowed to introduce the concept of "norms of population physical development", which later became known as the "*average person*".

Later, as in the description of I. Kant, the position on the formation of the image when viewed by thousands of men, when more clearly expressed those components that were layered on the top of each other, reflecting the picture of the middle type of body structure, which is most common and its components were invested in the idea of F. Galton's method [21] of multiple layers of photographs proportional in size to obtain the contour of the average person. The method used was called "*collective photography*". An important step in distinguishing the general from the private and assigning a quantitative description of the qualitative indicators of photographs was the operation of a single proportionality of these indicators. However, the high cost of the method led F. Galton to the statistical method of representation of each component of the body in its overall structure. In fact, the operation of dividing the quantitative characteristics, which reflects the size of the compared object and its qualitative structure was performed. Based on this, in the following times the concept of "*general average criterion and its variation relative to the obtained average value*" was formed. The characteristics of the average values reflected the partial ratio of the constituent components of the body in the overall structure of "collective photography" [1].

More accessible and acceptable for practical use was the method of "clinical anthropometry", developed by M.Ya. Breitman in the first quarter of XX century [6]. The essence of the method was to determine the assessment of the proportionality of fifteen elements of the body in relation to their linear dimensions to its length, which characterize the qualitative structure of the construction of the considered somatotype. An important feature of this method was that a single element of the

overall structure was displayed in fractions of a unit, or as a percentage of the whole, which was the length of the body. Based on the idea of endocrine theory of control of metabolic processes, M.Ya. Breitman interpreted the features of partial size relations in the construction of the structure of the somatotype as an external reflection of the peculiarities of metabolic processes occurring in the body. On the basis of a large volume of practical clinical observations, he developed the theory of prenatal diagnosis and its course in time, which allowed us to speak not only about the direction of inconsistency, but also about the strength of its manifestation. The standard of comparison was based on the principle of constructing the "average person" as the most characteristic viable structure of the observed norm of somatotype in the appropriate environment of his stay.

A similar idea of the external reflection of the internal features of metabolic processes comes W. Sheldon in a quarter of a century, but in the second half of XX century [22]. He builds his theory on the relationship between the external structure of the somatotype and the phylogenetic conditionality of its formation, based on the role of partial participation of "*embryonic petals*", which identified three basic types in the classification of the structure of somatotypes, which are expressed as ecto-, endo- and mesodermal. In essence, this kind of construction of his theory, he used the method of representation of the "*average person*" by A. Quetelet and the method of "*collective photography*" by F. Galton.

In the graphical representation of his research results, he used the Gibbs-Roseboom equilateral triangle, widely used at the time, which is practically a reflection of the three-dimensional representation of the jointly conditioned interaction of three independent characteristics that act as coordinate axes of a "single cube". This is a cube in which each edge is equal to one and divided into six equal parts according to the entered sigma distribution when placing the density of the observed feature in accordance with the law of normal distribution. In this case, there are seven points that are outside the sigmoid zones of division of each coordinate axis. The intersection of this unit cube with a plane perpendicular passing through its three vertices gives rise to the Gibbs-Roseboom triangle. This explains the seven-

point scale, which is used to assess the activity of "embryonic petals" in the formation of the corresponding structure of the somatotype [1; 4].

In all these approaches to the distribution of quantitative representation of the volume of jointly determined interacting, independent characteristics and their partial ratio of the qualitative structure of the generated formation by default there is an extremely important position revealed by Geoffroy Saint-Hilaire (1836) on the need to separate mass growth and its formation and interdependent processes in the course of developing systems [8].

In the third quarter of the XX century, almost simultaneously, general theories of self-organization of developing systems were developed, which were presented in the works of L. Bertalanffy [20], K.P. Anokhin [2], Lotfi A. Zadeh [9; 23]. Each of them revealed different aspects of the process of self-organization of developing systems, and was aimed at substantiating the general principles of self-organization of developing systems, regardless of the nature of their affiliation, based on the conventional concept of H. Poincaré, which states that "the division of sciences in some areas due not so much to the nature of things as to the limitations of human cognition. In fact, there is a continuous chain from physics, chemistry, through biology and anthropology to the social sciences, a chain that can not be broken anywhere, except by arbitrariness "[15].

On the basis of them, as complementary to each other, a general theory of self-organization of developing systems was developed, which is interpreted as "humanistic systems" and according to the common definition given to them by G. Hacken [18], they are called "synergetic".

Thus, it is established that an important provision of the general theory of development of self-organizing systems is the statement that each level of organization and its complexity requires adequate research methods that have the necessary and sufficient ability to solve research problems or analyze their results. The obtained modern research methods using special semantic feature spaces in no way deny the whole variety of the existing arsenal of research methods, as they are the root basis on which the method of computer mathematical modeling is based.

An important requirement for the effective use of research methods is their adequacy to the required level of ability to solve the problem and the appropriate way of presenting it in the form of verbal descriptions, tables, graphs, figures, analytical expressions that reflect the revealed patterns, based in all cases on the conventional concept, the validity of which is substantiated by the general theory of self-organization of developing systems, which approved the principle of invariance of the laws of self-organization.

Conflict of interests. The authors declare that no conflict of interest.

Financing sources. This article didn't get the financial support from the state, public or commercial organization.

References

1. Azhippo, A. Yu, Pugach, Ya. I., Pyatisotskaya, S .S., Zhernovnikova, Ya. V., Druz, V. A. (2015), Ontologiya teorii postroeniya kontrolya i otsenki urovnya fizicheskogo razvitiya i fizicheskogo sostoyaniya [Ontology of the theory of constructing control and assessing the level of physical development and physical condition], Harkov: HGAFK; 192 p. (in Russ.).
2. Anohin, K. P. (1974), Obschaya teoriya funktsionalnykh sistem organizma [General theory of the functional systems of the body], Moskva, pp. 52 – 110. (in Russ.).
3. Ashanin, V. S., Pugach, Ya. I. (2014), Postroenie semanticheskikh prostranstv dlya opisaniya psihosomaticheskoy deyatelnosti cheloveka v ekstremalnykh usloviyakh [The construction of semantic spaces to describe the psychosomatic activity of a person in extreme conditions]: uchebnoe posobie, Harkov: HDAFK, 88 p. (in Russ.).
4. Balk, M. B., Boltyanskiy, V. G. (1987), Geometriya mass [Mass geometry], Moskva: Nauka, 160 p. (in Russ.).
5. Behterer, V. M. (1991), Ob'ektivnaya psihologiya. Pamyatniki psihologicheskoy myisli [Objective Psychology. Monuments of psychological thought]. Moskva: Nauka, 478 p. (in Russ.).

6. Breytman, M. Ya. (1949), *Klinicheskaya semiotika i differentsialnaya diagnostika endokrinnyih zabolevaniy* [Clinical semiotics and differential diagnosis of endocrine diseases], Leningrad: Gosudarstvennoe izdatelstvo meditsinskoj literaturyi, Leningradskoe otdelenie, 636 p. (in Russ.).
7. Gegel, G. W. F. (1975), *Nauka logiki: sochineniya* [The Science of Logic: Works], Tom 1, Moskva: Myisl, 454 p. (in Russ.).
8. Zhofrua-Sent-Iler (1836), *Obschaya i chastnaya istoriya anatomii teloslozheniy* [General and private history of body anatomy], Parizh. (in Russ.).
9. Zade, L. A. (1974), *Osnovy novogo podhoda k analizu slozhnyih sistem protsessov prinyatiya resheniy. Matematika segodnya*. [The foundations of a new approach to the analysis of complex systems of decision-making processes. Math today] Moskva: Znanie, pp. 5–49. (in Russ.).
10. Ilenkov, E. V. (1968), *Problema abstraktnogo i konkretnogo v svete «Kapitala» Marksa. Filosofiya i sovremennost* [The problem of the abstract and the concrete in the light of Marx's "Capital". Philosophy and Modernity,], Moskva, pp. 186–213. (in Russ.).
11. Kant, I. (1966), *Kritika sposobnosti myishleniya. Sochineniya* [Critique of the ability of thinking. Compositions], T.5. Moskva: Nauka, pp. 238 – 239. (in Russ.).
12. Kant, I. (2017), *Kritika chistogo razuma* [A Critique of Pure Reason], per. s nem. i predisl. N. Losskogo. Sankt-Peterburg: Azbuka-Attikus, 766 p. (in Russ.).
13. Kettle, A. (1911), *Sotsialnaya fizika* [Social Physics], Sankt-Peterburg, 241 p. (in Russ.).
14. Ponomarev, Ya. A. (1976), *Psihologiya tvorchestva. Akademiya nauk SSSR. Institut psihologii* [Psychology of creativity. USSR Academy of Sciences], Moskva: Nauka, 302 p. (in Russ.).
15. Puankare, A. (1983), *O nauke* [On Science]. Moskva: Nauka, 260 p. (in Russ.).
16. Pugach, Ya. I. (2013), "Fundamentals of constructing a semantic space for an orderly presentation of research results", *«B'deschego v'prosi ot sveta naukata»: materialyi IX Mezhdunarodnoy konferentsii*, Sofiya: Byal Grad-BG, Tom 39, pp. 13–15. (in Russ.).

17. Uhtomskiy, A. A. (1966), Fiziologiya cheloveka [Human physiology] / pod red. EB. Babskego. Moskva: Meditsina, pp. 23 – 656. (in Russ.).
18. Haken, G. (1985), Sinergetika ierarhii neustoychivostey v samoorganizuyuschih sistemah i ustroystvah [Synergetics of the hierarchy of instabilities in self-organizing systems and devices], Moskva: Mir, 423 p. (in Russ.).
19. Hramko, Yu. A., Bernal Dzhon Desmond (1983), Fiziki: bibliograficheskiy spravochnik [Physicists: bibliographic reference] / pod red. AI. Ahiezera. Izd. 2-e ispr. i dopoln., Moskva: Nauka, p. 29. (in Russ.).
20. Bertalanffy, L. (1969), General system theory. New York, 289 p. (in Eng).
21. Galton, F. (1989), Natural inheritance. London: Macmillan, 266 p. (in Eng).
22. William H. Sheldon (1940), The varieties of human physique: An introduction to constitutional psychology? New York: Harper & Brothers. (in Eng).
23. Zadeh, L. A. (1965), Fuzzy sets. Information & Control, Vol. 12, pp. 94-102. (in Eng).

Received: 18.05.2020.

Published: 26.06.2020.

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