Role of the education system in overcoming crisis events[1)]

Korolenko Pavel Vasil'evich

Doctor of Physics and Mathematics, Professor

M.V.Lomonosov Moscow State University, Moscow, Ruusia

Annotation. The possibilities and ways of adapting the thinking style of learners to the conditions of development in various areas of society's activity of crisis phenomena are considered. Now such phenomena are largely the result of the development of the COVID-19 pandemic. The need for more complete coverage in the educational process of the provisions of the dynamic chaos theory, fractal and aesthetic concepts is pointed out. The characteristics of such serious obstacles to the development of mankind as technological singularity and cognitive dissonance are given. The description of the results of interdisciplinary research is of great importance. The prerequisites have emerged that make it possible to consider interdisciplinarity as an independent scientific direction. Attention is drawn to the important role played by the methods of process the received data. It is shown that the methods of Fourier analysis and fractal formalization are distinguished by their efficiency. The Fourier transforms of the processes under study, their fractal and scaling parameters demonstrate greater clarity and resistance to disturbing factors. The presence of fractal invariants in the processes and structures under consideration makes it possible to study a wide range of environmental problems and find solutions to pressing social issues.The characteristics of the attributes of a new style of thinking in assessing crisis situations contained in the article may be useful in teaching and educating personnel of a new formation.

Keywords: crisis, pandemic, thinking style, dynamic chaos, fractal, aesthetics, interdisciplinarity

Introduction

To increase the effectiveness of pedagogical activity, it is necessary to take into account changes in the socio-economic, cultural and scientific areas of society. Particularly rapid changes requiring consideration occur during periods when crisis phenomena are observed in various directions of social activity. Now such phenomena are largely the result of the development of the COVID-19 pandemic. Educational technologies in such a situation can provide guidelines for

1) This work was supported by the Russian Foundation for Basic Research. Project № 19-02-00540.

neutralizing negative consequences if they rely on the achievements of modern science.

The purpose of this work is to develop new setting points to ensure the necessary analysis of the events in the course of the educational process and the formation of an adequate response to them.

General analysis of unstable development

To date, a lot of mathematical models have been developed that make it possible, on a rigorous scientific foundation, to predict the emergence and ways of overcoming emerging obstacles to the sustainable development of the socio - economic basis of the human community. Among them, a special place is occupied by synergetic models based on ideas about the predictability horizon. The presence of such a horizon, determined by a sequence of bifurcations, requires new approaches to studying the nature of cyclical crisis phenomena [1,2]. At the same time, the views on short-term and long-term plans need a radical revision. Their successful implementation largely depends on a correct assessment of the relationship between the duration of the crisis and the horizon of predictability.

A society can go through a crisis in a rapid “power mode”, when the predictability horizon is commensurate with the time of the crisis and the necessary economic and financial resources have been accumulated. A slow passage of an unfavorable situation is also possible, when the predictability horizon is much less than the time spent in the crisis zone. This will require a probabilistic assessment of possible future alternative solutions. It is advisable to manage the course of events in this situation through small systematic efforts, changing tactical and strategic moves, ensuring shifts in ideology, public opinion and education.

As follows from the literature data, it is necessary to take into account such a serious obstacle to the development of mankind as a technological singularity [3]. The reason for the technological singularity is too rapid technological progress and the loss of human control over artificial intelligence. Technological singularity can be combined with the so-called cognitive dissonance [4] - with the state of mental discomfort of a person caused by the collision in his mind of conflicting scientific, ideological and cultural ideas. Cognitive dissonance has negative manifestations due to the inconsistency of past experience with the present situation. This psychological phenomenon affects our behavior and perception of the world. The desire to reduce dissonance is intensified in an environment of destructiveness during a crisis. These factors are serious obstacles to the stable progressive development of society. However, it should be considered that the chain of events that are immanent in nature can be disrupted by random, inherently large-scale phenomena, such as the Covid-19 pandemic. It seriously disrupted the established socio-economic life of society. Despite this, attempts are being made to preserve the general vector of development of society at all its hierarchical levels. Great hopes are pinned on the development of the digital economy, a remote form of performing production duties. At the same time, there is an understanding that the qualifications of workers in the production and management

spheres, their general intellectual level are an important factor in neutralizing the above-mentioned challenges. But qualifications are determined not only by the sum of knowledge and skills. Now, in the “covid era”, due to the rapidly changing environment and the emergence of new uncontrollable factors, a radical change in the general style of thinking is required for both managers and ordinary workers. The transformation of the thinking style is an urgent requirement of the time and is directly related to the introduction of an innovative approach to learning at all levels of the educational process.

Methodological base of the educational process

Let us consider the attributes of the training process and education of specialists of various profiles and status, capable of making responsible decisions in an environment with signs of instability. They should be based on the ideas of convergence of knowledge and interdisciplinarity. This is due to the logic of the development of breakthrough areas of scientific research. Their feature is the combination of previously independently existing conceptual attitudes, methods and approaches to achieve the set goals. Since the most interesting scientific results are obtained in the border areas of various disciplines, the role of interdisciplinary views has increased significantly [5-7].

Now interdisciplinarity should be considered as an independent scientific direction. This can be done because it is characterized by a certain subject, the role of which is played by the search for the most general and universal laws and phenomena. Like any autonomous discipline, interdisciplinarity has its own specific instrumentation, physical and mathematical apparatus. The most important components of the apparatus are the theory of probability and mathematical statistics, the theory of dynamic chaos with fractal elements, the foundations of nanotechnological processes. They allow you to find the necessary guidelines for action in a rapidly changing environment and find means to dampen negative processes. It should be noted that in the educational process these disciplines should be taught as a single unit, since the ideas embedded in them are closely intertwined and mutually complement each other. A modern teaching system should include the following aspects:

Let us list the attributes of the process of training and education of specialists of various profiles and status, capable of making responsible decisions in an environment with signs of instability;

1) Ambivalence and multivariance. In sociology, ambivalence is considered as a social phenomenon, the sources of which lie in the contradictions of the system of values of the human-loot, in contrast to its relation to yourself, to other people around the world. In a pandemic, when the disunity of people increases, the established forms of their interaction collapse, the usual channels of information are broken, the ambivalence of judgments and internal assessments can

make serious changes in the state of society. There are attempts to apply the category of "ambivalence" to the analysis of conflicts of norms inherent in science as a social institution that. This is due to the initial ambivalence of the most valuable samples that scientists follow. The emerging situation requires, when making decisions, a competent goal setting, identifying potential results, establishing decision criteria, separating criteria and comparing "yes, no" alternatives, and, most importantly, identifying and assessing risk. However, it is necessary to compare each alternative individually with some ideal pattern created. Some innovation should also be envisaged, i.e. formation and implementation of a previously unknown alternative. In this case, managers are faced with a situation where they need to make a choice in the absence of ready-made alternatives. Therefore, in this case, creative thinking should prevail over rational.

Due to the nonlinearity of social processes, it is impossible to make a reliable forecast, because development occurs through the randomness of the choice of the path at the moment of bifurcation. However, the question arises: is the number of options for the development of the system at the bifurcation point limited? Synergetic modeling made it possible to prove that even at bifurcation points not “everything” can happen: the number of real scenarios is always limited. As soon as the events have entered one of the modes, the system irreversibly changes in the direction of the corresponding final state (attractor). At the point of bifurcation, the so-called "catastrophe" occurs - the transition of the system from the region of attraction of one attractor to another due to fluctuation processes. The presence of noise is a condition for the transition from one stable state to another, but for this, these stable states must be sufficiently close to the unstable point.

2) Cognitive elements. Cognitiveness is the ability to perceive and process data that comes to us in various ways. An actively developing cognitive psychology has begun to explore how information processing affects behavior and how various mental processes are related to the acquisition of knowledge. Acquiring new knowledge we make decisions in response. Various cognitive abilities are involved in these processes: perception, attention, memory, thinking. The most important cognitive process is thinking. It allows you to combine all the information received and establish the relationship between its constituent data. For this reasoning, synthesis and problem solving are used, i.e. executive functions. Despite the multichannel nature of the analysis carried out one should take into account the fact that in crisis situations there is a possibility of making erroneous decisions. The cognitive research perspective depends on the creation of a neurocomputer interface based on direct contact between human and “computer” consciousness. It can significantly change the idea of human intelligence and the ways of its development.

3) Metaphysical representations. Sometimes a person faces questions that he cannot evade, since they are imposed on him by his own nature or objective circumstances; but he cannot correctly answer them, since they exceed all his knowledge and capabilities. However, with the help

of intuitive considerations and a chain of hypotheses, he is able to obtain solutions with varying degrees of reliability. Further development of scientific concepts and experimental research can confirm or refute the constructed concept. The disadvantage of metaphysical ideas is the difficulty of detecting erroneous statements, since they go beyond the limits of all experience and do not satisfy the previous experimental criteria. Despite the imperfection of the metaphysical method, it is one of the ways to form a forecast for the possible development of events.

4) Aesthetic component. The presence of an aesthetic component in the style of thinking provides a transition from one logic to another and allows one to discover deep meanings before their universally significant manifestation and justification. This indicates the enormous epistemological and heuristic potential of the aesthetic principle. The subject of aesthetics is human sensibility, which is responsible for a holistic, figurative comprehension of the world by a person. Such a definition also includes the sphere of the beautiful, the sublime, the comic, the tragic, and other aesthetic categories that characterize a person's sensual comprehension of the world. It also covers the field of science, confirming the correctness of the chosen direction of search.

Presentation of analysis results

When implementing the above approach to the orientation of training in the conditions of unstable processes, an optimal choice of the form of presentation of the results of the analysis is required. So, in many cases it is necessary to analyze not the obtained dependences and structures themselves, but their Fourier transforms, which demonstrate greater clarity and resistance to disturbing factors [6,7]. This property of the Fourier transform was confirmed when conducting test exercises with students on the basis of numerical modeling of processes with varying degrees of order. Fig. 1*a*,*b* graphically shows two such processes, modeled using the Weierstrass fractal function [6,7]. Such dependences can characterize both a change in some physical parameters (for example, temperature fluctuations in the atmosphere), and a change in some economic indicators (for example, the stock price on the stock exchange). Fig. 1*b* in comparison with Fig. 1*a* is characterized by a higher value of the fractal dimension and, accordingly, stronger fluctuations. Despite significant external differences between the processes, the Fourier spectra demonstrate almost complete coincidence (Fig. 2). Additional calculations performed using other models have confirmed the effectiveness of the Fourier analysis from the point of view of the stability of the studied characteristics. In all the cases considered, the fractality of the object gave rise to the fractality of the Fourier image.

The use of fractal representations has proven to be effective in interpreting the results of the analysis of a particular changeable situation. Thus, the presence of fractal invariants allows one to study a wide range of environmental problems and find solutions to acute social issues,

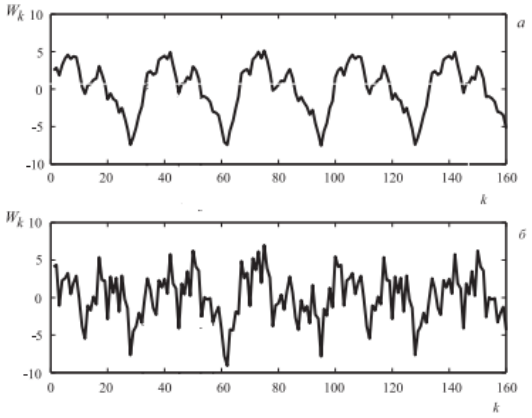

Fig. 1. Graphical representation of processes based on the Weierstrass function. *W* is the value of the Weierstrass function, *k* are significant digits on the time scale. *a* - fractal dimension *D* = 1.15, *b* - fractal dimension *D* = 1.95.

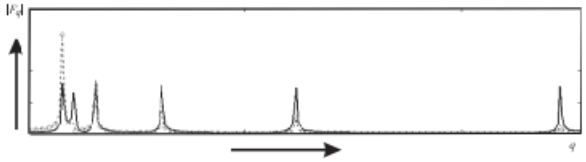

Fig. 2. Spectral composition of the processes shown in Fig. 1. Continuous curve - *D* = 1.95, dotted line - *D* = 1.15; F_q is the amplitude of the spectral components, *q* is the spatial frequency.

The properties of Fourier transforms and fractal parametrization make it possible to interpret a number of provisions of modern neuroaesthetics, in particular, they allow, on the basis of physical and cognitive ideas, to give an explanation of the phenomenon of the beauty of fractals [6]. These ideas are based on the concept of spatial frequencies selection of the fractal image in the cerebral cortex. The discovered stability and fractality of Fourier images indicates the possibility of accelerated processing of optical signals in specialized areas of the cerebral cortex. Fast Fourier processing of visual signals creates a feeling of comfort and evokes a sense of beauty when contemplating a fractal object. Thus, the results obtained make it possible to substantiate from a physical point of view the effectiveness of using visual art therapy in medicine based on the presentation of fractal images to patients, as well as to give a physical interpretation to some of the provisions of modern aesthetics. The given example should be attributed to the use of transdisciplinary technology, which combines the concepts of significantly remote areas of scientific research.

Conclusion

The development of society at the present stage is unstable due to the influence of factors that are difficult to predict, which include the spread of the Covid-19 pandemic. The dramatically changed situation requires the introduction of qualitative changes in the teaching system, which should be focused on highlighting alternative approaches to making forecasts for the short and long

term prospects for the development of society. Teaching should use concepts that have been formed in an interdisciplinary field, including synergetic and fractal ideas, as well as innovations in the field of technology and, above all, nanotechnology. The characteristics of the attributes of a new style of thinking in assessing crisis situations contained in this article may be useful in teaching and educating personnel of a new formation.

References

1. "Chaos theory | Definition & Facts". Encyclopedia Britannica. Retrieved 2019-11-24.
2. In Russion. Budanov Vladimir. Electronic publication. http://www.intelros.ru/subject/haos/176-vladimir_budanov_socialnyjj_khaos_scenarii_proiskhozhdenija_adaprtacii_upravlenija.html
3. Eden Amnon H., Moor James H. Singularity hypotheses: A Scientific and Philosophical Assessment. Dordrecht: Springer, 2012.
4. Miller Monica K., Clark Jordan D., Jehle Alayna. Cognitive dissonance theory (Festinger). The Blackwell encyclopedia of sociology. Published 2015 by Wiley & Sons, Ltd.
5. In Russion. Korolenko P.V., Konopal'tseva N.YU., Mishin A.YU. et al. Fur'ye-optika kak mezhdistsiplinarnaya tekhnologiya // Fizicheskoye obrazovaniye v VUZakh. 2019. T. 25, № 3. S. 123–131.
6. Zotov A. M. , Korolenko P. V. , Mishin A. Y. et al. Physical bases of neuroaesthetics // Moscow University Physics Bulletin. 2019. Vol. 74, no. 6. P. 625–630.
7. Averchenko A., Konopaltseva N, Korolenko P. et al. Fourier optics of fractal structures // Bulletin of the Russian Academy of Sciences: Physics. 2018. Vol. 82, no. 11. P. 1383–1387.