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The Role of Information Technology in the Formation of the Creative Thinking of the Future Engineer

El papel de la tecnología de la información en la formación del pensamiento creativo del futuro ingeniero

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ABSTRACT

The paper presents the research results on the role of information technologies in the formation of a creative type of thinking. Particular attention is paid to the formation of students' creative thinking at technical universities. The analysis is based on the paradigmatic approach, which allows us to identify the dynamics of educational processes and carries a multitude of heuristic possibilities for analyzing the current state of affairs. The ways and methods of forming the creative thinking by the future engineer are indicated. The formation of creative thinking involves the study of a new type of determination, namely, the teleological one.

Keywords: Essentialism; integrity; paradigm; philosophical anthropology.

RESUMEN

El artículo presenta los resultados de la investigación sobre el papel de las tecnologías de la información en la formación de un tipo creativo de pensamiento. Se presta especial atención a la formación del pensamiento creativo de los estudiantes en las universidades técnicas. El análisis se basa en el enfoque paradigmático, que nos permite identificar la dinámica de los procesos educativos y ofrece una multitud de posibilidades heurísticas para analizar el estado actual de las cosas. Las maneras y los métodos de formar el pensamiento creativo por el ingeniero futuro se indican. La formación del pensamiento creativo implica el estudio de un nuevo tipo de determinación, a saber, la teleológica.

Palabras Clave: Esencialismo; integridad; paradigma; antropología filosófica.

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INTRODUCTION

A specialist in the technical area in the 21st century should be a subject of modern culture, a carrier of high morality and civic engagement. A high level of professional culture is characterized by a developed ability to solve professional problems, i.e. developed profession-al thinking and consciousness (Guseva, 2012), note the teachers. The main sign of the developed thinking and consciousness is its creative character.

The formation of cybernetics had a great influence on the improvement of teaching methods, which led to the consideration of the educational process in the "information aspect", i.e. consideration of the possibilities of applying concepts, methods and theoretical regularities of the transformation of information to the educational process of people. At the same time, information is understood as any knowledge, messages, signals and symbols. The information approach to learning required a rethinking of the content and methods of teaching (Bim-Bad, 1994). Now there are many concepts which characterize the learning process using information technology (Laird, 1993). For example, the concept of "learning system", "programmed learning", "step-by-step formation of mental actions" and "construction of algorithm for learning material". These new trends associated with the use of information technology in teaching, require their reflection.

MATERIALS AND METHODS

The subject of study is the learning process. The subject is the impact on the learning process of information technology. The research methods are theoretical methods: the unity of the historical and logical, the ascent from the abstract to the concrete. Training is a purposeful process carried out by external management of the cognitive activity of the learner, leading to the acquiring of information, the formation and development of his/her cognitive potential. From the point of view of the information approach to learning, it is necessary to con-sider its both external (information processes that provide a communicative aspect of the sys-tem) and internal manifestation (information processes occurring in the head of the learner and not only in the head, but also in the mind).

Thanks to information technologies, a new educational space is formed. As V.E. Guseva notes, the concept of information technology is especially bright when using Internet technologies which promote the formation of a fundamentally new interactive educational environment for learning and communication (Guseva, 2012). In the educational process, it is important not only the information technology itself, but how much it provides development and educational purposes. We believe that in relation to the processes of using information technologies in teaching, it is possible to use the theoretical concept of investigating the dynamics of the change in rationality types, that is, the idea of T. Kuhn about the paradigm of scientific cognition Since the paradigm as a model and a sample serves to characterize the rational knowledge, it is quite correct to resort to the teachings of V.S. Stepin about global scientific revolutions as a change in the types of rationality.

In the classical period of development of information technologies, the emphasis is placed on them as ways and methods of transferring the information. It is assumed that the use of new technologies leads to a new way of learning. Technologies were attractive, as they facilitated the ways of obtaining, storing and transforming the information. It is often possible to observe in high school that the professor's lecture turns into reading presentations which students have prepared for practical classes. The subject itself is eliminated from the communication process (Ingarden, 1983).

In the non-classical period, information technologies are recognized as a unique way of "feedback", that is, the subject becomes an observer, which determines the effectiveness of communications.

In the post non-classical period, it is necessary to develop a creative environment which will realize the creative potential of each student. Each type of rationality presupposes the formation of a certain type of thinking: the classical type forms a rational-empirical style of thinking; the post non-classical type of rationality

is based on the scientific and theoretical style of thinking, and the post non-classical type of rationality presupposes the formation of lateral or creative thinking.

In the synergetic world picture, information plays the role of order and that the negentropic factor. Accordingly, information technologies serve as a "measure of order" of the educational process. In such a section of physics as thermodynamics, it is customary to assume that order and entropy (a state of disorder, chaos and uncertainty) differ in the number of combinations, which will not change in the state of the system as a whole. According to Boltzmann's theory and entropy formula, the ratio of order and disorder, variability and stability is determined by the formula S = klnW, where W is the number of different micro-combinations which exist within the macroscopic system and do not destroy it. A certain number of information bits is needed to know the multi-variance of the process, and this circumstance can be expressed by the formula I = S, but the knowledge of all possibilities of system development is negative entropy or negentropy, which can be expressed by the formula N = -S; as a result, we come to the following relation: I=-S=N.

It is known that every year the amount of information is doubled. Moral and theoretical aging of information is also a problem for education. The use of information technology makes it possible to withdraw the boundaries of the known and unknown as well as expand the zone of proximal development. To operate huge blocks of information is possible only if the student has the skills of philosophical reflection.

As V.V. Nalimov, to understand the intellectual activity of a person in fullness and breadth, it is necessary to assume that all possible senses are initially packed on an unlimited continuum, compressed as pressed numbers on the real axis (Zimbardo, 2010).

The person and the society in which he lives are super complex self-organizing systems, where the information of a special type namely meaning appears. There are many theories of the semantic sphere of human culture, but the most popular in our time is B. Nalimov's probabilistic theory of meanings (Nalimov, 2011). The basis of this theory is the belief that quantum mechanical processes are an analog of thinking processes and allow modeling the formation and evolution of meaning. As an argument, we give the correspondence (Table 1).

Table 1: Correspondence between Probabilistic model of meanings and Quantum theory of measurements

Probabilistic model of meanings	Quantum theory of measurements
m is a variable which describes a set of meanings	q is a variable which describes the freedom degrees of a physical object
Some text	Physical object state
P (m) is a probability function that describes a set of meanings	W (q) is a probability function that determines the parameters of the probable position of the particle

The use of information technology involves "folding" a huge number of information bits into meaning, that is, in other words, operations with information (storage, transmission and transformation) assume the semantic structure of the educational process. In order to clarify the mechanism of this process, let us turn to the concept of V. Allakhverdov. He distinguishes between the superficial and basic contents of consciousness. The idea, frankly speaking, is not new. We can remember the research programs of I. Lakatos. In the base layer there is information which was received, but at the moment it is not realized. The opposite surface layer works with the information which it only received, which is new and changeable. But, interestingly, consciousness works only with information which constantly changes. The content of consciousness cannot remain unchanged, as V.S. Allakhverdov (Allakhverdov, 2000). Information technology contributes to meeting this need. Consciousness "plays" with meanings, creating new ones. This is also the task of visualizing the information.

The most important feature of new information technologies which determine the revolutionizing impact on the learning process are new opportunities for providing the educational information in the form of images. The visualization of information allows us to represent the connections and relationships in the process under study, the trends of their development, which activate imaginative thinking, playing an important role in the cognition of reality (Guseva, 2012).

In general, pedagogy often meets a one-sided approach, for example, to the development of the intellect especially when it comes to the use of information technologies in educational process. It may appear that only the cognitive functions of the human psyche are developed. Such a philosopher and psychologist of the "Russian Abroad" period, Vasiliy Vasilievich Zenkovsky, examines in detail the problem of the absolute priority of the cognitive approach in the educational system in the paper "On Pedagogical Intellectualism", published in the journal "Russian School Abroad" in Prague in 1923. He sharply negatively assesses both pedagogical and ethical intellectualism in philosophy, psychology and pedagogy and believed, that as a general pedagogical principle, this faith must be rejected without any hesitation. We must learn to look bravely in the eyes of the truth, do not be afraid to admit that the process of spiritual maturation is extremely complicated. The learning processes, and indeed the growth of intelligence goes somewhere "upstairs", in the bright and spacious part of the soul, and from the dark bowels of it arise such complex and strange movements (Zenkovsky, 1993).

In creating the classification of types of educational strategies and the study of their dynamics, we rely on the research of I.N. Stepanova, who uses a paradigmatic approach to the analysis of education and the principle of essentialism. She writes that the paradigms of philosophical-anthropological essentialism are regarded as generally accepted in the community of philosophers of different historical epochs of representations about the essence of man and at the same time as models for solving the main problems that make up the content of philosophical anthropology" (Stepanova, 2006). Relying on the idea of V.S. Stepin about global scientific revolutions as a change in the types of rationality, we, following the author of the study "Philosophical-anthropological paradigms and their role in the development of education" believe that every historical period of understanding the nature of man and his/her development is associated with a certain type of rationality. In philosophical anthropology, analogous to the scientific knowledge, there are classical, non-classical and post non-classical types of rationality. The meanings of universal universes which form a categorical model of the world in their connections are found in all cultural fields of a particular historical type in everyday language, in the phenomena of moral consciousness, in philosophy, in religion, in the artistic world mastering, in the functioning of technology and in political culture (Stepin, 2001). So V.S. Stepin notes such a culture feature that manifests itself in the resonance effect of new ideas. The same resonant interaction is characteristic of philosophical and pedagogical culture. The philosophers, culture experts, and historians noted the resonance of various spheres of culture in the period of the formation of new which that have a philosophical meaning, while analyzing the various stages in the development of science, art, political and moral consciousness in a synchronous section (Stepin, 2001), as Stepin in his article "Culture" in the philosophical encyclopedia. Consequently, pedagogical culture may also be classified as classical, non-classical and post non-classical. So, the classical type of rationality treats the nature of development as socialization and interiorization, whereas the non-classical type – as actualization and self-transcendence.

RESULTS AND DISCUSSION

Within the framework of anthropological essentialism, classical, non-classical and post non-classical types of rationality are possible. For the post non-classical type of rationality in pedagogical thinking and culture, there is inherent recognition of multi-factority, non-linearity, self-organization, openness and dialogism of the pedagogical process. All these characteristics get a new sound in the context of programming training or use in the teaching of information technologies.

A distinctive feature of the post non-classical type of rationality is methodological and theoretical pluralism. In modern science this type of rationality finds its expression in synergetics and in the theory of self-organization. Under the self-organization, we mean the process of the system structuring managed from within of this system (Krivikh, 2002). The ideas about development, which exist today as a completely controlled, algorithm structured and projected process, come into conflict with the synergetic approach with its non-linearity, variability, paradoxical feature and unpredictability. But this contradiction indicates the need to develop new views on education. As S.V. Krivykh, the synergistic approach will allow to consider all the connections and relationships which the child enters into in the process of development. Considering the process of formation of the child's personality as a process of self-organization and self-development, it is necessary to bear in mind the contacts and inter-action of this child with the external environment (Krivikh, 2002). The opportunities for self-organization and self-development are increasing in the process of using the information technologies.

What is the value of synergetics in the approach to development and education? Can such a paradigmatic approach reveal new aspects and goals of informatization of education? We believe it can! First, it is its human dimension, as the comprehension of all the wealth of the world and culture is associated with the comprehension of the man's inner world of. Secondly, synergetics will allow us to overcome the opposite trend in the processes of education and development. Thirdly, it will allow not to be afraid of life, for example, of chaotic, unstable states, but to perceive the chaos of life as a necessary creative character of development. This is especially true for programming training or use in the teaching the information technologies. Fourthly, the value aspect of synergetics lies in the hope for the best and personal responsibility of everyone for the future of the country and all mankind. Perhaps the most important thing is that in synergetics a new type of relationship between pupil and educator is born.

What is the heuristic role played by the appeal to the types of rationality and to global scientific revolutions? What does such an approach for analyzing the role of information technology in education and training give us? In the post non-classical world picture, information plays the role of order in relation to the whole system. The post non-classical type of rationality allows us to look at the role of information technologies in the educational process. For example, the idea of integrity, as the ideal of any classical education, in the center of which there is an integral personality, and not a one-dimensional person.

As I.A. Bulgakova, a lot of interpretations of anthropological integrity in modern philosophy can be distinguished. But, in our opinion, the following concepts are particularly bright: a) an integrative essentialism, which is developed by I.N. Stepanova; b) energetic anthropology developed by S.S. Khoruzhy; c) ontological anthropology developed by Yu.M. Fedorov. In modern philosophical systems, there are different sections of the study of integrity, its nature and character (Bulgakova, 2015; Bulgakova, 2016). A new type of integrity allows a person to be inside the system, but not outside. Loss of integrity leads to self-estrangement, for example, if the development of intellectual and cognitive structures becomes dominant as well as if a part becomes more important than the whole. The payment for unilateral development is the alienation, and after it the regression and spiritual degeneration of the individual.

An important determinative factor of mental activity is target determination. This is a special type of determination (determination by the future), which is present in constructive thinking and in which social needs and interests are expressed.

The concepts of "goal" and "whole" are etymologically related, which can be traced in terms of "teleology" and "teleonomy". Synergetics creates a new type of holism. A synergetic approach to a person is a holistic approach, so (Kurdyumov, 1994). According to N. Wiener's remark, any system carries a goal. In domestic anthropology, the integrity of the inner world of man is set by spirituality, which focus is the heart. The "heart" in Russian philosophy conceptually acts as a form of contemplative comprehension of the world, being the focus of the spiritual integrity of the individual and his/her freedom. It determines the behavior of the individual. In contrast to abstract rationalism, which creates a world without will, without love, according to one logical necessity, the heart constitutes actions freely, as P.D. Yurkevich. The philosopher recognizes moral value only for actions which emanate from the free movement of the heart and from the love of the heart to good. Therefore, the act of the heart, without canceling the idea of causality, represents the manifestation of the personality in itself, from his/her spiritual nature, and not under the influence of a naked rational idea (Khoruzhy, 1994).

In the context of Russian culture, spirituality is the main system-forming factor and a measure of order which structures the entire inner space and harmonizes the relationship of man with the world. The creative process is conditioned by multiple factors, dominants and determinants. It can be spoken about a network or chain of determinants. If the main activities are determined by one or more factors, then creativity requires many factors and conditions. Features of engineering creativity consist in target or teleogical determination (Enikeeva, 2018). An appeal to the peculiarities of the post-non-classical type of rationality presupposes a rethinking or "rediscovery" of time, as I. Prigozhin. We believe that the use of information technology generates a different attitude to the time. They are more oriented to the future. American psychologists believe that people oriented toward the future tend to be less depressed than others because they do not spend time thinking about the troubles of the past (Zenkovsky, 1996). This orientation in time allows the persistently moving towards the in-tended goal (Table 2).

Table 2: Relationship between attitudes to the future, psychological characteristics and behavior

Characteristics	People who focus on "Future"
Aggressiveness	Less aggressive
Depression	Less depressive
Energy	More vigorous
Drug use	Rarely
Alcohol consumption	Less
Friendliness	No differences
Honesty	More conscientious
Emotional stability	No differences
Openness	More open
Search for novelty	More pronounced
Preference for constancy	More often prefer constancy
Dependence on rewards	More dependent on rewards
Self-esteem	Self esteem is higher
General anxiety	Less anxious
Average score for study	High average score
Number of hours per week spent for study	More
Falseness	Slightly lie

In the context of these studies, the developing is a special form of social time, which immerses the educator and educated in historical reality. And for the national culture, the developing is a way of thinking about the future. A business game is a method of conducting a lesson, which is used in educational activities with the help of information technologies.

Psychologists found that when submitting material in the game form, about 90% of the information is absorbed. The activity of students is bright and as a rule of a lasting nature.

Currently, there are three areas of application of the game method:

a) Educational sphere: the teaching method is applied in the curriculum for training and advanced training.
b) Research sphere: it is used for modeling the future professional activity.
c) Operational and practical sphere: the game method is used to analyze the elements of specific systems for the development of various elements of the education system.

In the process of preparing and conducting a business game, each participant should have the opportunity for self-assertion and self-development. A business game is a controlled system. Training is carried out in the Industrial University of Tyumen with the help of the system Educon. The advantage of using the active methods for conducting classes involves the use of information technologies. But it is in the business game that many kinds of modern technologies are involved: the Internet and films (documentary and artistic). As a result of a series of business games, students came to the conclusion about the need to create a computer game, where the main character will be philosophy.

CONCLUSIONS

On the basis of the conducted research it is possible to state: the post non-classical type of rationality is connected with the formation of creative thinking. A huge role in this process is played by information technologies, as they set new principles for working with information. As the experience of pedagogical activity shows, as well as the use of active teaching methods, information technologies contribute to the formation of a new type of thinking.

The advantages of using the information technologies in educational processes are as follows:

1. Operating with huge blocks of information.
2. The special role of integrity, when the trainee is not outside the system of symbols, but inside of it.
3. Teleological determinism is the kind of determinism that is necessary for the formation of the creative thinking of the future engineer.

BIBLIOGRAPHY REFERENCES

Allakhverdov, V.V. (2000). *Consciousness as a Paradox*. DNA Publishing, Saint Petersburg.

Bim-Bad, B.M. (1994). *Pedagogical Currents in the Early Twentieth Century*. Russian Open University, Moscow.

Bulgakova, I.A. (2015). *Anthropology of Education in Russian Culture*. Publishing House Tyumen State Oil and Gas University, Tyumen.

Bulgakova, I.A. (2016). *Philosophy of Personal Development*. Publishing House Tyumen State Oil and Gas University, Tyumen.

Enikeeva, S.D. (2018). Russian education system: a new concept of development in the context of global informatization. Moscow State University named after MV Lomonosov, Moscow.

Guseva, V.E. (2012). *Pedagogical Technologies in a Professional Educational Institution*. Publishing House Tyumen State Oil and Gas University, Tyumen.

Ingarden, R. (1983). *Man and Value*. Catholic University of America Press, Washington.

Khoruzhy, S.S. (1994). *After the Break. Ways of Russian Philosophy*. Russian Orthodox and Humanitarian Institute, Saint Petersburg.

Krivikh, S.V. (2002). *Theory and Practice of Realization of the Antropological Approach to the Construction of Educational Systems*. Publishing House TSU, Tyumen.

Kurdyumov, S.P. (1994). *Psychology and Synergetics*. Institute of Philosophy RAS, Moscow.

Laird, G. (1993). *The Idea of Value*. Cambridge University Press, Cambridge.

Nalimov, V.V. (2011). *Spontaneity of Consciousness: Probabilistic Theory of Meanings*. Paradigm, Moscow.

Stepanova, I.N. (2006). *Philosophical-Anthropological Paradigms and Their Role in the Development of Education*. Kurgan State University, Omsk.

Stepin, V.S. (2001). *Culture. Philosophical Encyclopedia*. AST, Moscow-Minsk.

Zenkovsky, V.V. (1993). On Pedagogical Intellectualism, in: *Collection of Pedagogical Heritage of the Russian Abroad in 20-ies*, pp. 18-25. Education, Moscow.

Zenkovsky, V.V. (1996). *The Problem of Personal Development in the Light of Christian Anthropology*. School-Press, Moscow.

Zimbardo, F. (2010). *Paradox of Time*. Rech, Saint Petersburg.