

Methods of Eco-Thinking Forming in the Education System

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Abstract—From ecology as the "protection" of the environment to the ecology of "everything". The meaning of ecology as protection, in this case, expands to finding optimal solutions to problems in a certain area, their research and activities. Naturally, with this approach, a specific area arose - the ecology of thinking, which can be represented as transdisciplinary, complexity, culture-like area. Moreover, in this new ecoparadigm, the understanding of the subject, environment and content of his activity naturally changes. Among possible applications, we are interested in the field of education. Paradoxical, mathetikal approaches and the method of cognitive design will be applied.

Keywords—ecoparadigm; mathetika; paradox; cognitive design; bodily cognitive value paradigm of education

I. INTRODUCTION

Analysis of the challenges of modernity confirms that the field of research tends to be generalized and goes beyond the limits of strictly disciplinary consideration. At the same time, the need for the convergence of the types of knowledge and ways of thinking relevant to various areas of activity begins to be clearly manifested. In science, there is a tendency to realize the limitations of the linear model of the development of scientific knowledge, and it is being replaced by the "research program" as a unit of the science model. The transdisciplinary approach adds to this program awareness of the social reality of the study (environment) and the category of the knowing subject. It is the activity of the subject in the environments of knowledge that sets the modern model of the increment of scientific knowledge [1].

Complexity¹ is another characteristic of the modern general scientific paradigm. In it, each element of scientific

consideration requires the study of a multitude of attributes, given for different reasons and at different levels, as well as the nonillimibility of the subject from the processes of scientific systematization. Moreover, his activity is taken into account as a factor that changes the conditions of their occurrence. The way of describing such complexity at the meta-level is interdisciplinarity, at the meta-meta-level — transdisciplinarity. In turn, when building complexity relations for media modeling, we will proceed from the following assumptions: 1). knowledge of the world by man requires consideration of the following circumstances: first, knowledge of things is limited by the method of knowledge; the second, reaching the limit of knowledge implies its overcoming (the principle of formation). By virtue of the idea of the infinity of the universe, in any of its dimensions, knowledge is also infinite (actual/potential). However, we can fix the "heterogeneity" of the methods and results of knowledge at each of its stages, which is a prerequisite for the emergence of the phenomenon and noumenon "complexity"; 2). The complexity lies at the heart of the paradox. Thus, "paradoxical methodology can become the basis for the logical description of integral objects in the complexity model of the world; 3). the emergence of the concept of transdisciplinarity can be interpreted as the result of describing the methods of the cross-border transition of the subject of knowledge between the elements of the complexity of post-non-classical cultural texts and worlds of knowledge in general [2]. Thus, the concept of complexity is

However, the "complexity-based" school begins much earlier, in the works of I. Prigogine and I. Stengers (1984), Gleick (1987), Hall (1991), Waldrop (1992). A new interpretation of "complexity" gets in the work of V.I. Arshinov, V.G. Gorokhov, V.V. Chekretsov "Nanoethics - the convergence of ethical problems of modern technologies or pro-domains to the posthuman future?" (Epistemology and Philosophy of Science. 2009. № 2). Further in the article V.I. Arshinov Ya.I. Svirsky "Innovation complexity: complexity world and its observer. Part Two." it is described the formation of a new paradigm of complexity and the concepts of complexity associated with it and the observer of complexity.

¹ The term "complexity" in Russian was first proposed by the translators of M. Castells book "The Information Age: Economy, Society and Culture" (translated from English by O. Shkaratan. Ed. By HSE, 2000 608 p. URL: <http://culturca.narod.ru/cast.htm> (accessed 02.12.2018)).

applicable to achieve a holistic result in the construction of multi-level educational environments.

The characteristics of the current ecoparadigm are interconnected in a certain way. In the post-non-classical paradigm, the subject is non-eliminating from the process of observing and systematizing knowledge, which causes an effect of complexity and sets the possibility of a transdisciplinary synthesis of knowledge in the process of cognition and creation. Moreover, the measure of the complexity of systems becomes dependent on the degree of knowledge, understanding and value system of the perceiver of a particular object or process [3], [4].

Such a strategy of incrementing scientific knowledge is ecoparadigmatic, since it creates maximum opportunities for the self-realization of the subject and the development of environments, through culture-like complication, of human communities [5], [6].

II. METHODOLOGICAL BASIS OF ECOPARADIGM: MATHETIKA, PARADOX, COGNITIVE DESIGN

Historically, the methodology of educational activity is more than two thousand years of history of ideas, showing that the philosophical system describing the structure of the world is a projection of the device of human ability to cognition, understood at various stages of the development of man and humanity, later in the context of existing scientific paradigms. The essence of the process of education of a person must be considered in close connection with the process of education of all mankind, its cultures, and also from the position of improving its ability to learn. The proposed approach to the ecology of thinking analyzes the relationship between the complexity of the system and the subject's readiness to distinguish between types of uncertainties, as well as the possibility of considering the many characteristics of the environment and the activities of subjects of knowledge.

The methodology of modern science and technology is close to solving the riddle of human creativity. The main method of creation (creativity) is a thought experiment and simulation of reality in paradoxical environments. In this case, the content of the activities of the subjects is cognition.

We use the developments in the field of mathetika and "paradoxical methodology" (see "Fig. 1") [7].

The term "Mathetika" (in Latin) was introduced by Ya.A. Comenius more than 400 years ago in the book *Spicilegium didacticum* ("Picking spikelets"). "Mathetika" in Latin means "discipleship", which is understood by Comenius as the science of knowledge. Mathetika complements the Great Didactics as a "teaching" paradigm, and together they define the full content of education.

Comenius believed that the three main instruments of knowledge are Senses, Mind and Faith. Having determined, each of them, he created a "triadic" method of knowledge, keeping in mind that each of these tools must be used individually, in pairs, sequentially or in combination. Their consistency and interdependence enable man to comprehend

the truth of a special kind - "eternal truths." It is on them, according to Comenius, builds the Church's teaching, which prepares a person to "meet God". From the point of view of ontological and epistemological bases of activity of the subject of knowledge, determines the direction of human evolution, Comenius, allocates "innate concepts" and "attendant concepts." "Just Congenital idea anyway, are inherent in the nature of Souls, in contrast against the introduction, which is acquired observation or experience and is derived from the above by means of the work of thought. The concepts of Goodness, Truth, Deliverability, Due, Knowledge, Desire and Opportunity — the axiom of self-evident Truth [8]."

Comenius mathetikal ideas, in fact, were constructivism: the meaning of human existence and humanity was to uncover the natural inclinations given to man at birth so that he could develop his "human-divine essence" and enter the "heavenly gate" after death. At the same time, a significant expansion of the idea of the earthly path of the formation of man is the comprehension of the entire social hierarchy in which humankind resides, reliance on the level of civilizational development of society and its influence on achieving the highest spiritual level of human development. The concept of the formation of the "human in man" by the great Czech philosopher J.A. Comenius described in his work *"De rerum humanarum emendatione consultatio catholica"* ("General Council for the Correction of Human Affairs"), which was to urge people to general advice on how to find the tools and ways of becoming Man described in Mathetika, in one of the sketches for those chapters should have been included in the "General Council".

As for the "divine architectonics" of the Comenius model of knowledge, in modern science the basis of "God" or "Absolute" loses its ontological essence and goes into the category of epistemological foundations, in particular, manifest themselves in the idea of "integrity" as a necessary condition for the foundations of theoretical constructs and their extrapolation efficiency on civilization processes. Rejecting the exclusively ontological status of integrity as a special relationship between the elements of the substance, we come to the necessity, at the same time, of its epistemological interpretation — as a condition of human cognition. Outside of manifested consciousness, integrity is not unconditional and necessary. At the same time, the conscious ability of a person, as we can assume, is a way of generating other (non-natural, "meta-natural") cause-effect series, defining the similar character of "spontaneous", free causality (according to Kant). In this case, the idea of integrity can be either a "point of intersection" of the series of causality or a "point of their attention," indicating the requirement of a transboundary, transdisciplinary way of considering this kind of reasoning.

However, from the first attempts to build a complete picture of the world, a person encounters problems posed by various types of uncertainties, such as paradox, contradiction, antinomy, etc. Moreover, from the point of view of scientific methodology, the essence of the paradox and its insolubility lies in the contradiction between the ontological and epistemological foundations adopted in science; the paradox

is insoluble in "its", which gave rise to its scientific paradigm, due to the limitations of the theory, and at the same time — the ability of human knowledge.

The explicit description of the paradox underlies the need to solve the problem:

The old is already rejected, and the new has not yet been formed. The disclosure of a new is a mathetikal, cognitive task. The "trigger mechanism" for the realization of self-transcendence is the existential striving of the subject, which is actualized as a result of the "collision" with the paradox. In a sense, the paradox can be viewed as such a representation of uncertainty, which is a leveled and actually an endless source of self-improvement.

In real life, paradoxes manifest themselves in the form of problems. Obviously, the number of paradoxes defining the area of the identified problems is limited, which allows us to form a visible picture of their solution at the meta-level. This approach allows us to build a new concept of the education system, the content of which will be the consideration of paradoxes as milestones of solving problems and tasks of various levels of uncertainty and complexity (Fig. 1).

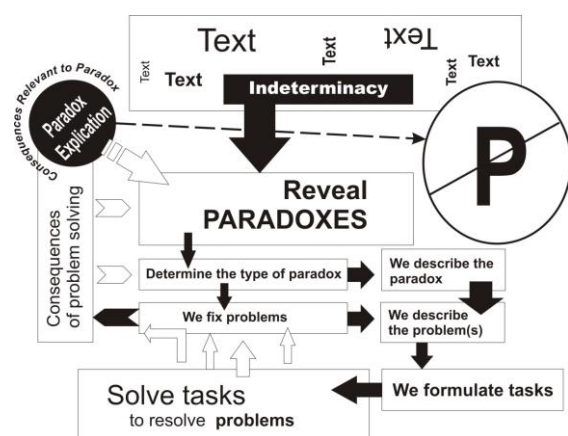


Fig. 1. The scheme - the paradoxical method.

The steps of a paradoxical methodology begin with fixing some text. We will consider the text in its post-non-classical interpretation. The post-non-classical text is a transcendental object, which includes pre-language, linguistic and post-lingual components.

We isolate elements with signs of uncertainty. In particular, — the lack of unambiguity and integrity in the description of the "behavior" of the objects of consideration.

The next stage is to find adequate paradoxical representation. Based on this methodology, we have identified, formulated and defined the roles of the following types of paradoxes.

The paradox of the single and the plural (Parmenides) "Being is, there is no non-being" [9]. Feelings perceived continuity. Thinking at the same time divides continuity. The perception of a person strives for integrity, invariably encountering ever new uncertainties. The search for the root causes of existence necessary for the realization of the integrity of thinking, in the process of cognition, leads to the

realization that it is impossible to achieve them due to the infinite process of forming language and text. If a person reaches the limits of the language, he will cease to exist as a form of life with consciousness.

The "paradox of education" implies a fundamental multi-directionality of the process of the formation of competences for professional activity, defined "from the outside" by the state system and the process of cognition, determined by the desire for self-transcendence. The existential meaning of the paradox of education: "I myself can / I can do everything" is a modal paradox in relation to myself, accompanying gaps in various fields of activity of the subject (omnipotence, omniscience and others. Immanent (inseparable) "divine" qualities-aspirations of man).

The "paradox of knowledge", existing simultaneously in two worlds — the material and the ideal, man himself is the path that binds them. The existential meaning of the "paradox of knowledge": in classics and non-classics (analytically) it is impossible to know oneself, for synthesis is permissible only under the condition of the union of Reason and Feel, only through Faith.

The paradox of "Understanding the other": consists in the impossibility of achieving a complete understanding of the other (indistinguishable subjects), despite the unity of the language. The removal of the problems caused by this paradox consists in achieving a state of "love." The existential meaning of the "understanding of the other" paradox consists in becoming, by overcoming borders. The knowing subject knows himself, self-expanding his subject to the boundaries of the "other" and "world-in-whole" (becoming this world).

The paradox of "databases" — the information of "database" No. 1 does not correspond to the information of "database" No. 2.

The paradox of "knowledge bases" — the information of "knowledge base" No. 1 does not correspond to the information of "knowledge base" No. 2.

"Discovery paradox", pointing to the "causes of things" and the relationship between them and the knowing subject. A paradox discovery not created is abstractly possible, practically not feasible (for example, as the result of a mental experiment).

The "Fight with the shadow" paradox — "shadow" — is what we "see": the idea / "Shadow" is not reality, it is from the world of the ideal / "Shadow" that helps to solve real problems.

The "value paradox" — the meaning of my life — love; for love I give my life. The meaning of my life is valuable, but for the sake of value, I give my life.

Let be,

x, y — individual variables;

a — individual constant — life;

A — predictor — value;

B — predictor — meaning;

$$\exists x \exists y ((A(x) \& B(y) \rightarrow (a, x, y) \rightarrow \exists x (A(x), la)$$

Next, we ask the question: is it possible? What's the point of this? What problems from this can follow?

In parallel, from the selected type of paradox we fix problems, derive consequences from them. From the described paradox, we derive a description of the problems, and then, we formulate problems for solving problems. Solving problems, we come to the resolution of problems; we fix the achieved result and deduce the consequences regarding the ways and methods of their solution. On this basis, we are explicating the paradox: for example, by specifying, we change the contexts for identifying and using the paradox, which will either lead to new paradoxes or allow the creation of alternative post-non-classical texts.

In addition to paradoxes, the researcher will face a number of uncertainties, such as 1) aporia; 3) antinomy; 4) contradiction (formal), contradiction (dialectical according to Kant); 5) cognitive gap; 6) creative gap; 7) value gap. To overcome uncertainties, including various types of gaps, is to be achieved at the subject level by identifying problems and creating special educational environments. To this end, in modern education systems, steps have been developed to identify the presence of cognitive gaps at different levels: database gaps, the base of knowledge gaps, sense-like gaps. It is easy to show that the gap to eliminate cognitive gaps almost automatically leads to the formation of creativity (gaps and value gaps) in subjects (individuals and societies).

The creative gap is an imperfect/incomplete act of cognition, necessary for overcoming the types of uncertainty described above and solving problems, by identifying new ways to solve them, by creativity.

The value gap is the relationship between the laws developed and not yet mastered by the subject of activity and the laws governing the development of culture/realization of oneself as a form of life necessary for solving problems of different levels of mutual cooperation. The search for models and the creation of methodologies for resolving such types of uncertainties is the content of the philosophy of education. At the same time, the principle of anti-interferenceism between philosophy and science warns against trying to embrace everything with rationally, with the help of science, leaving room for the unknown and fundamentally unknowable. This position is essential for the formulated by us method of "cognitive design in education" (the term was introduced by Zykov M.B., Sabanina N.R. [10]).

Cognitive design is a method that contains the basic principles of human intellectual activity as grounds; a necessary element of the method is the modeling and design of the productive activities of the researcher, based on the laws of the holistic process of knowledge ("Fig. 2").

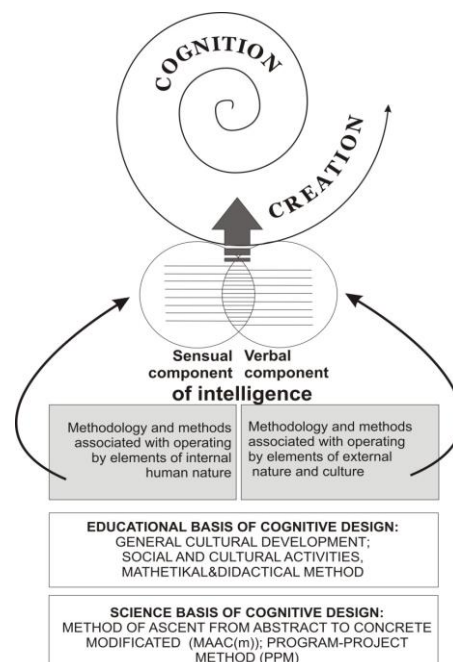


Fig. 2. The scheme - the method of cognitive design.

Translated from the Italian word "design" means "plan", "composition" — the art of connection. In cognitive design, intellectual activity is the result of a similar harmonious combination of thinking and feeling in the process of cognitive activity. In turn, cognitive activity — the implementation of naming and relationships of creation; unification of acts of operating information and the act of creation in culture.

The result of the process of thinking is the formation of concepts, a scientific model of the world, the ability to act rationally. Forms of abstract thinking: concept, judgment, inference. The details of the stages of the formation of thinking in Russian pedagogy are presented in the works of L.S. Vygotsky, P.Ya. Halperin, N.F. Talyzina, V.V. Davydov [11].

The result of "sensual ascension" is a person's ability to be aware of sensations, emotions and feelings — his own and other people's, to act in accordance with this type of knowledge, as well as to form a value system and world view. Moreover, in accordance with the method of cognitive design, verbal abstraction and sensory ascent should be considered together (see "Fig. 2"). It is clear that the stages of formation of the orienting basis of action involve both cognitive aspects of conscious activity and affective ones. The formation of each of the levels of verbal abstraction (correlated with the types of the orienting basis of action ²) is closely related to a person's ability to be aware of the

² P.I. Halperin formulated six stages of the formation of mental actions and concepts: 1) the stage of creating and maintaining a motivational basis of action; 2) the stage of creating an indicative basis for the action and understanding it by the subjects; 3) the stage of formation of the action in a material or materialized form; 4) the stage of formation of the action in loud socialized speech; 5) the stage of formation of the action in the "external speech to oneself"; 6) the stage of formation of the action in the inner speech.

"affective" side of his inner world. The stage of "sensual ascent" will be corresponding to the stage of verbal abstraction. Thus, the result of sensory ascent is the spiritual and moral development of a person, while the result of verbal abstraction is the improvement of the thinking ability. In the below-presented visualization ("Fig. 3") a post-non-classical model of educational processes is used in relation to the levels of the moral formation of a person by mastering values I, II, III orders [12], [13].

The harmonious development of human consciousness involves the integrity of verbal and sensual abstraction and

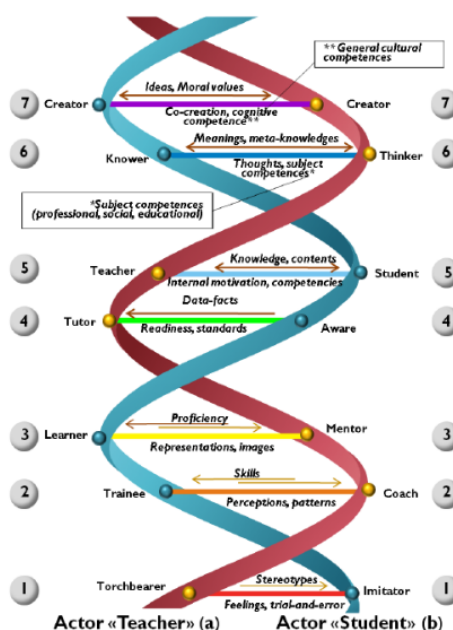
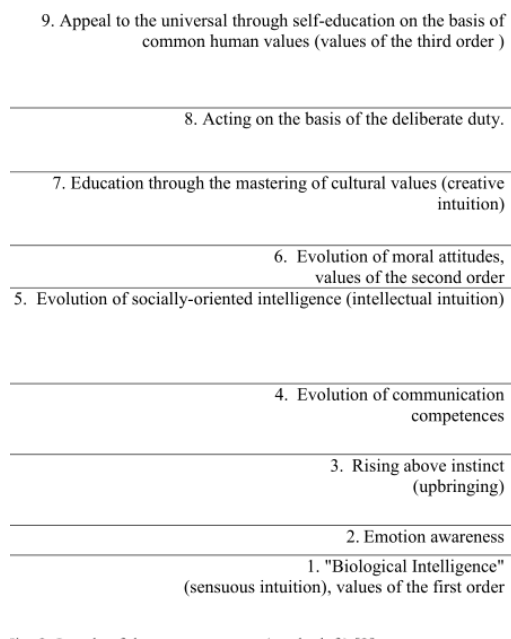


Fig. 3. Levels of the sensory ascent (on the left) [2]; verbal abstraction and idealization (on the right) – the post-non-classical model of educational processes [3].

III. PARADOXICAL ANALYSIS OF EDUCATION PROBLEMS. CONSEQUENCES

Consider the problem areas presented in the reports of the participants of the All-Russian Conference with international participation "Mathetika and the future of pedagogy"³ in relation to various types of uncertainties [14].

Sequential consideration of the problems allowed to reflect the priorities set by the participants in the field of education. The greatest number of problems was attributed to the field of the "Understanding of another" paradox — communicative epistemic (for example, problems of moral and semantic communication between a teacher and a student; problems of effective communication: neurophysiological research), as well as the field of "Value

dips" (such as: intercultural barriers and ways to overcome them in the intercultural environment, the controversy of the introduction of a plurality of ideological systems in the educational cycle). Moreover, in these areas, the most proposed solutions have been proposed. This result, obviously, indicates the need to move to the next stage of development of the education system, in particular, the body-creative-value paradigm of education, the solution of relevant tasks, the creation of adequate models. Let us understand the body-cognitive-value paradigm of education as a set of models and methodologies of education that have emerged in science based on the latest modern achievements in various fields of research that define the integrity of the biological, social and spiritual nature of man. In turn, the creation and reading of post-non-classical text, the implementation of mathetikal, environmentally friendly strategies in education, are necessary and sufficient conditions for the implementation of this paradigm of education in the context of the complexity model of cognition [15] [16].

The ideas and models for solving problems, also proposed by the participants of the conference, and distributed by us in a similar paradoxical way indicate the

³ According to the materials of the All-Russian scientific-practical conference with international participation "Mathetika and the future of pedagogy", which took place on November 30 - December 1, 2017 in the Moscow State Pedagogical University. The direct organizer of the conference "Mathetika and the Future of Pedagogy" was the Educational and Scientific Center for Interdisciplinary Problems of Education and Cognitive Studies of the Institute "Higher School of Education" of the Moscow State Pedagogical University.

significant difficulties of interinstitutional and moral and legal regulation in education.

Indicative is the fact that not a single idea and solution related to the group of problems associated with overcoming "knowledge" and "knowledge" gaps and the corresponding paradoxes of "knowledge bases" and "databases" was not presented at the conference. This situation can be interpreted in two ways: on the one hand, perhaps solutions to these problems are obvious — information and possibilities of understanding are publicly available, on the other — they cannot be solved, because of the existence of more complex difficulties: people's health, low socio-cultural level of participants in the educational process, lack of motivation and/or other necessary resources for development in this area [17].

IV. CONCLUSION

Based on the foregoing, the paradoxical approach allowed the presentation of the argument for the need to urgently solve certain types of multi-level tasks of the education system. Namely:

1. To identify the level sequence of solving educational problems directly in the education system.

2. Mark the possibility of overcoming the presented "epistemological gaps".

3. To identify those problems whose solution goes beyond the framework of an exclusively mathetikal-didactic (pedagogical) approach to the field of science, technology, infrastructure and management and propose solutions in the context of transdisciplinarity.

Indeed, the resolution of most of the problems is obviously unattainable in the old paradigm. This is due to the fact that modern challenges to the subjects of the educational process are fundamentally different in the way they are overcome due to changes in the goals and objectives of operating information in the modern world. This means that its acquisition, preservation, use, redistribution and inheritance change the nature of the construction of any relationship at all levels of mutual cooperation. So a significant problem is the use of artificial intelligence. The risks associated with it for the preservation of humanity are irrefutable and the scientific community is increasingly coming to realize the need to develop and implement post-non-classical eco-friendly strategies for civilizational development.

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