

In continuation of the discussion about ratio science and human knowledge in the education of modern man

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ABSTRACT

The authors point up the problem of interrelation of natural-science and humanitarian knowledge and the role it plays in the development of culture in the XXI century. At the beginning of the XX century P. Florensky, a Russian philosopher, defined two types of culture - contemplative-creative and predatory-mechanic, and pointed out the menacing character of the natural-science knowledge, that was going to prevail. Later, in 1959, Charles Snow, an English writer, warned people of the danger of a future split between two traditional cultures, natural-science and humanitarian.

Since that time the topic has become even more actual, that is why scholars - philosophers, physiologists, psychologists and educationalists - consider it again and again and see the way to solve the problem in a principally new approach to education.

In this article definite ways of approximation of natural-science and humanitarian knowledge are suggested, that are based on project making and follow the principle of mutual complementarity. Experience shows us, that mechanic augmenting is not effective in teaching the Humanities. Solving sociocultural problems needs sufficient humanization and humanitarization of the education in general. Humanization and humanitarization of natural-science and technical knowledge on the basis of the culturological approach will give special importance to creative, spiritual and moral aspects in the development of a personality.

Art can become a universal generator of methods, approaches and effective means for improving the quality of the educational process and general development of the cultural level of teachers and students. The ability of art to express the worldview and make for acquiring and transmitting knowledge and skills and forming opinions about the world and its values, for communication and optimism, for keeping memory, for esthetic transformation of the world made it universal means of self-expression, that integrates all kinds of spiritual culture at all times.

KEYWORDS

ratio science and human knowledge, culture, civilization, sinistrocerebral and dextrocerebral processes, rational-logical thinking, emotional-figurative thinking, art, education, educational process, upbringing, development.

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Introduction

At all stages of human existence when a child was being prepared for adult life the society tried to pass him/her the scope of knowledge and experience in all spheres, that were important for the future cultural development. Besides that, humanitarian knowledge made for understanding and accepting of basic human values, and natural-scientific knowledge, being a system of mechanisms, that served culture, acquainted the child with civilization achievements. Traditional humanitarian sphere included literature and art, and the necessary corresponding skills for practice in this creative sphere. Natural-scientific knowledge has always had the latest human achievements in science and technique as its base, and its acquiring needed knowledge of objective nature laws and being able to follow instructions of using them. All this formed the worldview of a person, who was to build the future of culture and civilization.

Humanitarian knowledge to which panhuman values have always been actual, has had this potential at all times, because changing of cultural forms does not change the basic meaning of values (Likhachev, 2000). Natural-scientific knowledge, based on discoveries of some certain time, is amplified and sometimes even radically changed. Humanitarian knowledge teaches people to feel the world in all its diversity, to see, understand and accept what is beautiful and to reject what is ugly and destructive. In other words, it forms the spiritual basis of a person. Natural-scientific knowledge makes for development of logic and intellect, and consequently it helps people to develop their experimental activity for the sake of technical progress. That is why a balanced interrelation of natural-science and humanitarian knowledge can make for harmonic development of a personality and the society in general.

But the XX century, which is rightfully called “the century of technical progress”, broke the balance and made the natural-science knowledge prevalent. In 1919 P. Florensky, a Russian cosmist philosopher, pointed up the menacing character of this phenomenon, and stressed that there are only two worlds of experience – the panhuman experience and the “scientific” experience, and correspondingly there are two types of culture: contemplative-creative and predatory-mechanic (Florensky, 1993). Later, in 1959, Charles Snow, an English writer, warned people about the future danger of a split between two traditional cultures, natural-science and humanitarian, in his lecture “The two cultures and the scientific revolution”. Snow thought that, if people did not take urgent measures, this split could lead to the end of civilization (Snow, 1963).

This problem, defined half a century ago, is becoming especially actual nowadays. Maybe this is why many scholars agree, that “one of the most dramatic problems of modern time is the completely artificial and false contraposition, and hence the opposition of natural-science and humanitarian culture” (Meyder, 1987). G. Preti, an Italian philosopher, presumes, that this mutual strain gives us an opportunity for a multiple-type discourse existing around a mutual nucleus of values (Preti, 1968). A dramatic situation existing in many vital spheres has played the role of a drive, it was the danger of ecological, technological, political or social catastrophe. If this situation persisted, it could be “fully realized, which would mean the end of the humankind” (Peruzzi, 2011). Maybe this is why Levi-Strauss, an outstanding anthropologist, predicted:

“Either the XXI century will be the century of the Humanities, or it will not be at all” (Levi-Strauss, 1985). Surely, this does not mean stopping the development of natural-scientific and technical knowledge. Scholars and public figures consider humanitarization of natural-scientific and technical knowledge, its integration with the humanitarian sphere, which will help to overcome the tendencies of technocentrism, form a moral basis, which will prevent people from using scientific and technical achievements for doing harm to humankind.

One of the purposes of culture is self-improvement with the help of methods of education and cognition, used in the process of upbringing (Gurevich, 2003). The problem of interrelation and interaction of natural science and humanitarian knowledge as two “cultures”, which, notwithstanding the difference of their language, style, argumentation, mentality and values, share the same approaches and principles of general education.

Methods

The development and realization of the idea of humanitarization are directly connected with the changing of approaches, principles and methods, on which education is based. A need appears of 1) new contents of education, that will give children knowledge about the interrelation and mutual conditionality of everything in the world; 2) new forms and methods, making for creating of a broad “humanitarian thinking’.

Experience shows us that mechanic augmenting is not effective in teaching the Humanities. To solve sociocultural problems we need substantial humanization and humanitarization of all education. Humanitarization of natural-science and technical education based on the positions of the culturological approach will give us new meanings to creative, spiritual and moral aspects in the development of a personality. A complex integrative realization of the culturological approach helps to re-create the whole spatially organized image of culture. The widening of the humanitarian boundaries of education is possible by means of integration of various humanitarian disciplines; and in such a context components of all educational spheres (including natural sciences) become humanitarian.

At the same time, when the model of the modern scientific worldview is constructed on the interdisciplinary synthesis of knowledge, which also makes for restoration of the whole worldview according to the principles of synergetics (Arshinov, 1994). The worldview here is presented as a single dynamic mutually conditioned process. Being connected with mathematics, methods of synergetics are to some extent universal, and its transdisciplinary language is close both to the natural-scientific and the humanitarian language. Using approaches and methods of synergetics “forms a special meta-level of culture” (Budanov, 2007).

Examining the methods of the natural sciences and the humanities, scholars agree that they seem similar: “All theoretic or generalizing sciences (it does not matter if they are natural or social) use the same method <...> (consisting – I.K., S.K.) in giving deductive causal explanations and their verification (through verification of predictions)” (Popper, 1993).

For the humanities a definition of trends is important (trends that help us to understand the causes of stability or transformation of phenomena, processes,



characters) and also an analysis of deep, not always realized, constructions, that influence a person, even if they are not seen.

Statistic analysis, synthesis, induction, deduction, observation, comparison, analogy and modeling, which are used in natural science research, will impart problem thinking and creativity into the process of teaching the Humanities. Besides, methods of teaching the Humanities and Art (emotional perception, identification, associations, dialogue, language of images and meanings) will sufficiently help students to master the principles of natural science.

In modern education art can become a universal generator of methods, approaches and effective means of improving the quality of the educational process and development of the general culture of teachers and students. F. Nietzsche, one of the greatest philosophers of the XIX century, thought, that “we should look at science from the viewpoint of an artist, we should look at art from the viewpoint of life...” (Nietzsche, 1987). The abilities of art to express a worldview, to make for studying and transmitting of knowledge and skills, to judge about world values, to promote communication, to boost the morale and keep the memory to change the world esthetically made it a universal means of self-expression, of integration of all kinds of spiritual activity at all times.

Using the language of images, the language of art in the process of teaching Science and Mathematics will impart language diversity into this process, because the accuracy of natural-science disciplines and the diversity and infinity of the Humanities make an oppositional pair. As we know, it is opposition, that stimulates development. So, everybody can find in both spheres something relative to his/her experience and interests and be esthetically pleased. Maybe, it is the simplest and the most real way to realization of the idea of integration of the two cultures.

Results

Using the method of multilingualism in all educational spheres promotes the possibility of transmission and density of information; the universal language of symbols reveals the connections of IDEAS, that are in the contents, OBJECTS characterizing the real world and PROCESSES, that are going on in it. L.D. Landau insisted that the aim of theoretical physics consists in finding new connections between phenomena, which seem to have little to do with each other (Volkenshtein, 1999). It ensures simplicity and minimalism of the system that connects different phenomena. The principle of mutual complementarity suggests ways of search and use of new connections, of general and universal rules for the sphere that is being studied, that will make learning easier.

and omnipresent notion, directly connected with art and human emotionality Integrity is guaranteed by convergence of different spheres of knowledge due to their convergence, their vaguely seen commonality, that is, interchange or mutual complementarity of similar elements of school education.

A universal, “image”, imparts value and a subjective hue into the attention to the new knowledge; it can be based on associative ties in actualization of a child’s emotional and vital experience. As we can speak about an image of the object, about images of phenomena and actions, transformations of the object, ways of human relations, etc. Not only does this approach stimulate creativity in acquiring knowledge by a child; it also creates necessary conditions to form a

creative approach to any kind of activity. A. Korzybski, an American psychologist and educationalist, stated that one should always be engaged in creative activity, as it makes for mental health, on which one's physical health depends (Korzybski, 1933).

A real educational process needs cultural and educational connections and the teachers' understanding of the fact that development and education of each child is their common aim that is why their work must be based on the same principle of mutual complementarity. Each teacher contributes, using the resource of his/her subject; as a result, there appears some general understanding in the mind of a child. The construction and coordination of the collective work of teachers of all subjects is a necessary condition of following the principle of mutual complementarity.

In our experiment teachers, knowing the students and their problems, created projects that could quickly and effectively solve those problems. Educational projects were formed in temporary creative micro groups. The characteristic features of the groups were the following. The participation was voluntary, the groups were dynamic, innovative, they were short-time and characterized by creative freedom. The groups were created according to a certain idea or project. The technology of their creation and their work can be presented as an algorithm of several step-by-step actions (Table 1).

Table 1. Stages of the work of a creative micro group

Stage	Contents	Aims	Note
Stage 1	Appearance of the idea – the topic of an interdisciplinary project.	Discussing the idea and search of participants.	-
Stage 2	Identification of problems, identification of aims. Analysis of specific languages and methods.	Forming a micro group, sharing duties.	-
Stage 3	Collecting materials, 1. consulting the research manager.	Defining the scope of activities.	Invitation of senior students.
Stage 4	Working with the contents.	Defining the general structure of the work.	Invitation of senior students.
Stage 5	Preparing and conducting the integrative work.	Presentation of a multidisciplinary project	Invitation of students.
Stage 6	Discussion, assessment of actions and results.	Generalization of the experience; sharing materials.	Seminars, publications.



The preparation of teachers for generating and realizing projects included a set of activities. A program was created for capacity building, for improving theoretical knowledge and professional skills. The program consisted of 4 modules: general culture, psychological and educational culture, technological culture and universal languages and methods of art. A variety of activities (lectures, reports, seminars, disputes, round table meetings, business games and master classes) prepared teachers to mutual creative work. Systematic cultural, psychological and educational and technological knowledge was formed, that was necessary for working out of interdisciplinary integrative projects based on understanding of the mechanisms of their work.

In the process of our research the teachers' attitude to the suggested innovation was studied (Table 2). At the beginning of the experiment (the negative stage) nearly all the staff (in every school) showed no interest in the innovations, and the attitude of some teachers was even negative; but gradually, as the planned activities were being carried out, the number of teachers whose position was that of creative cooperation, grew (Table 2)

Table 2. The attitude of school teachers at different stages of the experiment (average; %)

Stage of the experiment	The teacher's attitude	Interested in innovations	Against innovations	Not against innovations, but not willing to take part
Beginning of the experiment	The negative stage	6,5	86	7,5
The second stage of the experiment	The adaptive stage	22	37	41
The third stage of the experiment	The stage of creative cooperation	86,6	-	13

The specialization of the teachers, their working experience did not sufficiently differ. Our observation helped to find out that among the teachers willing to actively participate, besides Art teachers there was a considerable percentage of teachers of Mathematics and Physics. If we take into account that the essence of the experiment consisted in imparting of methods of art into all educational spheres, such a position of Mathematics and Physics teachers can become a topic for a new research.

The third stage of the experiment showed the presence of a close-knit group of teachers in which 86,6 % of teachers were actively working to realize the idea of the project. The other teachers, though not taking part in the innovative

activities, adopted a positive or neutral attitude. There were no more active antagonists of the project.

In the process of modelling, the following criteria of choosing contents, forms and methods of our activities were defined:

1. Consistency of teaching;
2. Planning lessons according to the principle of mutual complementarity;
3. Degree of language variety and oppositional attitudes;
4. Reasonability of introducing of “images” and associations in the teaching process;
5. Art lessons as the integrative base;
6. Possibility of translation in the conditions of any secondary school.

As a result, the teaching process became livelier and more dynamic, it corresponded to the children`s interests and experience. Active search of associations to feelings that had been experienced earlier made school subjects more understandable, emotional and attractive. The principle of mutual complementarity made for connecting of different spheres of knowledge into a whole vision of the world, the earth and universal values. As a result, the children got the necessary knowledge in an atmosphere that promoted positive emotions. They were given problem-solving and creative tasks, which required not only conscientiousness and attention, but also actualization of the knowledge they had, being capable of transference from one educational sphere to another, finding an extraordinary decision, sometimes skipping over an informational gap. The effectiveness of the educational process and the percentage of acquired knowledge grew. The diagram below shows average data of effectiveness of an ordinary lesson and a lesson based on the principle of mutual complementarity, including the multilingual method, methods of cultural dialogue and figurative-associative connections (Figure 1)

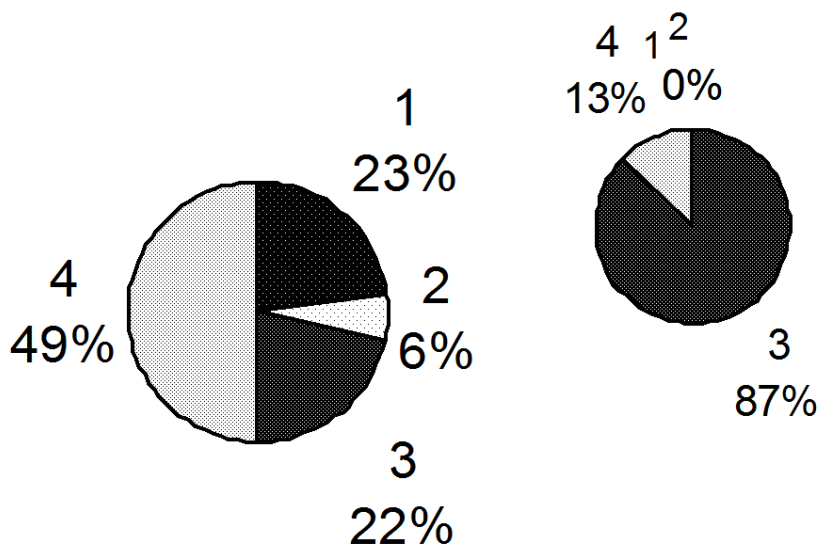


Figure 1.Diagram of effectiveness of ordinary lessons and lessons based on the principle of mutual complementarity. Meanings: 1 – mark «3» (23% and 0%), 2 – mark «2» (6% and 0%), 3 – mark «5» (22% and 84,4%), 4 – mark «4» (55% and 12,6%).



In 1968 G. Preti stated that the presence of multiple discourse around two cultures in a society which coexist and interact stressfully, is a resource of future development rather than a problem (Preti, 1968). In modern discussions, they sometimes rightfully mention the mutual complementarity of the two cultures. It was this principle that we took as the base of the educational process in several Moscow schools («Ellada», #996, #594). This principle helped us to overcome:

The mismatch between the wholeness of culture and its fragmented presentation in different school textbooks;

The gap between the whole perception of reality, inherent to children and the traditional separateness of school subjects;

Alienation of a child from the cultural tradition, absence of a whole and emotional attitude to the world;

The mismatch between the scope and forms of realization of the educational process, alienation of school subjects from each other, from life and the experience of a child;

Inability to find effective means of interaction of technical and semiotic artefacts in culture and its symbolic reality.

The idea of education having development of culture as its aim only when it stimulates only creative, and not reproductive activity of the students, has been realized in the organizing of the learning process according to the principle of mutual complementarity.

The main task of forming integral thinking of students, which needs harmonious work of both hemispheres of the brain, was solved due to activation of both dextrocerebral and sinistrocerebral processes. The traditional approach means that a child is fed with information and taught RIGHT algorithms of actions in any given situation stimulates the sinistrocerebral processes. Dextrocerebral (emotional, figurative) processes are not needed; they are usually well developed in childhood, but atrophy later. Not only is the creative potential, given to the child by Nature itself, not realized; it is destroyed. Mastering sciences teaches thinking according to existing laws, according to standards. Art forms another type of thinking, emotional and figurative, that promotes development of imagination, activates creativity and widens the limits of given algorithms. If we figuratively compare of the process of perception, processing and re-creation of information by the two cerebral hemispheres with the process of mounting to the top of a building, we shall see that the left (verbal and logical) hemisphere it is like going upstairs, whereas for the right (figurative) hemisphere it is like being smoothly accessed by a lift. Thus, when the right hemisphere actively works, it makes not only for the speed, but also for the quality of perception.

V.V. Medoushevsky thinks that “the right hemisphere – <...> embraces the world of whole images and fixes it with the help of intonational and figurative language of culture” (Medoushevsky, 1980). Basing on works of neuropsychologists, this art specialist insisted, that figurative and sensory

memory and thinking fix general ideas, which are the heritage of social and cultural experience of the humankind. Modern psychologists express the opinion that “a man learns about the world through images, not through a sum of knowledge” (Zinchenko, 1990).

Does it mean, that active work of the right hemisphere will enable us to achieve a harmonious balance between natural-science and humanitarian spheres in the process of bringing up a person, who will be responsible for the future of humankind? The integrative educational process, based on culturology, synergetics and the principle of mutual complementarity, has shown that our ideas were right.

Such an educational process makes for introduction of a child to universal human culture that is presented as integrative, in the variety of its phenomena. The understanding of culture being not a set of separate subjects, but an interconnection of knowledge about the man and the world as the man's living place, and the ability to use that knowledge. The humanities give a child the ability to comprehend the mutual complementarity of things and vulnerability of the world, to see and learn the essence of what happens in it, to build a personal system of values. Natural sciences enable a child to master all knowledge, necessary to modern people, understand the logic of processes going on in different spheres of science and technique. At the same time mutual complementarity of natural-science methodology, humanitarian ways of learning and artistic characteristics of perception makes it possible to fill the existing gaps and embrace a greater scope of information. Learning any whole phenomenon, represented in a symbolic system, is promoted by a mutually exclusive use of the two languages, originating from common logic; such an approach widens the logical structure of a subject. This is the principle of complementarity, expressed by N. Bohr, and it can explain any phenomenon by means of various languages, that make a panoramic view possible. This way multilingualism, understood here as using different language systems in an educational process representing the same knowledge, helps to comprehend and acquire the material.

Languages of the art, whose potential in modernization is hard to overestimate, are used as a complementary language. Their use synthesizes different forms of information: verbal, emblematic and symbolic. When we use figurative information in an educational process, this process becomes significantly more effective. Artistic symbols and images make it possible to condense the information maximally and to enrich the contents. Images and symbols give us the possibility to feel the world and what is happening in it, not only to know all that.

Languages of the myth, proverb, fairy tale, drawing, scheme, illustration or sound make the learning material more comprehensible, which is easier for figurative forms than for verbal ones, and promote the compact “package” of the information (Zinchenko and Nazarov, 1991; Kashekova, 2010; Kriulina, 2003; Lotman, 1998). This way, using of **oppositional language and oppositional pairs of notions** helps to create an effective learning process. Languages of science, that form the logical thinking, influence mainly the intelligence. Figurative languages of art influence the emotional sphere. As **linear and discrete languages of sciences are opposed to continuous and spatial languages of art, their integration unites mutually exclusive**



complementary components of the contents of the education, realized due to the **interdisciplinary** and **transdisciplinary** integration.

In the cognitive process, not only “pure” knowledge is important, but also cognitive orientation and emotional perception which answer the following questions: Why is this knowledge needed, how is it connected with another knowledge, how can it be used? A separate fact, even if it is very convincing, but taken separately (without the whole context, including the space, that has given birth to it, its natural ties, criteria of its correspondence to other facts of the same class or group) can seem unconvincing and unnecessary to a child.

Conclusion

A sociocultural dialogue, important for modern culture, is possible under the condition of its integrity, that can be achieved by means of consolidation of resources of humanitarian and natural-science education. Notwithstanding a mass of features that make the “two cultures”, natural-science and humanitarian, different, because each of them has its own traditions, languages, models, patterns, methods and aims, they can successfully interact. They have “a single set of values, that root in human nature, and are available to everyone, that can express themselves in different forms with different syntax and semantics...” (Peruzzi, 2009). Educational practice proves some scholars` predictions: “The unity of science and art is a most important guaranty of future development of culture. We should find and cultivate what unites sciences and arts, not what separates them”, - wrote M.V. Volkenshtein, an outstanding Russian physicist, chemist and biophysicist (Volkenshtein, 1999).

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