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Cognitive Factors of "Art+" Cross-Cultural Pedagogical Technology

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***Abstract*: The authors believe that the strategy of modern education should be aimed at updating the content of education and developing mechanisms for its mastering in accordance with the realities of the modern world and the psychology of present-day childhood. The article reveals the ways of finding answers to the issues, which are topical for modern education, namely, how to convey to pupils the necessary amount of fundamental and most modern knowledge, how to ensure knowledge acquisition, how to spark children's interest in learning the world, and teach them to apply acquired knowledge in practice. Based on the research in the field of cognitive psychology and pedagogy of art, the authors distinguish the factors of creative cognition, describing the "ART+" cross-cultural pedagogical technology and its principles, as well as provide guidelines on the application of technology in the educational process of secondary school to make the learning process fun and creative.**

***Keywords*: culture, art, science, education, cognition, creativity, perception, scientific and artistic cognition, emotions, creative work, artistic creativity, image, imaginative models of the world, educational process, semantics, sign-and-symbolic systems.**

I. INTRODUCTION

In the modern world, education is undergoing major changes associated with global transformations both in culture and civilizational processes. In culture, this is the so-called cultural or artwork turn (M.A. Dikovitskaya, W.J.T. Mitchell) [1, 2], which is caused by the fundamental change of the information transmission technique – from verbal to the visual mode. In the context of civilizational processes, these are unprecedented breakthroughs in robotic and nanotechnologies, whose results literally overturn the perception of the real world. According to A. Toffler, American philosopher, sociologist, futurist, and creator of the post-industrial society concept, today humanity is on the crest of the Second Wave and about in 2025 will enter the era of Third Wave. If the scientist's estimations are correct, it means that there will be a change of civilization. Since the emergence of a man on Earth, this will be the beginning of the third civilization (the first one was agricultural – from ancient times to the 18th century; while the second industrial civilization lasted from the 18th century to the present day) [3].

It is known that education in all ages and in all societies has sought to convey to the next generation the knowledge, ideas, values that were important for the further development of culture and civilization. However, the growth of innovative processes at an unprecedented pace changes the human environment, destroys the generally accepted rules and views, and sets new challenges for education. According to E.B. Morgunov, "changing the living environment generates new stereotypes of behavior and consumption, new skills, habits, traditions, new work morals. In the end, a new philosophy of life emerges, whose carrier is a new man" [4].

The unprecedented growth of information and the pace of emergence of innovation in science and technology possess new challenges for today's education: how to convey to pupils the necessary amount of fundamental and most modern knowledge, how to ensure knowledge acquisition, how to spark children's interest in learning the world, and teach them to apply acquired knowledge in practice?

Thus, the strategy of modern education should be aimed at updating the content of education and developing mechanisms for its mastering in accordance with the realities of the modern world and the psychology of present-day childhood.

II. METHODS

In connection with the above, one should turn to the research of psychologists, who adhere to a cognitive approach to education. According to the creators of this approach, J. Bruner and W.M. Rivers [5, 6], human thinking depends on the degree of language acquisition, but language learning should not be limited just to the perception and mechanical memorization of the rules. It is important that pupils are involved in the active process of learning the essence of phenomena from the standpoint of personal interests and guidelines, as well as the interests of society.

The idea of the language importance for the comprehension of information was considered also by N. Bohr. This idea lays the basis of the complementarity principle developed by him.

Bohr has put forward a thesis about the effectiveness of the comprehension of any integral phenomenon, which is reproduced in the sign system, by the mutually exclusive use of two languages, coming from conventional logic. This approach extends the logical structure of the subject language.

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The described phenomenon was called by the outstanding physicist the complementarity principle [7]. Using the principle expressed by Bohr, one can explain any phenomenon by means of different languages, giving the possibility of a panoramic view of the imagined phenomenon. Thus, for example, explaining to the interlocutor the way to a certain point, it is possible to resort to natural language and give the verbal description of the road and the name of surrounding settlements. But at the same time, one can use the language of the drawing, and draw a path diagram, supplementing it with the language of the geographical map of the given area with the names of the nodal settlements indicated on it, etc. In this case, the information will be more complete and it will be easier for the interlocutors to understand each other.

Bruner J. wrote that language is an instrument of the most general nature, since it points the way and directs the muscular efforts of man, the senses, and thinking abilities. Specific tools that save effort in perception include diagrams, drawings, schemes, and models. The most important thing is that they reduce heuristics time and help to plan actions [5, 8].

In culture, language mechanisms provide intense generation of new knowledge [9]. In view of the fact that the inherent ability of culture to create new texts, in fact, determines the education, which contains texts of great culture, though selected and systematized according to pedagogical tasks and methods, one can say that conditionally new texts, which are mastered by pupils, create conditions for their constant generation [10]. In education, these texts are presented in the languages (in sign systems) of those educational areas to which they relate.

Lotman Yu.M. believed that "art is a perfectly organized generator of languages of a special type, which provide an indispensable service to humanity". Art provides an understanding of the incoming information necessary for the survival of the organism in nature and society.... Humanity needs a special mechanism – a generator of more and more new "languages", which could serve the human need for knowledge. At that, it turns out ... that in terms of hierarchy, the creation of languages is a more compact way of storing information than the increase to infinity of messages expressed in one language" [9].

The possibility of creating a new language in the future, integrating all languages and concentrating on the entire cultural experience of mankind was suggested by E.V. Sokolov, who believed that such language would become the property of any person. According to the author, this language "cannot exist without metaphors, symbols, analogies, and therefore should approach the artistic language" [11]. Thus, **linguistic diversity** is a significant mechanism of education.

Based on the Bohr thesis on the effectiveness of the mutually exclusive use of two languages, as well as the works of Lotman, and studies of cultural scientists and educators [10, 11, 12, 13, 14 and others] one can talk about the productivity of the teaching and educational process built on the inclusion of opposition languages and opposition pairs of concepts.

Languages of science, when forming logical thinking, affect mainly the human mind; while languages of art, developing artistic and imaginative thinking affect emotions. Their joint use in the educational process significantly increases the effectiveness of training.

Since it is linear discrete languages of sciences that are oppositional to the continuant continuous-spatial languages of arts, their integration can create mutually exclusive additional components of a single integrated mechanism for building a new educational space [15].

Oppositional pairs are present at different stages and in different forms of human intellectual activity. In other words, the emergence of any level of semiotic development of the world immediately causes the emergence of its opposition [16].

Kelly J., one of the founders of the cognitive direction in psychology, wrote that each person is to some extent a researcher because seeks to understand, interpret, and predict the world of their emotional experiences based on their past experience [17]. Different people realize the objective reality in different ways because any event can be viewed from different standpoints. The choice of possibilities in the interpretation of the inner world of experiences or the outer world of real events is extremely great. A striking example of this are works of art with a similar theme, but completely different in plot and content.

Kelly assumed that a person perceives the world by means of constructs accumulated in his mind. Constructs are personal systems or models consisting of ideas, thoughts, attitudes, and experiences. With their help, a person comprehends, interprets, and explains the world, events, and does it in terms of similarity and contrast [17], i.e. uses all the same opposition pairs. The system of constructs that each person uses to interpret their experience is unique because it is built on the basis of personal experiences and qualities of character.

The naturalness and efficiency of the **mechanism of comparison and interrelation of opposition pairs** are proved by time. It was on this opposition in antiquity that all the myths were built, which, as is well known, were the “textbook” of life, activating the development of culture. All works of art are also based on the oppositions of good and evil, life and death, sacrifice and selfishness, self-sacrifice and self-will, light and dark, high and low, beautiful and ugly. In the context of the present study, the languages of science and art are **the oppositional pairs in the structure of comparison and interrelation.**

The introduction of art languages in all educational areas makes it possible to use the mechanism of **integration and convergence of all school subjects with art.** Art languages contribute to rely on the personal emotional experience of pupils, develop their associative memory and emotional-visual thinking. The integrity provides the approach of different areas of knowledge or objects due to their convergence – implicit commonality in the structure, functions, or similarity of semantic elements, i.e. exchange of similar components of educational programs in different subjects with art.

As a mechanism, the convergence causes the phenomenon of resonance, whose various manifestations have recently been actively studied by Russian philosophers,

psychologists, and educators [18, 19, 20, 21]. Resonance, in turn, underlies the transfer of information and related associations. Associative memory significantly increases the ability to perceive and remember, as well as reveals a variety of opportunities in creative activity.

Integrity and convergence of all school subjects with art suppose an appeal to the image as a basic concept of art. The ambiguity of this concept and the role of creative thinking in the mental life of a person can make it a **key pedagogical mechanism of education** [22]. After all, an image is both the appearance of a real object and an image that conveys an idea about it, subjective judgment, metaphorical synthesis, a model of the existing, as well as a generalization expressed realistically or hypothetically. In this case, the formation of the scientific worldview should occur together with the development of models of artistic, mythological, and religious pictures of the world [22].

Mental processes, such as attention, perception, memory, and making informed decisions are included in the sphere of cognition, which is interpreted in psychology as an act of cognition. The concept of "cognitive" is an indicator of an individual's ability to analyze incoming messages, to compare, to solve problems, i.e. to be an active subject of the cognition process. But the perception of each person is subjective: different people receive different knowledge from the same events and phenomena, i.e. the incoming information is filtered due to cognitive factors affecting the person. At the same time, cognitive factors are subjective, they depend both on genetic characteristics, individual characteristics of a person, as well as on education.

Cognitive processes studied by cognitive psychology are associated with the study of memory, completeness of information perception, imagination, and mental processing. The components of cognition do not include emotions due to their spontaneity and subconsciousness. However, research in this area still does not exclude issues related to feelings, imagination, decision-making abilities, which are considered on par with attention, memory, and logical thinking. Despite the traditionally accepted opposition of scientific and artistic knowledge, it is clear that the problems associated with the development of cognition in education can be successfully solved by the joint use of scientific (memory, logical thinking) and artistic (feelings, imagination, associative memory) ways of knowing.

In psychology, the cognitive approach is based on the comprehension of the individual as a person able to understand, analyze, and evaluate. Any conduct is treated as 1) action, 2) the thoughts that force to commit this action; 3) feelings experienced while performing the action. Actions performed by different people, even with the superficial resemblance, can be different because thoughts and feelings behind them are different. People see and interpret situations, in which they act, differently. Therefore, accordingly, they can react in a different way. At that, psychologists believe that subjective interpretation of situations is a more important factor for decision-making than the objective significance of these situations.

Cognitive factors were considered by many psychologists from different standpoints (M. Basadur, J.P. Guilford, J.B. Carroll, et al.) [23, 24, 25]. In particular, Carroll identified eight cognitive factors affecting the level of human cognition: associative flexibility, practical and imaginary flexibility, expressive flexibility, visual flexibility, fluency of speech and words, originality, and sense of independence. Guilford believed that the cognitive process, being interpreted from the standpoint of flexibility, originality, and the ability to improve, has impact on divergent productivity. In the article "Three faces of intellect" issued in 1959, Guilford presented a cubic model of intellect, called Guilford's cube [24]. Three dimensions of the cube served the vectors for the classification of the three sides of intellect, namely, Content (the nature of the information motivating the performance of actions); Operations (basis on which cognitive actions were performed); and Result (forms of information processing) (Fig. 1). In total, the cube represents 15 factors whose combination may result in a huge number of options. In this theory, it is valuable that Guilford presents visual, symbolic, semantic, and behavioral content. That is, almost all the elements, which make up the content, correlate with art, which is fully characterized by imagery, symbolism, and semantic diversity.

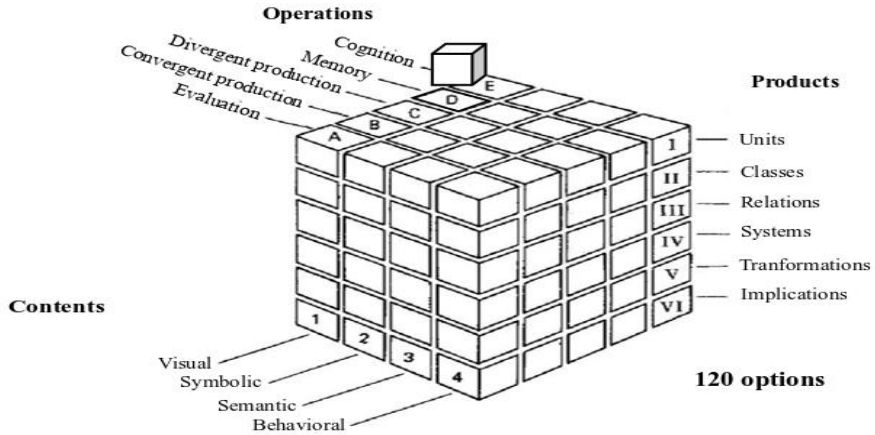

Fig. 1. Cubic model of intellect called Guildford cube with a clear example of modeling the result (memory for visual elements).

The listed components, which make up the factors of three vectors, may intersect with each other giving different intellectual abilities of a person. They are directed along three dimensions – Operations, Content, and Products. But this is just a diagram. Filling each component with a certain meaningful content of the school subject (history, mathematics, etc.) along with used additional art languages, will significantly expand the possibilities of education. To make it clear, let illustrate the **intersection** and **complementarity** mechanism, which reflects a result, by means of example (the desired cell is on the top surface of the cube): the intersection of units, memory (memorizing), and visual components gives the result, which is interpreted as a memory on visual units. Thus, the structure of intellect theory comprises up to 120 different intellectual abilities organized along three dimensions – Operations, Content, and Products.

III. RESULTS

In the context of the above, the authors have developed a cross-cultural pedagogical technology called "Art+", which promotes the use of cognitive components of creativity in the learning process, greatly facilitating the perception and memorization of educational material.

The "ART+" cross-cultural pedagogical technology, which works based on the complementarity of natural science and humanities, meets the requirements of contemporary culture with its inexhaustible abundance of information, the dominance of visual images, the tendency to integrate, strongly manifested semantic nature and new demonstration forms of mythological perception of the world. The use of new connections, general and universal laws of phenomena and semantic elements of the studied discipline with art provide interchange and complementarity of natural science and humanitarian knowledge [22].

Based on the factors of cognition identified by Carroll, the authors use *flexibility* as the ability to quickly get bearings and find an alternative without dwelling on a single solution, to search and find options. From this standpoint, the proposed technology is characterized by the following flexibilities:

- *associative flexibility*, which is based on emotional and associative experience of pupils, i.e. the development of associative experience through art images. Building associations based on personal experience enables getting personal experience and appropriation of the education content, as well as the phenomena of the surrounding world, reflected in art;

- *practical flexibility*, i.e. explanation of new material and training tasks are based on the ability to transfer knowledge from one area to another, and apply them to solve real-life problems, the ability to meta-activity;

- *imaginary flexibility*, which is a problematic presentation of content, where the child is provided not with ready-made concepts, but a purposeful chain of questions and images that gives him the opportunity to find the right answer, to discover new knowledge, to imagine the prospects for its application and development;

- *expressive flexibility*, where creative thinking and art images help to make new knowledge emotionally vivid, expressive, relief, and colorful. Associations, images, and metaphors will give it liveliness and colorfulness;

- *visual or image-bearing flexibility* relies on primordial images, traditional art images, mythological representations, appeal to reminiscences and awareness of their transformation in an artistic culture that will help to link new knowledge with the general cultural experience of mankind, will provide an understanding of the integrity of culture.

- *fluency of speech and words* means the active use of the communicative function of art, namely, the involvement of the child in the dialogue to develop speech and value judgments;

- *originality* that means a steady return to the semantic function of art, familiarity with the role of the sign and symbol in artistic culture, the ability to interpret the meanings of multivalued visual symbols, conscious use and transformation of signs and symbols in the interpretation of works of art, natural phenomena, as well as their own creative activities;

- *a sense of independence or freedom*, flexibility, which have always been characteristic of art, allow look for many versions and trajectories to fulfill educational and creative tasks, as well as to find original alternative solutions to the tasks.

The "ART+" cross-cultural technology focuses the child on the study of the world around in its integrity, i.e. with rational-logical and at the same time, emotional-figurative perspective. Studying the issues of creativity, E. de Bono has argued that even if there is only one element, we are able to imagine the image of an object or event because we focus on stable, established features [26]. But, the problem is that we, when seeking to view individual elements only as part of something common, cannot connect elements in a somehow new original way even in our imagination. This is quite consistent with one of the principles of the Gestalt approach, the essence of which is that the analysis of the parts does not give an understanding of the whole because the whole is more than parts since it is supplemented by the interaction and interdependence of its components [27].

The ability to find unfamiliar differences in the course of learning, to consider them from unexpected sides, to identify new combinations and model a new whole from familiar elements makes up a cognitive component of creativity.

Cognitive process interpreted from the standpoint of flexibility, originality, and ability to improve has impact on divergent productivity, which is considered by psychologists as creativity, i.e. the presence of a wide range of possible solutions, resulting from the generation of a large number of ideas.

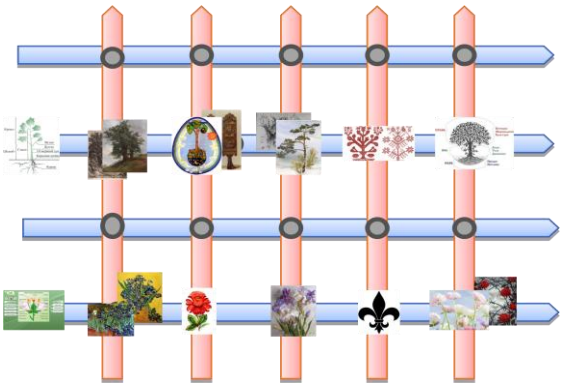

Fig 2. Mental knots of integrity and convergence with arts when studying the subject of "The world around us" in primary school.

Presenting the application mechanism of the ART+ technology can be done by means of grid, in which one direction represents meaningful vectors of the studied discipline, while the perpendicular direction shows the content vectors of art. Figure 2 shows an example of a grid to develop the content of "The world around us" lessons on the topics "Tree" in primary school (top row) and "Flower Structure" (bottom row). At that, the "knots" of understanding in the mind of the pupils appear at the intersection of scientific and artistic knowledge. Finding the knots of integrity and convergence of educational areas with art significantly increases the content and emotional-figurative saturation of information, significantly reducing it in form, i.e. providing a "tight package" of knowledge (Fig. 2) [22].

To develop the content and methodology of the lesson on any subject using the proposed "ART+" technology, one can use the principles of Guilford and Rubik cubes, transformed for the educational objectives (Fig. 3).

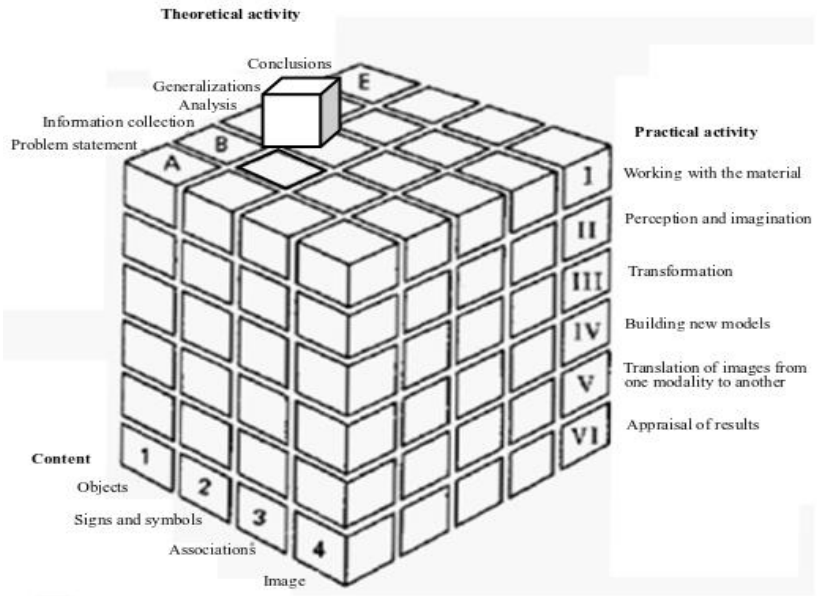

Fig. 3. Modeling the content and methods of the lesson using a cubic model

Before giving an example of modeling the content and methods of the lesson using proposed cube, the three faces of which show the three vectors of the lesson, namely, content, theory, and practice, it is important to focus on the dialogic principle, used in the construction of the learning process based on "ART+" technology. The dialogue is constructed both on the content level between science and art and between opposition pairs, as well as on the communicative level between the participants of the educational process. New knowledge is based on the pupil's experience acquired in the course of answering specially constructed questions formulated by the teacher during the conversation or arising from the pupils. Both basic and leading questions together with the answers serve a bridge between ignorance and new knowledge, which leads to the solution of the main problem of the lesson.

In case the lesson begins with the formulation of a certain problem (A), then at the level of theory, the cube will offer at least four different options:

Problem statement

The problem can be formulated in the following ways:

A-1 – strictly and specifically through the subject matter;

A-2 – by means of the demonstration of tree signs or its symbols;

A-3 – by displaying images that cause associative links to the tree;

A-4 – by presenting different images of trees from paintings of artists.

With the inclusion of the fourth vector, the practical one, each position is increased by five times in terms of its content (for example, A-3-V, etc.). The result (VI) is left for the following stages of the lesson. Here is an example of the development of tactics at the beginning of the lesson, if the teacher chose position A-3:

A-3-I – lesson begins with the work of pupils with self-selected images, calling associative links with the tree, presented in a variety of materials (works of fine or decorative art, literary images, etc.);

A-3-II – lesson begins with the perception by pupils of images, calling associative links with the tree and giving scope to the imagination in the course of perception of the works of art proposed by the teacher;

A-3 - III – lesson begins with the work of pupils with images, calling associative links with the tree in the course of transformation of their images (for example, a house for birds, the road to the sky, etc.);

A-3-IV – lesson begins with modeling by pupils of a variety of designs (graphics, applications or paper plastics, wire, etc.), calling associative links with the tree;

A-3-V – lesson begins with pupils' perception of the image of a tree in a particular form of art; then children are offered to find associative links with the images of trees in other arts and in their life experience.

In any case, displaying images is followed by the chain of probing questions, leading pupils to the independent solution of the problem.

As children grow older, it is important to teach them to formulate questions on their own as steps leading to the achievement of the goal.

Thus, one can see that the methodological modeling of any lesson can be very diverse, and depends on the creative intent of the teacher, the specifics of the material being studied, and the characteristics of the pupils.

Collection and analysis of information take place in all directions. But depending on the material found, the dominant line is revealed, which is used for making the generalization. Formulating conclusions, pupils return to the content of the lesson.

At all stages, practical activity is carried out in conjunction with the theoretical study, i.e., as far as possible, the theory is comprehended through practice.

The integration of scientific and artistic knowledge, when studying the topic of Tree, makes it possible to comprehend the image that embodies the universal concept of the world, mythological ideas about it, the importance of this image in the development of culture, the specifics of the structure and functioning of the tree, which served the basis for a special attitude to it in culture. Thus, expanding the boundaries of the child's understanding of the world, we help him to master the world not only rationally and logically, but also emotionally and figuratively. Using associative memory, imagination, logical constructions, the child himself constructs various models that in one way or another can be associated with the image of a tree: a tree as a model of the universe; as an axis of the world or a road connecting the underworld, earth and sky; as a symbol of the synthesis of earth, water and sky; or a symbol of the powerful energy of growth, the image of reborn life; finally, a tree – as a living organism or a house for birds and insects, a tree as a building material or raw material for the manufacture of fabric, etc.

Inclusion of oppositional languages, i.e. science and art and oppositional pairs of concepts in the educational process ensures its effectiveness, namely, increases pupils' interest in learning, increases the amount of memorized information, broadens horizons, and helps to understand the world in its integrity.

IV. CONCLUSION

Thus, the updating the content of education can occur through the expansion of the semantics of terms, concepts, and phenomena, i.e. their semantic load, by expanding the semantic field, which includes images, signs, and symbols. Mechanisms of the content development include linguistic diversity; comparison and relationship of opposition pairs; integrity through the convergence of art, and the use of the image. Constructing the educational process based on the principles of dialogic, mutual intersection, and complementarity allows pupils to personally perceive and accept new information, to build a logical chain, to complete the model, i.e. the education process itself becomes creative.

Psychologists, engaged in the psychology of artistic creativity believe that "artistic creativity is the essence, foundation and peak of creativity as such. ... Scientific creativity ...seems to be only a special case of art" (K.V. Selchenok) [28]. It is no coincidence that the great scientists of all time believed that everything true should be beautiful, and the laws of nature correspond to the canons of beauty.

Art brings to education cognitive factors that affect human thinking and make the learning process creative.

Qualities necessary for creative cognition include emotional-figurative perception, intuition, comprehensive, spatial, and associative thinking based on connections. These qualities enable perceiving the phenomenon simultaneously and holistically, solving complex, ambiguous, paradoxical situations; helping to know the world through emotions and metaphorical synthesis, manifesting non-alienated treatment of everything that surrounds a person [22].

The implementation of technology in the educational process of the school enables interdisciplinary integration, which allows combining the knowledge, obtained through disparate subjects, into a holistic picture of the world.

The implementation of the proposed technology is carried out through the following mechanisms:

1. **Linguistic diversity:** the inclusion of the opposition languages of science and art in the educational process.
2. **Reliance on the concept of image.** The universal concept of the image adds a value-subjective shade in relation to new knowledge and helps to rely on associative links in the actualization of the pupil's experience.
3. **Comparison and interrelation of oppositional pairs of concepts,** which is proved by time: it is this opposition that served the basis to construct myths of all people of the world, as well as the religious instructions, which were, as known, the textbook of life activating the development of culture in ancient times.
4. **Intersection and complementarity:** provide finding the mental knots of integrity and convergence of educational areas with art.

In education, which is based on "ART+" cross-cultural technology, art objects play a constructive role.

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