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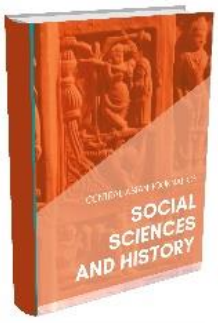

Using Innovative Technologies to Develop Creative Thinking

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Annotation:
IN article considered the concept thinking generally, creative thinking, history of learning creative thinking , ways of realization creative thinking , stages creative process, problems arising in the modern system of teaching fine arts, solutions and methods of modern education.

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Life is a continuous invention, the skills that we have mastered in schools and colleges are not very helpful in solving complex problems. This requires inventive thinking.

The idea of the need to develop effective methods for solving creative problems has been expressed for a long time. Its roots go back to ancient Greece, where the word "heuristic" was first encountered in the writings of the mathematician Pappus . And yet, until the middle of the 20th century, inventive problems were solved by enumeration of options approximately as follows: “What if you do it this way? ..” It didn’t work out. “But what if you do it differently? ..” Another mistake. This is how the name “Trial and Error Method” appeared and the belief that the desire to uncover the secrets of creativity is futile.

Approximately since the mid-40s of the last century, publications about several methods for solving creative problems have appeared in America and Europe at once. They are based on the principle of

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activation of the nomination and enumeration of options. For the first time, it was proved in practice that it is possible - albeit to a limited extent - to control the creative process. Unfortunately, activation methods have saved countless trial and error.

The theory of inventive problem solving is a technology of thinking that has been successfully applied and yields high results.

The theory of inventive problem solving is not concerned with the development of intelligence or the development of creativity .. It teaches activities, the products of which usually indicate that a person has high intelligence and developed creativity.

The theory of inventive problem solving allows you to transfer high-level problematic problems to a lower level, make them less creative , and makes it possible to simplify learning.

The essence of the theory of inventive problem solving is that it fundamentally changes the technology for the production of new technical ideas. Instead of enumerating options, the theory of inventive problem solving offers mental actions based on knowledge of the laws of development of technical systems.

The theory of inventive problem solving is based on three principles.

The principle of objectivity of the laws of development of systems - the structure, functioning and change of generations of systems obey objective laws. From here: strong decisions are decisions that correspond to objective laws, regularities, phenomena, effects.

The principle of contradiction under the influence of external and internal factors, contradictions arise, aggravate and resolve. The problem is difficult because there is a system of contradictions - hidden or obvious. Systems evolve, overcoming contradictions on the basis of objective laws, regularities, phenomena and effects. From here: strong solutions are solutions that overcome contradictions.

The principle of specificity each class of systems, as well as individual representatives within this class, has features that make it easier or more difficult to change a particular system. These features are determined by resources: internal - those on which the system is built, and external - the environment and situation in which the system is located. From here: strong solutions are solutions that take into account the characteristics of specific problem situations.

The main concept of the theory of inventive problem solving is contradiction. When a conflict occurs, there are two ways to resolve it:

1) compromise, reconciliation of opposing requirements, for example, for a certain design;

2) putting forward a qualitatively new idea or a fundamentally new design.

The famous phrase from "Alice in Wonderland": "... in order to stay in place, here you have to run with all your might ....". One of the contradictions of our time is that educators must teach their wards to survive in a world about which educators themselves do not have a clear idea. This contradiction makes us abandon the usual way of instilling in the future generation our own values, behavioral traits and knowledge and move on to the formation of a personality capable of independently acquiring new knowledge and quickly correcting the existing picture of the world in accordance with the newly acquired knowledge.

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It is traditionally believed that the education system should GIVE KNOWLEDGE. Those. what humanity already KNOWS - ready-made definitions, formulas, laws, examples of the application of all this in science, technology, art. All textbooks and the lion's share of methodological literature are devoted to how to LEARN this knowledge, how to put it in the student's head most effectively, how to teach a child to learn, how to GET KNOWLEDGE. A normal, conscientious student simply SHOULD get the impression that humanity already KNOWS everything, everything is already open, everything has found its explanation, everything has been invented ... You just need to LEARN about all this. LEARN what is interesting to a particular person from what is ALREADY KNOWN to mankind. It is even strange that with such an education, we still develop both science and technology, new technologies, new products appear ...

Of course, knowledge is necessary. But if you use the same knowledge all the time, where will development come from? For development, NEW IDEAS are needed, which can be developed and implemented on the basis of known knowledge. New ideas are the product of creative thinking.

Creative thinking is creative, innovative, constructive thinking. A person with such thinking can generate fundamentally new ideas in science, art, technology, etc., can see (and foresee!) problems, and can find effective solutions to problems.

On the other hand, man has already invented and created so many things that there is a threat to the very existence of life on our planet ... Therefore, the development of ecological thinking is very important. Those. systemic, dialectical thinking, able to see the connections and interactions of "everything with everything", to foresee the consequences of these connections and interactions, to see emerging contradictions and be able to resolve them.

How to form such sides of thinking in our students? Traditional transfer of subject knowledge, solving educational problems with **already known** the only answer is not to create such thinking. **The teacher should become the bearer of ways of creative systemic (creative and ecological) thinking** . Gotta give the kids **"food" and tool** for this kind of thinking.

"Food" give modern pedagogical technologies (RO Elkonin - Davydov, technology for the development of critical thinking, heuristic education, problem-based learning, project method, etc.) . These technologies enable children to **to "extract" and comprehend knowledge,** using their own resources (previously acquired knowledge, outlook, intuition), as well as textbooks, reference books, encyclopedias, the Internet, etc. For children, this is a good training for the work of thinking in understanding, comprehending, memorizing new knowledge for them, for orienting in a sea of information. In the process of working with these technologies, children have their own ideas, interesting thoughts, inspiration! (Read the enthusiastic reviews of children - participants in the distance heuristic Olympiads of the Eidos Center !) But without a TOOL (a modern, already existing TOOL), the work of obtaining **own** ideas, in our opinion, is not effective enough. And sometimes it's not available ...

Tool (or rather, a whole set of tools) for creative, systemic thinking, there are: these are various methods for activating creative thinking, including the most developed Theory of Inventive Problem Solving (THEORY OF SOLVING INVENTIONAL PROBLEMS) .

With the help of this tool, you can go further, not only to give knowledge and general EDUCATIONAL skills, but also to bring children to the forefront of science, technology, art, to

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acquaint them with **unresolved** problems, give children the opportunity to try CREATE YOURSELF **fundamentally new knowledge, solve real research and inventive problems** , namely:

- Identify the question, problem to which no answer neither in a textbook, nor in an encyclopedia, nor on the Internet,
- Put forward options for your own hypotheses for solving the problem (the THEORY OF INVENTIONAL PROBLEM SOLVING tools can help with this!)
- Develop methods of proof, experimental testing of the hypothesis.
- Generate new ideas for applying the knowledge gained at school.
- Check the performance of ideas on models, toys.
- To acquaint children with different types of human activity (production, science, art, etc.), with real problems in these areas. With the help of THE THEORY OF SOLVING INVENTIONAL PROBLEMS, generate options for solving these problems.

Not all ideas can be tested at home, not all children will want to work in a creative direction, but to show the POSSIBILITY of such activities, the possibility **games of thought** , inspiration from this process - we can do this!

IN The theory of inventive problem solving is most developed in the following areas:

1. RTV course (development of creative imagination) - a set of techniques and methods for generating fantastic, fabulous ideas;

2. "iron" theory of solving inventive problems - a set of laws, rules, techniques for solving technical inventive problems;

3. TRTL - the theory of the development of a creative personality - a set of "tips" for "designing" a creative life from childhood to old age.

In accordance with these directions, we originally compiled creative assignments for various subjects. For example , **for development creative imagination** :

- Compose a fairy tale from the life of ordinary fractions (or chemical elements, or literary terms, or geographical concepts, etc.) The main thing is that in this fairy tale reflected the properties of these objects. To do this, you must first all the properties, qualities, features of the object (i.e., its **resources**) identify and record. Then apply the "**animation" technique to the object,** conduct **analogies** between the qualities of an object and the qualities of a person, and then to compose a fairy tale.
- Draw the feelings "Admiration", "Sadness", "Joy", "Surprise" using simple geometric bodies (ball, pyramid, cylinder, prism) - integration of drawing and fine arts.
- Come up with a magical wind (integration with natural history), etc.

Inventive tasks revealed in the texts of literary works, in the texts of textbooks on natural history and other natural science subjects:

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Example: How, during a volcanic eruption, "to turn harm into benefit"? (There are in the theory of solving inventive problems is such, one might say, an ideological device.) That is, is it possible to benefit from this terrible and formidable phenomenon of nature? (Natural science, grade 5)

In the course of reasoning, it was established that volcanoes already have the following benefits: the formation of minerals (granite, ores, precious stones). During the eruption of Vesuvius, Pompeii was covered with a thick layer of ash very quickly, therefore, as it were, the life of that time was preserved. It was a terrible tragedy for the inhabitants of Pompeii, but for modern historians and archaeologists this is an invaluable gift. Next, the children figured out how to use the thermal energy of the flowing lava. It is necessary to direct the flow of lava into a natural or specially made recess, laying a coil of pipes along it in advance. Fill the resulting lava lake with refractory insulation from above. Supply water to the coil and heat the village with the resulting steam.

Algorithm for creative study of a phenomenon (object, process, substance):

- **detection** phenomena ,
- detection **resources** phenomena (properties, features), their classification,
- definition **borders** phenomena ,
- detection **connections** phenomena with other objects and processes of the surrounding world,
- formulation **questions** research character ,
- nomination **hypotheses** , designing experiments to prove hypotheses,
- development **models** phenomena ,
- detection opportunities **management** phenomenon ,
- generation of ideas for **application** phenomena,
- **ecological expertise** received ideas ,
- **development** ideas in the scientific, technical and social direction ..

The idea of the algorithm is to combine all stages of research and inventive work in one general lesson on a specific topic (or a series of lessons, or in a student's research work)

Subsequently, it turned out that this algorithm is close to the general scheme of the cognition process. [1] It differs in that the theory of solving inventive problems is more specific, detailed and supplemented with tools for solving research and inventive problems that arise in the course of studying.

Let's explain the steps of the algorithm:

- *detection* phenomena (this can be a topic of the curriculum or some fact, an observation that surprised or interested the student in an event, and so on. That is, at this step it is selected (offered, established) **object of study.** For example: the phenomenon of "wetting" and "not wetting" (physics); the rate of a chemical reaction or the element "chlorine" (chemistry); theme "Air" (the world around); topic "Adjective" (Russian language); the theme "Dishes" (fine art), etc.
- *identification resources* phenomena (properties, qualities, features, capabilities, functions) - i.e. **description** object of study,

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- *identification connections of this phenomenon with other phenomena of the surrounding world, determining the place of this phenomenon in the overall picture of the world.*
- *definition boundariesin* which the phenomenon manifests itself (spatial, temporal, temperature. Dependencies on pressure indicators, vibrations, magnetism, electrical phenomena, etc.)
- *formulation questions related to this phenomenon, i.e. is chosen subject of study, research. For example, why the same liquid one surface wets, and the other does not wet? Why do dust particles dance in the air? Why is chlorine heavier than air?*
- *offering options explanations phenomena (options can be both figurative and scientific). Explanations can be given at different hierarchical levels: at the level of bodies; at the level of substances of which bodies are composed; at the level of the structure of substances (crystalline, molecular), etc. Putting forward hypotheses of answers to questions. Design proofs and experiments on the received hypotheses.*
- *development _ models, theories phenomena, formulating interdependencies, regularities.*
- *identifying* opportunities *management* phenomenon; it is already easy to do, knowing the resources, connections, boundaries of the phenomenon.
- *options applications phenomena (not only remembering already known options, but also generating new ones) - inventive and design activities.*
- *environmental expertise of projects - "Do no harm!", "Check whether your project corresponds (adapted, adapted) to the potential (possibilities) of the natural environment?"*
- *development* ideas to the social and social level: each scientific and technical idea brings something new into the life of society. "See what the consequences of the implementation of the idea will be for your family, friends, school, city, etc." "Consider the consequences of implementing an idea in a single version, in mass use. How will this affect the life of society?

At each stage of the algorithm, it is recommended to use the tools of the theory of inventive problem solving and other methods of activating creative thinking:

- *detection phenomena; (identification of contradictions , ambiguities, questions "why…")*
- *identification resources (functions, properties, qualities, features) phenomena;*
- *connections with other phenomena, determining the place of the phenomenon in the overall picture of the world (system operator)*
- *definition borders*, in which the phenomenon manifests itself; (**number axis method, Su-field analysis**)
- *offering* options *explanations* phenomena (options can be both figurative and scientific) (**analogies, methods of eliminating contradictions, system operator, "reversal" of the problem, laws of system development, funds of physical, chemical, geometric, biological effects, Su-Field analysis , ARIZ)**
- development *models* phenomena; (**analogies, modeling by little people)**

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- possibilities *management* phenomenon; (**resources, system operator, su-field analysis, laws of development of technical systems)**
- options *applications* phenomena . (**method of focal objects, method of garlands of associations, morphological analysis)**
- *ecological expertise, idea development* **(resources, system operator, systems development laws)**

In life, it usually happens like this: some people discover, study and describe phenomena, others explain them, others use them in inventions, fourth people conduct environmental assessments, etc. All this stretches for years ... And we want to compress the whole process into one lesson! Of course, this doesn't happen in real life ... But we wanted to let children experience the most interesting things in scientific and technical creativity - the flight of thought, inspiration from the generation of ideas! This inspiration and gives strength for months and years of research, experimentation, development and testing. And the algorithm allows you to see the perspective and the relationship of different stages of scientific and technical development.

In addition, different types of students' personalities will find a role in such educational work: both theorists and practitioners, and dreamers and critics.

The algorithm turned out to be long, in one lesson there is simply no time to go through all the steps. You can go to a series of lessons, you can master it gradually, you can focus on some steps. It is possible to give different groups parallel tasks according to the algorithm, for example, after frontal work on identifying resources and formulating questions :

- one group solves research problems "for explanation",
- another group generates ideas "for invention".
- the third one determines borders phenomena ,
- and the fourth one clarifies the connection of the phenomenon with the surrounding world and the possibility of controlling the phenomenon.

After the exchange of the received product of educational activity:

- one group can do an environmental review of ideas for applying the phenomenon,
- the other - considers inventive ideas for their development,
- the third - considers the social consequences of the possible implementation of the idea,
- the fourth compares the products obtained with the presentation of the material in the textbook and gives recommendations for supplementing the work of students and supplementing the educational material.

But it is necessary to keep the full text of the algorithm in front of the eyes of all students during the lessons so that everyone feels and understands their place in the general chain of actions. And besides this, there should be handouts on the tables on the techniques and methods necessary at this stage that activate creative thinking.

Expected results of the systematic application of the algorithm:

- promotion competence students ,
- development of interest in research and inventive activities,

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- skills building applications various ways and methods of creative thinking,
- development of creative, systemic, predictive, flexible, critical thinking,
- formation active vital positions .

Analysis and Conclusions .

1. Experimental application **algorithm for creative study of a phenomenon (object, process, substance) -** (hereinafter - the algorithm) showed that the algorithm is quite efficient in different subject areas and for different age categories of students.
2. The algorithm corresponds to the main stages of research and development activities of scientists, inventors, designers and technologists.
3. The algorithm is close to the general scheme of the cognition process. It differs in that the theory of inventive problem solving is more specific , detailed and supplemented with tools for solving research and inventive problems that arise in the course of studying.
4. By studying a phenomenon (object, process, substance) with the help of an algorithm, a systematic thinking develops, a skill is developed to identify problems, unsolved problems. Created unified painting world - mysterious and beautiful !

Using the tools of the theory of inventive problem solving, children successfully put forward hypotheses that explain the mysteries of the world, design experiments to test hypotheses, generate ideas for applying the knowledge gained at school and, thus, develop creative and environmental thinking.

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