The OTSM-TRIZ based system of models for teaching students to organize their thinking

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Abstract
Using OTSM-TRIZ instruments, we have developed a system of models for teaching students to organize their thinking. This system allows them to deal with problems in different fields of knowledge. The system of models includes: 1) the ENV-model (“Element – Name of feature – Value of feature”), 2) the poly-screen scheme, 3) the “Point of View” model, 4) the base models from ARIZ. To teach the system of the models we need the non-linear training technologies, such as “yes-no game”. Besides, we are developing didactic constructors, which will help teachers to create exercises and tasks for children.

There are three general kinds of activities to learn the system of models:

- researching object collections to receive new rules and new typical solutions,
- solving problems to get some positive results,
- producing creative texts.

Keywords: OTSM-TRIZ, education, teaching, a system of models, thinking

Introduction
We must teach students to solve “tomorrow problems” to prepare them for the life in the dynamically changing world, but we cannot do it because we know nothing about the future world and about the problems, which they will deal with (Murashkovska I., Khomenko N., 2001). It is the key contradiction of modern education and a lot of pedagogical researches are devoted to the problem of its resolution.

The general idea is to teach students to deal with any problems from different fields of knowledge. Therefore, students need tools to organize, transform and use their knowledge. Nowadays the role of these tools is changing: they are not only teaching tools, they become an important part of content of education.

With the help of OTSM-TRIZ instruments, we have developed a system of models for teaching students to organize their thinking.

1. The structure of the system and its properties
The system consists of three levels.

The first level includes a very simple variant of “Element – Name of feature – Value of feature (ENV) model” (Khomenko N, 1997, Sidorchuk T., 1998). It is the main tool for dealing with object descriptions and the base for building other models. Using this model we teach students to analyze a particular situation, to construct contradictions and to describe a view of the problem solution. Anymore we can develop abstract thinking with this model.

The second level includes:

- the “Point of view” model (a tool for teaching to estimate the world elements and to notice problems, Sokol A., 2002);
- the poly-screened scheme of talented thinking (the system operator) (Altshuller G., 1984) (a tool for teaching system vision and revealing problems).
Having a base level of ENV-model, we need to describe the situation from different points. It is a necessary condition for realizing and formulating problems. So we teach students “to play different roles” and to analyze how different people perceive the same problem situation. Then they can estimate “pluses” and “minuses” for different persons, and they are ready to solve problems. It is the first step in dealing with “Point of view”.

The second step is reflection, the skill to observe and analyze their own thinking process. To do it students must take different positions in a particular problem situation. The poly-screened scheme is a very important model for educational process, because it allows to teach students to find general features in a problem situation. If we have any problem in any object, we can say, that the structure and the evolution of this object are the general features for analyzing the problem. This statement is true for all subjects, so if students use the poly-screened scheme at different classes they form the world model, which is convenient for problem solving.

The third level includes the base models from ARIZ (the tool complex for teaching to analyze and to solve problems):

- the contradiction model (the abstract model of a problem);
- the IFR (the Ideal final result) and contradiction resolution models (the abstract models of problem solution);
- the resource model.

It is clear that these main tools from ARIZ conclude the whole system and it is wrong practice to learn and to teach them separately. Of course, there are a set of typical tasks, which can be solved with one instrument only. Nevertheless, if we teach to solve problems with that kind of tasks, we risk to grow up students who do not understand what a real problem is at all. Therefore, to teach problem-solving process we use the adaptive algorithm by T. Sidorchuk and N. Khomenko, because it is used to teach ARIZ as a complex technology. It is important, that while using the adaptive algorithm children need the ENV-model to describe the resources and to build the correct contradictions, the “Point of view” model to analyze the situation, to estimate the problem and to reflect the thinking process; the poly-screened scheme to extract the particular problem, to analyze and to exchange the resources.

The system of the models has the following properties:

1. It has the level structure, directed to the revealing, analyzing and solving problems.
2. It is universal. It can be applied to practically any subject (to math and biology, to native and foreign languages, to literature and art). Any abstract model can be concretized for the elements from any field of knowledge.
3. It is adaptive. The models for the creative products construction can be built on the base of this model system.

2. Some methods and instruments for teaching the system of models

To teach the system of the models we need the non-linear training technologies, such as “yes-no game”.

Besides, to teach the base notions connected with these models and to form elementary skills for dealing with them we are developing didactic constructors, which will help teachers to create exercises and tasks for children.

The simplest fragment of this constructor is presented in Table 1.
Table 1
The constructor for creating tasks for dealing with ENV-model (elementary level)

<table>
<thead>
<tr>
<th>Element</th>
<th>Name of feature</th>
<th>Value of feature</th>
<th>Kinds of tasks</th>
<th>Game tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>!</td>
<td>!</td>
<td>Find the element if you know feature names and feature values</td>
<td>A teacher sets a riddle; students guess it (ex.1).</td>
</tr>
<tr>
<td>!</td>
<td>!</td>
<td>?</td>
<td>Describe the element according to a particular plan</td>
<td>A teacher sets an object and a plan for describing it. Students create a riddle about this object using the plan (ex. 2).</td>
</tr>
<tr>
<td>?</td>
<td>!</td>
<td>?</td>
<td>Find the plan of the object description.</td>
<td>A teacher sets an object and its description and asks students to guess “the object passport” (ex. 3).</td>
</tr>
</tbody>
</table>

Example 1
Teacher: “Its color is red, its form is sphere, its size is more than that of a mouse but less than that of your head, its locations are kitchen tables and kitchen-garden. What is it?”
Students: “It is a tomato”.

Example 2
Teacher: “Please make a guess about a tomato according to the plan:
1. Color. 2. Form. 3. Typical location.
Students make guesses.

Example 3
A teacher: “You know than every person has a passport, which concludes information about him on the most important features. If we want to study some element, we need to find its important features, so we can imagine that all kinds of elements in different fields of knowledge have their particular passports. Please, create a passport for a tomato.
Students create “the passport”. The result of this work depends on their age and on the goal with which they study the tomato (at the biology class students reveal the “properties of a living being” as its features, at the art class they reveal color and form of on object, etc.)
Similarly we can construct elementary tasks for the poly-screen scheme (if we hid some screens and show the others), and so on.

There are three general kinds of activities to learn the system of models:
• researching object collections to receive new rules and new typical solutions,
• solving problems to get some positive results,
• producing creative texts.

Conclusion
The system of models is successfully used at experimental polygons in some Russian schools for teaching students to organize their thinking, to deal with information, to analyze and solve problems in different fields of knowledge.
References