Serious changes in the educational system are awaiting us

(An essay on the new function of education and TRIZ-pedagogy).

What to teach?

From the very beginning the main function of pedagogy was to reproduce the society's culture and to hand down the culture to the next generation. Culture is the total of the stereotypes of behaviour, accepted in the society, main scientific and everyday life notions and paradigms, stationary technologies and method of solving problems. The habit of brushing teeth daily, the criminal code, cheese-making technology, Vieta's theorem about the roots of a square equation – all of them are elements of culture.

The main contradiction of modern education connected with that function is the disparity between the high rate of storing knowledge of the humanity and the low rate of storing knowledge of an individual.

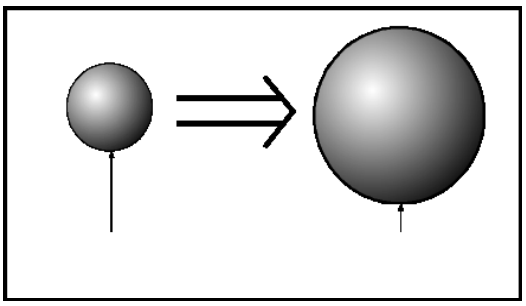
The total volume of the humanity's total knowledge is growing exponentially. But the technology of teaching remains practically unchanged and doesn't provide for proper growth of knowledge. What should we do?

Until now the growth of knowledge was achieved mainly by increasing the time of studying. Modern pedagogy knows also a series of the methods of intensifying the educational process, but they don't solve the whole problem.

There is also a strong (but not developed technologically) idea: to teach firstly not the concrete knowledge but the methods of the fast and efficient mastering of the knowledge (skill of studying). To develop this idea technologically is one of the tasks of modern pedagogy. And a lot of pedagogical inventions must be made in that field

But the content of the 21st century pedagogy will be determined by one more function that grew ripe in the informational boom of the 20th century. Which one? Let's make it clear.

A known physicist Leo Szilard suggested a simple image: let us depict all the humanity's knowledge as a globe. Then all the space outside the globe represents the unknown. The surface of the globe symbolizes the border with the unknown. But the larger the knowledge volume is the larger is the area of the border with the unknown. And every point of that area is a new open problem.



The number of the problems, which the people have to solve has grown sharply. And the responsibility for solving new problems has grown, too. A good solution to the problem means new possibilities. A bad one means new troubles, right up to ecological catastrophes. For the first time in the humanity's history there arose a need in the purposeful and mass (!) training of Solvers.

Let us say: the profession of a Solver is needed. Not simply physicist or engineer, chemist or biologist, psychologist or sociologist, but just Solver. Because the present more and more often knocks us together with complicated problems with many factors, and those problems are much broader than any concrete specialty. Somebody must tie the ends into a single knot; somebody must understand the language and interests of the representatives of different

specialties. And if the creativity itself may be studied and has its laws, somebody must be able to use them.

> Now let us make a digression. Let us imagine that the time machine has already been invented. Let a usual boy of 13 from a secondary school take this machine and go to Pisa University in the 13th century, where the best European mathematicians got together in order to compete in dividing the great numbers. It's a hard job, it needs great experience and intuition, and because the numbers are written in the Roman tradition (Arabic figures have come to Europe much later), and the methods of division simply don't exist – the answer is guessed and checked by the reverse operation… The competition ends with a knockout victory by our boy. Is he a genius? No, but he has got a simple method – division 'in column'.

Maybe, it is a way of resolving the contradiction? We can't make everybody a genius, but we can equip many people with strong methods of solving complicated problems. Can we?

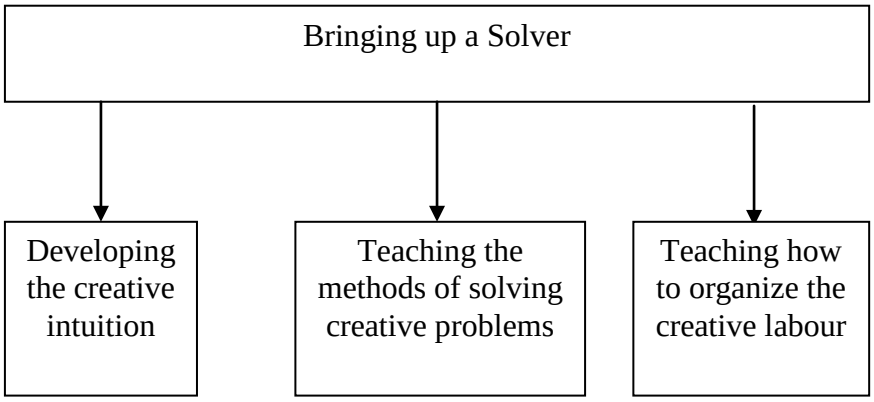
In any case, let us draw the conclusion: to prepare for meeting new problems that have not been met earlier is the second main function of pedagogy; that function arose as a result of the scientific and technical revolution. And that function becomes a chief one.

There remains an intricate question: how to build the educational course, the purpose of which will be the training of strong Solvers. Let us chart the main directions of such a course.

Teaching of a Solver

The purpose is the forming of the temper and thinking of a Solver ready to meet the new problems.

The reaching of the purpose supposes working out the pedagogical system we call now TRIZ-pedagogy. Contents of TRIZ-pedagogy will be determined to a great extent with such directions:



Let us discuss the content of each direction in detail.

1. Developing the creative intuition

It's said, that a famous designer of planes A. Tupolev needed only a glance at a sketch of a plane in order to draw a conclusion whether it would fly.

Developed intuition is the result of a great number of solved problems. The developing of the solver's creative intuition supposes that there must be a wide base of the creative training problems[1] in the educational course.

2. Teaching the methods of solving creative problems

Naturally, TRIZ-pedagogy is based upon the methods developed in the inventive problems solving theory: operators of taking away the stereotypes, methods of resolving the

[1] It may be divided into two parts: problems that don't need any special knowledge and 'subject' ones – problems on physics, chemistry, biology, art and literature… The greatest of the data bases of creative (including inventive and research) problems we know is accumulated in the editions, manuscripts and computer programs on TRIZ.

contradictions, algorithms of solving the creative problems and other solving mechanisms of TRIZ. At the same time TRIZ-pedagogy doesn't neglect other methods[2], using them as auxiliary ones.

Based on the experience of teaching various age groups the methods of creative problem solving, we conclude that the effective mastering of the special methods of inventing activity is based on the strong thinking. The main properties of such thinking are:

- find and mark the regularities in a heap of facts;
- see the features of objects and phenomena that are not given explicitly and the hidden resources for solving the problem;
- build the cause-and-effect resources including the branching ones with a necessary extent of details, master the apparatus of formal logic in the condition of insufficient knowledge;
- mark the main ideas and ask the questions that discover the essence of the matter (to people or to nature – when an experiment is conducted);
- make (generate consciously) hypotheses and build the system of checking experiments;
- operate with contradictions;

3. Teaching how to organize the creative labor

An individual may be a very gifted person but have no time for doing anything in his life. There will be no musician- virtuoso without hard work on the etudes. Fruitful work of a Solver mayn't be imagined without the skill of organizing the labor.

The labor organization includes[3]:

- planning the scientific work;
- skill of working with databases and organizing one's own databases;
- making abstracts;
- mastering the rapid summarizing, skill of 'reducing' the information into the laconic 'supporting signals' (images);
- skills of speed reading;
- planning the working time;
- …

The skills necessary for organizing the collective intellectual work seem to be important as well:

- skill of conducting the scientific discussion and exact argumentation;
- skill of making the report about one's achievements orally and in writing;
- skill of reviewing and editing other student's work;
- …

Conclusions

At the threshold of the third millennium the customary educational technologies that got ripe in the 17th-18th centuries[4] began to 'falter'. We'd like to realize the essence of the changes and not to remain behind the demands of time. Join us!

[2] For example, brainstorming, morphological analysis, Cynectics.
[3] Of course, this list is approximate.
[4] On that topic we recommend the article 'School-Factory is Doomed. What's next?'