TEACHING THINKING

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Abstract

In an age characterized by overspecialization and super-narrow specialization, Genrikh Altshuller suggests the idea that education should focus on the training of "universal professionals". He proposes to achieve this with the help of his Theory of solving inventive problems or Theory of inventive problem solving, or TRIZ in acronym. The science of inventions, TRIZ was initially restricted to the technical field. But Altshuller soon realized that TRIZ can be extended beyond the technical field, so that a general methodology of problem-solving (OTSM) was developed. OTSM can be applied in all fields of life and today TRIZ/OTSM also yields fruitful results in education.

Today, the idea of teaching thinking has fired the imagination of many inventive minds. The personality of Edward de Bono is outstanding among them.

In his science fiction novel *The Third Millennium*, G. Altov (pen-name of Genrikh Saulovich Altshuller) deplores the basic educational goal of our time: specialization. "…Specialization was the key to solving many problems, and we used this key to open door after door, and went ahead, not caring that somewhere behind us doors were slamming shut… This is the era in which scientific methods of professional selection flourish, the era of a narrow and super-narrow specialization."[1] Instead, he suggests "that specialization should be completely replaced with training universal professionals…" In the novel, he describes "a strange school where broad specialists were being trained. The teaching method in this school was also unusual; however, in the novel everything seemed logical and valid enough" (Khomenko & Murashlovska, 2006).

Genrikh Altshuller is also the author of TRIZ, i.e. the *Theory of solving inventive problems* or the *Theory of inventive problem solving*. The science of inventions, TRIZ was initially restricted to the technical field.

Journalist, essayist, and a science fiction writer, and working as a clerk in a patent office, Altshuller set out to discover generic rules that lie beyond inventive, patentable ideas. Imprisonment in a Stalinist gulag did not hinder his research: on the contrary, there he had the opportunity to meet the brightest minds of the time. After his release, Altshuller became the intellectual leader of Russian engineers and other "technically inclined" people. By the 1970s, there was a full-fledged TRIZ movement in the USSR, and its influence was soon felt abroad, too.

By the mid-1970s, Altshuller realized that TRIZ can be extended beyond the technical field and that the time had come for developing "a problem solving methodology that can help everyone, from children to rocket scientists, to solve simple and difficult problems more quickly and with better results" (Sidorchuk & Khomenko, 2006). This lead to the development of a *general methodology of problem-solving* (OTSM), which can be applied in all fields of life. It was Nikolai Khomenko[2], involved in the research and supervised by Altshuller since 1985, who

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took over the task of developing "a more general and universal theory that would allow one to learn how to work with problems regardless of the field in which they emerge" (Nesterenko, 2006: 261). In 1997, Altshuller approved the theoretical basis for OTSM that resulted from Khomenko's research.

Based on classical TRIZ, OTSM develops and supplements it. Its purpose is "to develop instruments for analyzing and solving complex composite problems that are universal and do not depend on a specific field" (Nesterenko, 2006: 261).

"OTSM is dedicated to people who have no engineering background, but want to learn how to solve their private and professional life problems. TRIZ opened the door to understanding how universal tools can be used for solving complex cross disciplinary not typical problem situations. OTSM is a meta-knowledge about how to use specific-domain knowledge to solve problems more easily" (Khomenko, 2006, from personal e-mail).

The OTSM "toolbox" consists of three "blocks": axioms, models and technologies.

1. The **axioms**, i.e. the most general rules of thinking, stipulate among other things that *people think in models* of elements. As the models mirror only fragments of reality, the problem-solver must be able to build models that ensure the most effective thinking process.

2. OTSM has developed two basic **models**. Their function is to allow the user to describe the "problem field" and respectively, the process of problem solving.

a. The **ENV Model**, i.e. Element – the Name of a trait (parameters, features, etc.) – the Value of the trait (parameters, features, etc.) helps one to describe the elements that take part in a problem situation. The model is also basic for describing contradictions.

b. The **Fractal Model of Problem Solving Process** pertains to the thinking process. With OTSM, a problem is broken down into "strokes", i.e. sub-problems, the solving of which provides the user with Partial Conceptual Solutions. The function of each stroke is to contribute to solving the problem as a whole.

3. The role of each OTSM **technology** is to solve one specific type of problems within the overall process of analyzing the problem and constructing an acceptable solution for it.

a. The technology ***New Problem*** says that people often come across "problems" that are completely different from anything they have encountered so far and neither their own previous experience and training, nor that of their peers can help to solve them. The "new problem" technology helps the person to analyze the problem situation and find the contradiction that lies at its roots.

b. The technology ***Typical Solution*** shows that during a lifetime people accumulate lots of "typical solutions", i.e. patterns to be used to solve various problems they encounter. Classical TRIZ is also offering a number of typical solutions, described according to the formula: "IF these conditions and this problem occur, THEN we have to do this …"

c. The technology ***Contradiction*** comes to help problem-solvers when it is not clear which typical solution can be applied. In such cases, the initial problem must be re-analyzed and altered. The *Contradiction* technology helps the user to formulate more clearly the results

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that are expected. With the problem reformulated, it also becomes clear which typical solution can be applied and how the contradiction can be solved.

d. The technology ***Problem Flow*** shows that a complex problem should be broken down into its components. The partial solutions that result allow the user to build an acceptable solution for the problem. The minimal requirement for a solution to be considered "good" is that it should not worsen any of the sub- or super-problems.

Viewed as "an inter-disciplinary language for providing specific knowledge about a problem situation with the purpose of analyzing it and constructing a solution" (Nesterenko, 2006: 263), TRIZ-based OTSM was also embraced by educators. First in the USSR, and later in other countries of the world, there appeared training programs meant to enable people of all specialties (not only those involved in technical studies) to master the technologies of problem solving. At present, the international project *Jonathan Livingston* (to which the TA Project also belongs) caters for the development of various OTSM-education technologies.

As the promoters of TRIZ/OTSM insisted, it is never too early to start developing a child's mind. As a consequence, "many TRIZ-specialists began working with schoolchildren in the mid-80s, and later the age of the trainees dropped to preschool. First long-term (5-10 years) experiments with schoolchildren and preschoolers started yielding interesting results: the children demonstrated interest for studying and reading books, and reacted to problem situations calmer than other kids of their age. This gave inspiration to many new followers of TRIZ-pedagogy to develop training programs for children of different ages." (Khomenko & Murashlovska, 2006)

The purpose of the TRIZ/OTSM-pedagogy is the development of "powerful" systematic thinking by training children (young and older) to *solve problems* by using *contradiction solving techniques*. Not any problems, but difficult, non-standard ones[3]. "A problem is difficult because it contains a contradiction. Solving a difficult problem means resolving the contradiction" (Khomenko & Murashlovska, 2006). To help educators "develop thinking in preschoolers", activity books were published, such as Nikolai Khomenko and Tatiana Sidorchuk's *Thoughtivity for Kids*[4], a book aimed (as the subtitle of the book suggests) at *Developing Creativity, Imagination, Problem Solving and Language in ages 3-8 through TRIZ and other innovation methods.*

Sidorchuk & Khomenko (2006: 53) define thinking as "the highest form of human knowledge, which reflects the immediate reality, by summarizing and mediating it, establishing connections and relationships between objects and phenomena. … Thinking relies upon certain sensory information, but exceeds the limits of this information, penetrating into the very essence of a phenomenon."

The authors also suggest (2006: 53) that the development of thinking is based on four mental operations – analysis, synthesis, comparison and generalization – and that the creative problems (or "open problems") suitable to develop these operations should have three basic characteristics: vagueness of condition, variability of solving methods, and many versions of the final answer.

"Life is filled with contradictions and problems", the authors declare, so that educators need to help their students cope with them. To do so, they must teach their students to:

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- perceive every individual element as belonging to a single structure and, at the same time, to extract the problem element from the whole picture;

- grasp the fundamental stages of development of systems (birth, development, and aging); understand that the end of one system actually represents the beginning of a new system (i.e. evolution);

- find and formulate contradictions in objects and phenomena; use the resources available to resolve the contradictions.

Ultimately, OTSM-TRIZ pedagogy focuses on:

- removing psychological inertia;
- acquiring mechanisms of creative problem solving and resolving contradictions;
- the of development of creative personality.

Today, the influence of OTSM-TRIZ is far-reaching (there are numerous TRIZ organizations and attendance to TRIZ conferences is not only numerous, but also select). Furthermore, the results of OTSM-TRIZ education show that teaching thinking is a worthwhile endeavour.

Obviously, teaching thinking has been in the attention of other scientists and researchers. For those who want still further information concerning the teaching of thinking skills, they should also consult the work of Edward de Bono, who pioneered the concept of "lateral thinking" and who in 1979 co-founded (with Michael Hewitt-Gleeson) the School of Thinking. De Bono views thinking as "a deliberate act rather than a reactive one". To help develop creativity and practical thinking, he has provided a range of "deliberate thinking methods".

Having spent the last 30 years teaching thinking at all levels (from children and individuals to corporations and governments), De Bono has also written 75 books, with translations into 37 languages. A mere list of some of the titles gives us a glimpse into the rich world of de Bono's creation. Educators may find interesting the following titles: *The Use of Lateral Thinking* (1967), which introduces the term "lateral thinking"; *The Five-Day Course in Thinking* (1968); *Lateral Thinking: Creativity Step by Step* (1970); *Practical Thinking* (1971); *Children Solve Problems* (1972); *Teaching Thinking* (1976); *De Bono's Course in Thinking* (1982); *Learn-To-Think: Coursebook and Instructors Manual* (1982), co-authored with Michael Hewitt-Gleeson; *Serious Creativity: Using the Power of Lateral Thinking to Create New Ideas* (1992) – a summation of many of De Bono's ideas on creativity; *Teach Yourself How to Think* (1995); *How to Be More Interesting* (1998); *Thinking in the New Millennium* (1999); *Simplicity* (1999); *How to Have A Beautiful Mind* (2004); *How to Have Creative Ideas* (2007).

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NOTES

[1] Quoted Khomenko & Murashlovska, 2006: 257.

[2] With the kind permission of Nikolai Khomenko, I shall reproduce here from an e-mail he sent me in 2006, in response to my request to illustrate the usefulness of TRIZ/OTSM to the ordinary man.

"I have helped a family of good old friends to overcome a crisis and avoid divorce. My friend had some problem with his wife and decided to divorce her. She loved him a lot and did not want this. She was looking for help everywhere and was trying to force him not to divorce, but all her attempts were returned with the opposite reaction. He insisted and even went to Court. The divorce was pronounced. But she was looking for a chance to get him back. When I discussed with her the situation, even before divorce was pronounced, I proposed her a simple TRIZ tool: the Ideal Final Result. She was clever enough to understand, but it took some time to make her realize what she could do. It all took less than one year: he started the divorce and then came back to his family. Eventually, they married a second time. It was many years ago and their daughter is an adult now. "

[3] A very good example for "powerful" thinking and problem solving skills comes from *The Adventures of Huckleberry Finn*, the episode when Huck and Jim are rafting down the Mississippi and two slave hunters approach them. Huck knows that he must keep the slave hunters off his raft at all cost: at stake is not only Jim's safety, but also his own. He solves the problem by using what I would call "the technique of the contrary": he makes them practically run away by begging them to come; only, he insinuates that there is something terribly wrong with the man on his raft, that he has some very bad catching disease. The situation involves contradictions on both sides: Huck wants to "do his duty to society" and tell the slave hunters that "his man" is black, but his humanitarian feelings prevail; the slave-hunters want to get on the raft and check on the identity of the person there, but concern for personal safety is stronger. The problem is obviously solved to the advantage of the person whose mind is quicker.

[4] The book was translated from Russian into English by Khomenko's daughter, Natalia Khomenko. The very title of the book (the suggestively coined *thoughtivity*) promises that the activities therein are interesting, innovative, and quite different.

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