USING OF TIPS PROGRAMS PACKAGES IN ENGINEERING EDUCATION

B. Busov, A.I. Gasanov, S.M. Kokin, M. Bartlova

ABSTRACT
One of the tasks of higher school is to teach students for creative work. This task equally concerns both to students of natural sciences specialities, and the pupil – "humanities". In this report the main features of the computer programs which purpose is the forming of future engineers creative thinking are discussed. In a basis of these programs lays the theory of the solving of the invention tasks TRIZ. Such programs with success are used for preparation of the future engineers at Technical Universities of the Czech Republic and Russia.

KEYWORDS
Innovation, Creativity, Computer programs, TIPS (TRIZ)

INTRODUCTION

One of the basic tasks of a higher school is to teach students for engineering creative work. Now the appropriate educational courses are in progress in tenth universities of Russia and former republics of the Soviet Union, at Technical University of Brno, Czech Republic. These courses are based on programs developed in USSR and Russian methodology for the search of new technical solutions - the "Theory of Inventive Problem Solving" (Russian abbreviation TRIZ).

The basic postulate of the TRIZ is the rule that all technical systems develop under the objective laws and first of all, - through overcoming of the contradictions in their development. The carried out research works allowed not only to formulate such laws, but also to develop a number of tools for the tasks solution having invention or design character. The basic tools are the Algorithm of Inventive Problem Solving AIPS (in Russian ARIZ), the system of simple and complex manners for overcoming the technical contradictions, special language of modelling of technical systems functioning, information sources of physical, chemical, geometrical effects and phenomena. The set of these tools, as demonstrated by application experience, is very effective for invention and design activity in all fields of technology.

The list of basic engineering subjects confirmed by Ministry of education of Russia has not in the past included the discipline "Methods of engineering creativity" (or courses with other names, but having the same purpose). That is why all the work on the statement of such educational discipline was undertaken by groups of professional developers and teachers united in the International

Association TRIZ. In its frameworks the active development of the educational programs, textbooks and other methodical materials intended for schoolboys, students, and also - young teachers of the TRIZ is propounded.

One of the basic tasks of the subject “Methods of engineering creativity” is exposing future engineers of system to dialectic mentality, allowing them to see objects of designing in a historical development. It is achieved by detailed studying of the laws of technical systems development, by showing the genesis of such development, the place and the role of technique in life both of separate man, and mankind as a whole. It is necessary to teach students´ skills to forecast the consequences of concrete solutions in engineering and economic practice in order to humanise all the process of the designing of new technical systems. The studying of TRIZ tools, which is in complete conformity with studying of the laws of technical systems development, allows the future engineers to acquire knowledge of concrete methods of search for essentially new ideas in invention and design.

TEACHING PROGRAMS PACKAGES

The logic of development of modern information technologies with necessity has resulted in the use of personal computers in organization of educational technologies. The given process, naturally, has touched upon the subject “Methods of engineering creativity”. Already at the end of 80’s in Soviet Union the first development of software the “Invention machine” (IM) for support of invention activity was executed [1]. As an intellectual basis of this project the working tools of the TRIZ were accepted. Justified evaluation of this program’s first versions had shown, that the efficiency sharply raises, if the user is familiar with the theory of the TRIZ. That is why the special program “IM – Teacher” (early 90’s, Minsk, USSR) for supporting the process of training was created.

The software of a series by IM-systems indicated a basis for support of educational process at the subject “Methods of engineering creativity” at Technical Universities of Russia, but this did not happen. The main reason consisted in that the creation of the first versions by IM had coincided with the beginning of the deep crisis in economy of the Soviet Union connected to sharp change of structure of the economic relations and the disorder of state political system, existing at that moment. The development price, which the developers by IM-systems adhered to, the mentioned software appeared inaccessible to the majority of higher educational in Russia. In their turn developers of IM-systems further were forced to direct their efforts towards the western market. It led to abandonment of the creation of the Russian versions of the programs and this step, unfortunately, created an additional barrier to further applications of new IM-systems product in the Russian market.

Moreover, the modern versions of IM-system are focused on its use by users just like the ordinary tool and do not foresee deep study of the TRIZ. Higher education should provide not only formal study of separate tools of designing, it must also develop the special engineering outlook, style of thinking which allows engineers easy movement between decision of today's tasks to urgent tasks of tomorrow's day. Such tradition of higher education is based on deep study of the theory of a question in each concrete discipline. Therefore the same methodical requirements should be applied to software intended to support the educational process. The changing situation has

induced the teachers of various universities in Russia to begin independent developments in the field of training TRIZ programs creation. Among others it is possible to mention the program of invention activity support “Idea Finder” by A.A. Baryshnikov, program the “Machine of discoveries” by V.V. Mitrofanov and a number of others. It is necessary to notice that such programs are usually created without financial support, only on the enthusiasm of their originators. It has led to the situation that not all kinds of software, developed up to the present time, are executed at one professional level, though each of them can carry out the functions, which were planned by their authors.

The analysis of available programming products at sphere of invention activity shows, that the existing software intended for students of various age groups, can be classified as follows:

- The programs, in which the *separate tools* of the TRIZ (as an example we can mention a series of the programs created at the Chuvash State University by V.A.Mikhaylov; these programs realise micro algorithm of the application of typical manners for technical contradictions overcoming).
- Programs using set *of tools* (typical manners, standard models, funds of physical, chemical, geometrical and biological effects), and also – a number of the simplest fragments of such sets. An example is created under a guidance of I.L.Vikentyev and I.K. Kaykov (St.-Petersburg) the program “ DEBUT”, which is intended, basically, to work with the schoolboys. While solving an educational task this program gives an opportunity to use one or two prompt assisting, to get admission some theoretical materials and specially picked up technical information. At the end of the decision the user can verify his answer with control variant. Our experience permits us to say that the “DEBUT” with success can be used not only at schools but even at technical university while reading short acquaint courses of the TRIZ for the first-year students.

The programs of third type give the student and the teacher *a number of additional possibilities*. Such programs maintain detailed textbook on the TRIZ, complete TRIZ tooling (including detailed set of examples of their use), the collection of tasks for the decision both during lessons (under the guidance of the teacher), and during homework the advanced system “help”. Systems give the student convenient interface similar to interfaces of Windows (including an access to global networks, Internet).

The main feature of them is the next:

- These systems must be “open”,
- They must give the teacher the easy opportunity to bring changes and additions into separate blocks of the program.

Now each teacher can bring his own correctives into the theoretical material, form electronic fund of tasks that are similar to those the students will meet at their future professional activity. The solution of the problem of such programs creation become simpler with the occurrence of languages of visual programming such as VISUAL BASIC, DELPHI, etc.

The first variant of similar program (TRIVIUM) written on DELPHI was created at the MIIT, now the work on its perfection is carried out. The basis of this program forms the obvious fact that all invention tasks arising at practice are characterised by different levels of difficulty, and it is not known in advance how difficult each task will be. That is why we believe that every invention task solution must be carried out stage by stage. In the beginning we must try to apply the simplest methods (including non-algorithmic), the next step must be done only in the case if we cannot find the "strong" decision at the given stage. Each step means including to process of the decision more and of more "powerful" tools of the TRIZ, its information funds. In essence, the program is constructed on consecutive use of different variants of the ARIZ. At first stage "works" ARIZ-64 (stage of the preliminary analysis, following behind attempt of non-algorithmic technique use), then (at a stage of the profound analysis) the funds of manners, TRIZ-standards, funds of physical, chemical and geometrical effects could be enlisted into the solution. Only after that, if it is required, we must analyse the task on the ARIZ-85B. The examples of use of the similar approach for the invention tasks solution are given, for example in [2].

The program " TRIVIUM " includes the following mainframes:

- The standard block, allowing the setting up of a new task or a store of old solutions, based on previous solutions indicating the protocol for the solutions of a task;
- The textbook containing a complete statement of the basic principles of the TRIZ;
- The block with a set of tasks for training;
- The system of ARIZ (preliminary analysis profound analysis, complete analysis on the TRIZ-85B);
- Information funds including the description of manners for technical contradictions overcoming and the table of their choice, the system of TRIZ-standards and also fund of physical, chemical and geometrical effects and phenomena;
- The "help" information for the user;
- The block of examples of invention tasks decision and control answers of tasks for training.

With the help of information system, cross references and inner relation between blocks there is an opportunity to call separate fragments of TRIZ information (separate section of the textbook or materials from information funds) to the screen at any moment of invention task solution. It is clear, that the specificity of educational process imposes the features on a set of standard operations, which should be supported by the program of such type, whether it be program "TRIVIUM " or "IM – Teacher". For example the solution of each next task begins with opening of the block "tasks for training" (by the activation of the appropriate item of the main menu), or from input of new task terms with the help of the keyboard. Then with the help of main menu the student or the teacher chooses TRIZ tools for the invention task solution. After recording in special "window" the formulation of the answer on each next question of the program the system transfers the text of the answer in main "window", in which general protocol of task solution is formed. The next step of algorithm means the opening of a new "window" for the next formulation and so on. If the user has doubt in correctness of the formulation of the next step, he has an opportunity to include the additional help-information, having pressed on the button "Help".

SUMMARY

The experience of our work with training programs at the Moscow State Railway University (Russia) and at Brno University of Technology (Czech Republic) has shown, that the students quickly adopt these programs with high efficiency in the inventive problem solving, (not only training). So, there are examples of helpful use of training programs not only learning with the discipline “Methods of engineering creativity”, but also at course tasks and graduation work of designing. In any case, this training allows students not only to look deeper into the basis of the TRIZ, but also prepares a good ground for their perception of the specialized software products, focused on support of invention activity, for example, as IM (the “Invention machine)”.

Acknowledgement: This work was supported by Project Contact ME 400349 and by GACR Project 102/00/1586..

REFERENCES

1. Tsurikov V.M.:The project “Invention machine” .Journal TRIZ. - 1991. - V. 2, N 1. - P. 17 - 34.
2 A.I. Gasanov, B.M. Gohman, A.P. Efimochkin, S.M. Kokin, A.G. Sopelniak. M.: The Birth of the Invention ,INTERPRAX, 1995.

B. Busov
Brno University of Technology, FEECS,
Dept. of Power El. Engineering and Electronics
Technicka 8, 616 00 Brno
Czech Republic

busov@uvee.fee.vutbr.cz

A.I. Gasanov, S.M. Kokin
Moscow State Railway University
Obraztsova str. 15, 101475 Moscow
Russia

Gasanov@orc.ru

M. Bartlova
Brno University of Technology, FEECS,
Dept. of Physics
Technicka 8, 616 00 Brno
Czech Republic

bartlova@dphys.fee.vutbr.cz