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PECULIARITIES OF PROGRAMMATIC AND METHODICAL COMPLEX "TERRA MATHEMATICA"

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Issues of creating, spreading, implementing and supporting of programmatic and methodical complex TerraMathematica are studied in this article. Architecture, methodical materials and peculiarities of the product are revealed. Structure, architecture, functionality and aim of the supporting web site of the software product are examined with peculiarities of its use. Product importance is investigated in the process of pupils' extracurricular study of mathematics, special features of independent pupils' work with educational materials and modules of the complex. Advantages of the software product using by the pupils for parents are shown.

Keywords: *education software, mathematics software, distance learning, MathEditor, Solver*

Education of the 21st century is an education for the human. Developmental and culture making dominant is its deep stream; forming of reliable personality, capable of self-education and self-development, able to think critically and process different information, use obtained knowledge and skills to solve problems creatively, seeks to change his or her life and the whole country life for the better is the main aim of education. 21st century is the time of conversion to highly technological informational society, where the quality of humans' potential, level of erudition and culture of the entire population acquires decisive significance for economical and social growth of the country. Integration and globalization of social, economical and cultural processes, taking place in the world, prospective of Ukrainian state development during the next two decades require deep update of education system and condition its leading character [1].

Today there is no doubt that informational and communicational technologies (ICT) can significantly increase the level of teachers' and pupils' work efficiency and transform teacher-dominating educational processes into personality oriented education, increasing pupils' progress in studies, creativity possibilities and independent thinking skills. World informatization process can fundamentally change educational schooling system, allocating a teacher the role of guide to the knowledge. There is a need to remember, that education informatization consists of three equally important components. They are: using of technical equipment (computers, multimedia centers, and informational servers) during education process, using of specially developed pedagogical software, and methodical materials. Therefore equipping of comprehensive schools with computer hardware should be top priority task, as sufficient level of equipment is a basis for IT use in education. At the same time teacher of a comprehensive school may not be ready to take place of a co-creator in the process of new knowledge receiving, because traditional doctrine of comprehensive school has been based on the role of a teacher as a source of knowledge for centuries. Modern methodical and didactic works made possible the use of the newest ICT in the educational system of comprehensive schools.

Integration of modern informational achievements into the system of education of comprehensive schooling opens unlimited pedagogical capabilities for a teacher, permitting to fully detect the pupils' talents and develop them. Due to the ICT use there appears the possibility to diversify educational process, favouring forming the independent thinking skills of the pupils of comprehensive schools. Using informational computer environment in the process of education is one of identifying features of education informatization, requiring specially developed pedagogical software. Pedagogical software (PS) is software, used in the computerized educational systems as a means of pupils' and students' teaching and educating. Accordingly, there is a number of requirements assigned to the PS, and the most important ones are: compliance with curriculum on

the subject, approved by the Ministry of Science and Education of Ukraine, availability of methodical recommendations on PS using for leading different types of lessons and independent user's work, and division of PS teaching material on sections and modules, corresponding to certain topics of the curriculum. There should be a possibility to consider basic theoretical principles, use them in practice, fulfill check and self-check within the module. In accordance with these requirements, we developed programmatic and methodical complex (PMC) Terra Mathematica, designed to teach mathematics to the pupils of the 7th forms.

«Terra Mathematica» received into itself all the achievements of software products «Term 7-9», «Algebra 7», «Library of electronic visuals», developed by the RIIT of KSU under the direction of M.S. Lvov. Programmatic and methodical complex Terra Mathematica is integral multicomponent system, which main aim is supporting of a process of mathematical problem solving. This process is a sequence of steps, while performing each of them pupil implements certain transformation of mathematical object – a mathematical problem model. Thus, the main programmatic module of PMC is the special module – Task Solving Environment (TSE). The pupil can choose one of the types of the tasks and input the statement of a problem, using mathematical editor. After having input the statement of a problem, user chooses one of the modes of solving: automatic mode, mode of checking every step of solving, or mixed mode. When solving the task in automatic mode, user chooses the mathematical transformation he or she wants to implement out of the Reference Book, and a computer implements this transformation. In the mode of checking every step of solving user implements a step of the problem solving by himself (herself) and a computer checks correctness of this step implementation.

A user implements the process of task solving with a help of Reference Book and Mathematical Editor. Pupils gradually master the methods of work in the TSE, mathematical symbolism; get skills of work in the TSE, in particular, skills of work in the Mathematical Editor and use of Reference Book.

Programmatic module Task Book is designed to store task that can be solved by a user in the TSE or with the use of programmatic modules Graphics and Solver, so-called "mathematical tools". It's enough to press the button Solve to start solving. As well as a teaching aid, Task Book is structured on the chapters and paragraphs, according to the contents. Each paragraph contains a list of algebraic tasks. Authors of the Task Book have chosen tasks out of the various sources orienting on the curriculum of algebra of the 7th forms of comprehensive schools. Thus the majority of tasks are the ones to be solved at the lessons of algebra at the 7th form. The only exception for the 7th form is a paragraph containing tasks on solving the systems three linear equations with three variables, and several text tasks of advanced level on mathematical models compiling. Besides tasks offered to be solved at home, Task Book contains tasks of theme attestations. Every theme attestation is offered in 6 approximately equal variants of tests by the level of their complexity.

A peculiarity of Task Book is in the fact that all text tasks, e.g. tasks on mathematical models compiling and solving are supported with rich content. Computer checks the correctness of the mathematical model (linear equation or a system of linear or algebraic equations), made up by a pupil. If a pupil can't compile the model by himself, a computer can offer its variant.

Solved tasks are stored in the user's Copy Book, though Copy Book can contain both of tasks, already solved by a user or the ones he has began to solve and hasn't finished yet. Any task, being solved by a pupil in the TSE, can be saved in the Copy Book and a pupil can continue solving of it during the next session (Work of users in the system is personified; thereafter every user has several own Copy Books). All tasks solved by a pupil in the TSE are kept in Copy Books.

Training Aid is important module of the system. Theoretical material, agreed to the curriculum of mathematics learning by the pupils of the 7th forms of comprehensive schools, approved by the Ministry of Science and Education of Ukraine, is represented in the Training Aid. Programmatic module Training Aid (hereinafter – Aid) is electronic teaching aid by its essence, which offers teaching material to a user (pupil or teacher). This teaching material is structured in accordance with training course theme plan (theme, paragraph). This material is represented in the

hypertext form, with the use of modern facilities of knowledge presenting. Each paragraph of the theoretical material of the Training Aid is expected to be finished during one session or user's work. Every paragraph has its unique number. In addition to theoretical material, paragraphs of the Training Aid contain the system of task solving case studies. There are buttons Exercises with buttons Check Yourself, which perform contextual activation of the programmatic module Exercises, embedded in the end of every paragraph. It's recommended to use other training aids, both paper and electronic ones together with the Training Aid.

Programmatic module Exercises is designed to perform self-check of the pupils' knowledge and obtain calculating skills and algebraic transformation using skills in the process of simple tasks solving on the certain theme. The self-checking system, realized in this programmatic module, provides a user with a possibility to get basic skills in mathematical problems solving on certain teaching material. Every exercise contains three tasks of the same type. The next method is offered to solve the exercise: pupil has to solve the task orally or with a help of the draft, and then enter the result into the answer field. The correctness of the answers is checked by the system for all three tasks at once. The signal of red colour means that the answer is incorrect. In this case a pupil has to find a mistake and correct it. Yellow colour means that the answer can be simplified. Thus, if a pupil can't enter correct final answer immediately, he can give interim answer. Then the signal of yellow color would mean that a pupil is on the right track. Each type of self-checking tasks contains from ten to twelve tasks, out of which any three are randomly selected. Exercise solution can be repeated with other tasks (Exercises-Repeat). There is a need to mention, that a pupil's work on these tasks isn't graded by a computer, and a pupil's work can be graded by him or by a teacher.

Programmatic module *Solver* is designed to solve typical tasks, studied within algebra course in the 7th forms of comprehensive schools. From the point of view of the functionality this module is a module of computer algebra. There is a need to remark, that it's possible to solve much more complicated tasks (from the viewpoint of calculations) than the tasks, studied in the above-mentioned forms of comprehensive schools. The answer, or the calculations result is a result of each task solving. However, the circle of tasks to solve with a help of the Solver is smaller than the one in the Task Solving Environment. Despite the fact that this module isn't directly used in the process of tasks solving in the PMC Terra Mathematica, it can be used as a calculator in the process of studying of other disciplines (for instance, physics), or as a mathematical problems solver, appearing on practice. There is a need to admit that programmatic module Solver can be used in the process of independent work of pupils with PMC when difficulties appear during solving new case study.

Programmatic module Graphics is designed to solve the tasks graphically. The principal task of this type is solving of the system of two linear equations with unknown quantities. In this version user is able to solve other tasks as well. A good example is a task of calculating a straight line equation, when the line is drawn through two given points. The main peculiarity of the version for the 7th form is a realization of only two geometrical objects: straight lines and points in Cartesian coordinate system. Thus, there is a possibility to solve geometrical construction problems with a help of the ruler in this module. One more peculiarity is a possibility to use the paradigm of analytic geometry of points and straight lines in the Cartesian coordinate system. It gives a possibility to solve proper problems, using geometrical language. Thus, module Graphics has big enough didactic possibilities of using it in the 7th form. Wider possibilities of this module using are opened in the 8th and 9th forms. Full list of accessible objects to build is represented in the user manual. There is a need to make a remark, that the action "build ax+by=c straight line" is transformed into the building of linear function y=kx+b.

Programmatic module Reference Book plays very important role in the PMC «Terra Mathematica». It contains all transformations that can be used in the TSE while solving the task in the automatic mode. Each transformation is realized in the view of the reference, containing necessary information. In particular, each algebraic transformation is represented by the formula or several formulas, transformation name, mathematical comment needed and the reference How To, containing directions on performing certain action. So, there are rational numbers used in the course

of 7th form algebra, written as vulgar fractions or mixed fractions, and as decimal or periodical numbers. Certainly, a user must have a possibility to proceed from one form of the number to the other in the process of problem solving. Therefore references are realized in the Reference Book about writing numbers in different forms. When preparing to the lesson, a user (pupil or teacher) has a possibility to open the chapter Numbers from the main page of the full Reference Book, find paragraph named Forms of Writing Numbers and read three references, obtaining knowledge on all possible forms of writing numbers, offered by the PMC Terra Mathematica to a user. Full contents of the Reference Book are given in the electronic document "PMC Terra Mathematica user manual".

There is a need to admit that groups of transformations, represented in the certain reference, are especially important on the present grade level from the methodical point of view. They represent the teaching material, studied now. The Reference Book is designed in a special way for a user to select and "enable" needed transformations with a help of the certain interface element, named switcher.

Finally, the last chapter of the Reference Book represents answer key. From the methodical point of view, the fact is that answer and formula must be followed by logical conclusion. For example, linear equation solving has to be analyzed on the amount of answers. Such equation can have single answer or set of answers, or it can have no answers. The Referene Book provides a user with a possibility to make this conclusion. Some tasks are not typical in the conception of PMC Terra Mathematica. This means that there is no necessity to make logical conclusion, there is a need only to inform a computer about completing the work.

Wide spreading of the software needs some mechanisms of update and users support. There were three modules added to "Terra Mathematica" with this aim: update module, feedback module, news module.

Update module checks availability of new versions of programmatic modules and new arrivals in the tasks and exercises libraries. If the new versions are available, the program is automatically updated to the last version, available on the server.

Feedback module is designed to create a contact between users and developers. Functionality of this module provides a user with a possibility to address developers with gratitude, problem or error report.

News module is designed to connect developers and users. Functionality of the module provides for informing users of updates, new versions release, product improvement, new features.

Developers' sever provides a possibility of afore-cited modules for functioning and includes articles, news, users' questions, developers' answers, etc, as well.

Programmatic and methodical complex "Terra Mathematica" has initiated a new line of pedagogical software, concentrating on independent work of pupils with the software product at home, with a help of their parents. Today the programmatic and methodical complex is on the phase of improvement and implementation. Now pedagogical experiments are held with the aim to study the level of efficiency of using the programmatic and methodical complex. Their detailed results will be published later.

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