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PEDAGOGICAL SOFTWARE FOR PHYSICS: CLASSIFICATION, ANALYSIS, CREATION TOOLS

The article is devoted to the classification, analysis and creation tools of pedagogical software for physics. There is a concept of pedagogical software in the article and its value in the educational process is determined. Classifications of pedagogical software are also considered in the article.

The article analyses pedagogical software tools for the study of physics in upper-grade secondary schools. It is shown that computer models allow pupils to demonstrate in more detail the essence of physical laws, phenomena and processes.

The authors point out that there are few pedagogical software tools for physics and they analyse their in the article.

The presented pedagogical software provide an opportunity to effectively conduct lessons, minimize the time of preparation for them, enhance the emotional level of the educational process, and provide teaching of physics at school at the level of modern requirements.

Tools for creating educational materials for teachers who know computer technologies are presented in the article.

Key words: pedagogical software, physics, analysis, classification, creation tools, educational process, computer technologies, teaching of physics.

Pedagogical software tools (PST) are software packages, which are designed to solve different training tasks and a program documentation that determines the order of application of software. Different types of PST can be used in the learning process. They differ in program realization, goals and methods of application in the educational process.

The concept of a pedagogical software tool has been widely used since 1986 when the course in computer science has appeared in the educational process in secondary schools.

The first PST were considered as software and information systems, which consisted of computer programs that implemented the scenarios of learning activities, and in some way help to prepare for basic knowledge.

The modern PST is an electronic multimedia tutorial that contains audio-visual materials and auxiliary texts with a set of different learning tools (visibility, model of mechanisms, instructional and technological material, control and self-control cards of knowledge, skills and abilities, etc.).

Let's note that PST is not just a translation of the print edition into an electronic version. They are not intended to replace the usual textbook, but are intended to reinforce traditional teaching methods, since they have a number of advantages in the didactic plan, namely: they are more understandable and interesting to contemporary youth; contain the necessary quantity of illustrative materials of the proper quality (drawings, graphics, maps, diagrams, photographs, video fragments, audio support, animation, etc.), which significantly increases the level of mastering the educational material; provide for modular information provision with the possibility of its further expansion and changes in the structure of the content of vocational training; provide an opportunity for objective control of knowledge and prompt correction of the learning process; implement interactivity, dialogue, continuity, etc.; give an opportunity to implement an individual approach and organize an independent work.

So, on the one hand, PST are the software packages for use in learning different subjects. On the other hand, they are a didactic tools for various purposes of learning: the formation of knowledge, skills and abilities, control over the quality of their learning, so they are components of the learning process.

The purpose of the use of PST is:

- figurative and dynamic presentation of educational information, its systematization, constant and prompt recovery;
- development and consolidation of different skills and abilities;
- control over the acquisition of knowledge [1].

The use of a computer as a means of training puts forward the task of developing a scientifically sound typology of programs both at the level of didactics and at the level of private methods, taking into account the specifics of each subject.

There are many different approaches to the classification of PST, but there is no single opinion about general classification, as noted by most authors [2-5].

There is interesting classification, which is based on differences in approaches to drawing up programs. According to this classification there are linear, branched, generative programs, modelling and simulation programs, games, problem solving programs, free-choice programs, and dialog systems.

1. Linear programs are based on the idea of linear programming by American psychologist B. Skinner. Their main advantages are step-by-step delivery of material, operational support (the issuance of answers at each stage), individualization of study (each student can perform tasks at a rate that corresponds to his individual peculiarities and capabilities).

2. Branched programs are based on the idea of the principle of branched programming of American psychologist N. Crowder. They have different explanations for the solution options. In the history of programmed learning, the creation of branched programs has been a step forward compared with linear, although the student does not construct an answer in them, but make a choice from the set of proposed ones. The main differences between this program and the linear one are: the author of the program does not proceed from the fact that the student's answer must necessarily be correct; the student receives a comment on his answer and either adjusts his work or moves further in a certain sequence.

3. Generative programs. They give an opportunity to solve the proposed problem or task independently and only then ask the computer to answer the correctness of their solution.

4. The program of the mathematical model of learning – in essence, the creation of a formalized model of educational activity.

5. Simulation and simulation programs – simulating the simulation phenomenon.

6. Games. Computer games, unlike the usual, are based on the use of audio and visual effects and allow the player to exhibit various abilities.

7. Program of free choice. The students have the opportunity to choose programs from the central computer's bank, to make requests for information of interest to them. Communication with the central data bank is carried out within the local network or using the Internet.

8. Dialogue system. The complexity and variety of interaction with the computer depend on the programming language, the capabilities of the programmer, his competence in the subject.

The use of PST in the educational process contributes to increasing its effectiveness, substantially affects on the content, forms, methods and means of study.

Pedagogical software envisages various forms of organization of work: collective, group, individual, which allows teachers to plan classes with maximum consideration of individual characteristics of students.

PST may be as for teachers also for students.

A significant number of PST has already been developed today. Their use allows to solve with a computer a wide range of tasks of different levels of complexity from all disciplines. Among other PST for physics are interesting.

At present, for the senior school, such PST for physics are developed:

− Virtual Physical Laboratory 10-11 classes.
− Physics by 200 points.
− PST «Physics, 10 class».
− PST «Physics, 11 class».
− Library of electronic visual aids. Physics, 10-11 classes.

Electronic study manuals «Physics, 10 class», «Physics, 11 class», «Library of electronic visual aids. Physics, 10-11 classes» and «Virtual Physical Laboratory. 10-11 classes» were created by Kvazar-Micro corporation with the participation of collectives of authors, which included scientists, methodologists and teachers of physics of general education institutions.

PST «Physics by 200 points» was created by the company «Soroka Biloboka™».

PST «Virtual Physical Laboratory. 10-11 classes» (*image № 1*) contains laboratory works and laboratory practical's. In each work there are instruction, video accompanying the experiment, the necessary didactic materials and control questions for self-checking and fixing the topic.

Image № 1. *PST «Virtual Physical Laboratory. 10-11 classes»*

Description. PST contains such laboratory works for 10 class:

1. Experimental confirmation of the law of Boyle-Mariotte.
2. Measuring of relative humidity of air by the dew point.
3. Determination of the elastic modulus of rubber.
4. Determination of resistance of conductor.
5. Consistent and a parallel connection of conductors.
6. Measurement of electromotive force and internal resistance of the current source.
7. Observation of the effect of the magnetic field on the current.
8. Determination of electron charge.

Laboratory practical's contain:

1. Investigation of the relationship between pressure, volume and temperature of gas.
2. Observation of the Brownian motion.
3. Determination of the coefficient of surface tension of water by the method of tearing off the loop.
4. Determination of the coefficient of linear expansion of the solid.
5. Measurement of the relative humidity of air.
6. Measurement of power capacitor.
7. Investigation of dependence of resistance of metals on temperature.
8. Investigation of the dependence of semiconductor resistance on temperature.
9. Obtaining the voltage-ampere characteristic of the semiconductor diode.

10. Studying the transistor.
11. Measurement of the induction of a magnetic field of a permanent magnet.

PST contains such laboratory works for 11 class:

1. Study of the phenomenon of electromagnetic induction.
2. Determination of acceleration of free fall by means of pendulum.
3. Determination of refractive index of glass.
4. Observation of interference and diffraction of light.
5. Determination of the length of the light wave using a diffraction grating.
6. Observation of solid and linear spectra.
7. Study the tracks of charged particles by ready-made photographs.

Physical Practice:

1. Definition inductance coil.
2. Research of electromagnetic oscillations using an oscilloscope.
3. Study of resonance in electric vibrational contour.
4. Study of the structure and operation of the transformer.
5. Carrying out of qualitative spectral analysis of a substance.
6. Study of the phenomenon of photoelectric effect.
7. Study of ionizing radiation by means of gas-discharge counter and Wilson chamber.
8. Study of free and forced oscillations.

PST «Physics by 200 points» (*image № 2*) is a simulator in the format of a multimedia disk (ISO). The disk image is mounted on Daemon Tools.

Image № 2. *PST «Physics by 200 points»*

The computer program «Physics by 200 points» allows us to quickly and qualitatively test our knowledge in physics and prepare for external independent evaluation. The tasks cover all sections of school physics and are designed for a high level of student training. A reference book, which is included in the program will help students to recall the basic information they need to know and analyse the mistakes by means of detailed comments on the solution of each task.

The program's settings allow you to turn on hints, re-run tests, and evaluate the performance of the tests. Testing can be done on topics or on test variants that are formed by accident.

It is the possibility in the program to generate the test according to the structure of test of external independent evaluation. After completing the test, you need to fill in the form «А», according to which the program will assess the level of training and count the number of points. A computer program can be used to prepare for external testing, current, final control of students in cabinets where are computers or an interactive whiteboard and for independent work.

In the basis of the development of educational software (ES) for physics «Physics, 10-11 classes» are the possibilities of such information technologies as hypertext technology, computer graphics, multimedia. In addition, the ES contains a constructor of lessons, which allows the teacher to creatively prepare the lesson, to expand the range of pedagogical tools that he uses.

The content and structure of the PST «Physics, 11 class» are focused on solving educational tasks. The textbook is divided into the following rubrics:

– Theoretical classes (lecture lessons).
– Laboratory work (experiments).
– Portraits of scientists with biographical information.
– Subject heading.
– Constructor.

The constructor of lessons is easy to use for a teacher and so the teacher can form arbitrary sets of visual materials depending on the purpose and objectives of the lesson.

The main components of the content part of the PST «Physics, 11 class»:

1. Electromagnetic induction.
2. Garmonic oscillation of the burden on the spring.
3. Electromagnetic oscillations. Alternating current (AC).
4. Electromagnetic waves.
5. Elements of the theory of relativity.
6. Quantum physics.
7. Atomic physics.
8. Physics of the atomic nucleus.

PST «Physics, 10 class» (*image № 3*) contains the following sections (*image № 4*).
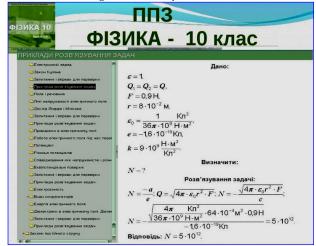

Image № 3. PST «Physics, 10 class»

Image № 4. List of sections of PST «Physics, 10 class»

The main menu of the program contains a list of sections of the manual. To go over to the section's contents, you need to select its title, which is a hyperlink to the start page of the section. An electronic manual contains an information block with text material on physics. Each page of the text is illustrated with graphic images. Each topic has test questions for self-checking. In addition to questions there are tasks to solve for students.

PST «Library of electronic visual aids. Physics, 10-11 classes» (*image № 5*) is for general education institutions. It is oriented on modern forms of education, is compatible with traditional educational materials, fully complies with the documents, which regulate the content of education. PST contains pictures, videos and animation from all topics of the physics course in school. It can to supplement the program-methodical complex «Physics, 10-11 classes» or can be used independently.

Image № 5. PST «Library of electronic visual aids. Physics, 10-11 classes»

It is also possible to use the free program for physics – PST «Live Physics». This is the Russian version of the program of the American company MSC. Working Knowledge). «Live Physics» is an environment in which students can simulate physical processes.

The presented PST provide an opportunity to conduct lessons effectively , minimize the time of preparation for them, to enhance the emotional level of the educational process, and provide teaching of physics at school at the level of modern requirements. Each teacher selects the PST independently.

In addition to the positive moments, PST have certain disadvantages – when student constantly communicating with the screen, he ceases to adequately feel the reality, which is why it is better to use such class of PST in parallel with the real physical experiment.

As a result of the review of the existing PST for physics, which are approved by the Ministry of Education and Science of Ukraine, we can noted that developer must comply with certain requirements that will determine the positive background of the student's communication with the computer. Developers must strictly adhere to a set of requirements for each PST, must to attract not only teachers, methodologists, programmers, but also psychologists and designers to the creation of PST.

Let's call the following technologies for creating PST among the different software tools that can be used by each teacher [5]:

1. Creating educational tools using Microsoft Office PowerPoint;

2. Creating didactic materials by means of Microsoft Office Publisher;

3. Using software SMART Notebook;

4. Using the program of creating lessons Easy School Book.

More detailed description of these technologies we shall refer in the following article.

So, let's summarize.

1. Pedagogical software tool is a holistic didactic system, which is based on the use of computer technologies and Internet resources.

2. According to the program implementation, we can consider computer training programs, expert training systems, computer games, etc. as PST.

3. A significant number of PST has already been developed today. Their use allows to solve with a computer a wide range of tasks of different levels of complexity from all disciplines.

4. The analysis of the PST for physics showed that at present for school there are such PST: «Virtual Physical Laboratory 10-11 classes», «Physics by 200 points», «Physics, 10 class», «Physics, 11 class», «Live Physics».

5. All PST have the advantages (they enable for teacher to construct a lesson by himself, adding to lesson illustrative material that raising the emotional level of the educational process, ensuring the study of physics in the school at the level of modern requirements) and disadvantages (when student constantly communicating with the screen, he ceases to feel reality adequately, he quickly tired, etc.).

6. It should also be noted that there is few number of PST for physics, so every teacher who owns computer technologies can independently create teaching materials for study Physics.

7. Among the technologies for creating a PST, we can mark such simple and popular software: MS PowerPoint, MS Publisher, SMART Notebook, Easy School Book etc.

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ПЕДАГОГІЧНІ ПРОГРАМНІ ЗАСОБИ З ФІЗИКИ: КЛАСИФІКАЦІЯ, АНАЛІЗ, ЗАСОБИ СТВОРЕННЯ

Стаття присвячена класифікації, аналізу та засобам створення педагогічних програмних засобів з фізики. В статті розглянуто поняття педагогічних програмних засобів та їх значення в навчальному процесі.

У статті також розглядаються класифікації педагогічних програмних засобів, аналізуються педагогічні програмні засоби для вивчення фізики у старших класах загальноосвітніх навчальних закладів. Показано, що комп'ютерні моделі дозволяють учням більш детально продемонструвати сутність фізичних законів, явищ та процесів.

Автори зазначають, що на сьогоднішній день розроблено недостатню кількість ППЗ з фізики. Представлені ППЗ надають можливість ефективно проводити уроки, мінімізувати час підготовки до них, підвищити емоційний рівень навчального процесу, забезпечити викладання фізики в школі на рівні сучасних вимог.

Для вчителів, які володіють комп'ютерними технологіями, в статті представлені деякі інструменти створення навчальних матеріалів.

Ключові слова: педагогічний програмний засіб, фізика, аналіз, класифікація, засоби створення, навчальний процес, комп'ютерні технології, викладання фізики.

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ПЕДАГОГИЧЕСКИЕ ПРОГРАММНЫЕ СРЕДСТВА ПО ФИЗИКЕ: КЛАССИФИКАЦИЯ, АНАЛИЗ, СРЕДСТВА СОЗДАНИЯ

Статья посвящена классификации, анализу и средствам создания педагогических программных средств по физике. В статье рассмотрено понятие педагогических программных средств и их значение в учебном процессе.

В статье также рассматриваются классификации педагогических программных средств, анализируются педагогические программные средства для изучения физики в старших классах общеобразовательных учебных заведений. Показано, что компьютерные модели позволяют ученикам более подробно продемонстрировать сущность физических законов, явлений и процессов.

Авторы отмечают, что на сегодняшний день разработано недостаточное количество ППС по физике. Представленные ППС предоставляют возможность эффективно проводить уроки, минимизировать время подготовки к ним, повышать эмоциональный уровень учебного процесса, обеспечивать преподавание физики в школе на уровне современных требований.

Для учителей, которые владеют компьютерными технологиями, в статье представлены некоторые инструменты создания учебных материалов.

Ключевые слова: педагогическое программное средство, физика, анализ, классификация, средства создания, учебный процесс, компьютерные технологии, преподавания физики.