

**Peculiarities of the electronic educational-methodical complex on studying branch of physics called
«Mechanical vibrations and waves»**

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Abstract: Annotation: This article states the aspects of using of curricular-pedagogical means in teaching physics, as well as revealing the content and features of the electronic educational-methodical complex called ‘Virtual laboratory work on mechanical vibration and waves’.

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Use of information and computer technologies in teaching allows expanding the didactic role and arsenal of the teacher, using such technologies of training which promote the development of personal qualities of learners, intensifying educational process, promoting the skills of independent learning and research skills.

We can include the following aspects of using computer technologies in teaching physics:

- demonstration of physical processes and phenomena;
- training and testing the learners;
- using computer technologies to demonstrate projects;
- carrying out the virtual work;
- measurement of units;
- possibility of independent preparation for learners;
- control over learners’ level of knowledge based on differentiated learning method;
- distance learning.

The detailed review of more than 50 sources on computer and information technologies in educational process, in particular, their implementation in teaching physics is summarized in O. Tigaj’s dissertation work [1].

M. Tsoy and others [2] analyzed the process of developing cyberspace in teaching in connection with the use of new information technologies, practical sides of creating electronic textbooks, functioning and tracing the training systems on the basis of the electronic textbook and basics of creating them. These authors described the electronic textbooks developed by them in the field of mathematics that allow improving the quality of teaching.

N. Tajlakova carried out the analysis of using computer and information technologies [3]. The author gives definitions to the following concepts: an electronic course, an electronic manual, an electronic textbook, electronic educational-methodical complex (EEMC).

Electronic educational-methodical complex consists of didactic, curricular-pedagogical means and technical interactive complex. It is also considered as a source of the teaching material prepared on the basis of computer and audio or video technologies. It enables to systematize, store, process or implement learning materials.

They conditionally defined its components, such as annotation, introduction, an operating program, a control system of studying the subject, a manual, a tutorial, tests, a handbook, electronic library of the complex.

Hardware of modern IT technologies includes a modern computer with its units. Software includes specific didactic materials which are called program-pedagogical means (PPM).

In other words, PPMs are a type of software which reflects a field of a subject, technology of its learning and conditions for realization of various kinds of learning activity [4].

The standard didactic requirements to PPMs are as following:

Scientific nature of the content, availability, systematic approach and sequence in teaching physics, visual maintenance and consciousness of learners’ activities, adaptability, an individual approach to teaching physics, development of intellectual potentials in learners and feedback maintenance.

Up to date, there is no accurate classification or topology of Program-Pedagogical Means. However,

judging from sources on the use of modern information technologies in teaching physics, it is possible to put forward the following didactic requirements:

1. Conformity of PPM to standards and training program of the subject;
2. Interactivity of models;
3. Possibility of giving feedback;
4. Conditions for formation of research skills;
5. Unity of training and supervising functions;
6. Differentiation of tasks;
7. Individual approach.

The most outstanding PPMs on physics are [5,6]:

1. 'The Free course of physics 2.5'. It is a fully interactive course of the secondary school physics including the illustrated textbook, interactive teaching models, laboratory work, tests, comprehension questions and tasks.

2. The 'Physics on your PC' program, which is a computer modeling medium with separate modules of experiments.

3. The 'Physics of the living' program, a computer design medium allowing learners to make physical experiments with automatic display of processes on the screen.

4. 'IC: the Tutor. Physics'. It is an electronic book on physics, consisting of a school course of physics, computer animation of the physical phenomena, video files, a set of tests and handbooks.

5. 'The course of physics of the 21st century' is a hypertext physics course book comprising the school program and possessing 210 interactive models.

6. 'Teach Pro the Answer book on the physics' is a detailed explanation of more than 1000 problems on experimental physics with speech comments, dynamic illustrations and a control mode.

7. The Tutor 'Cyril and Mefody' a modern interactive course on elementary physics with multimedia means.

It is also essential to mention the e-book 'Electronic controlling and training textbook on elementary physics for the academic lyceums and professional colleges' developed by O. Tigaj and K.A. Tursunmetov [7].

The textbook contains a complete basic course of physics for vocational educational institutions and renders all sides of educational process, namely: learning and controlling with the possibility of finding errors, self-control and self-correction of cognitive activity, demonstration of visual information, modeling and imitation of a series of physical processes and phenomena, performing a number of laboratory work and experiments in virtual reality. Also, this electronic book is provided with the

software to check knowledge and monitor learners' performance which can be realized by means of a set of tests.

However, present electronic textbooks and other electronic learning materials do not cover all branches of physics 'Mechanical vibrations and waves' according to the State educational standards for special and vocational educational institutions of the Republic of Uzbekistan.

These curricular-pedagogical means are basically designed for an eleven-year education system and therefore differ greatly from the physics curriculum designed for the academic lyceums and professional colleges.

On the other hand, they do not provide enough information on 'Vibrations and waves' which is considered to be one of the most difficult branches of the physics course to learn.

In accordance with this and considering those aspects stated above, we have developed an electronic educational-methodical complex and tested it in learning process in a number of academic lyceums and vocational colleges [8].

The electronic educational-methodical complex 'Virtual laboratory work on mechanical vibrations and waves' consists of following parts:

- a theoretical part on the theory of mechanical vibrations;
- the theory of mathematical pendulum;
- the theory of spring pendulum;
- animation of the movement of mathematical pendulum;
- virtual laboratory work 'Defining the acceleration of gravity by means of mathematical pendulum';
- animation of the movement of spring pendulum;
- methodical instructions for virtual laboratory work;
- virtual work 'Studying spring pendulum' consisting of three exercises:
 - a) Testing elasticity of a spring by means of statistical method;
 - b) Analysis of the relation of cyclic frequency and the period of spring pendulum to the mass of a load;
 - c) Studying vibrations of a spring pendulum from resilience of the spring.
 - studying decreasing vibrations with animation;
 - studying forced vibrations with animation;
 - the theory of mechanical waves and their features;
 - studying mechanical waves with animation;

- methodical instructions for virtual laboratory work ‘Mechanical waves’;
 - virtual work ‘Testing velocity of propagation of mechanical S-waves’;
 - virtual work ‘Testing velocity of propagation of mechanical longitudinal waves’;
 - the notion of sound and its properties;
 - studying the sound with animation;
 - studying stationary waves with animation;
 - methodical instructions for virtual laboratory work ‘Testing wave length and the speed of sound propagation in the air’;
 - virtual laboratory work ‘Testing wave length of a sound’;
 - virtual laboratory work ‘Testing the speed of sound propagation in the air’;
 - tests on each topic;
 - controlling and assessment program for checking the knowledge of learners;
 - electronic library.
- Electronic educational-methodical complex enables learners to do the following:
- acquaintance with the theory of vibrations and waves;
 - studying processes on animation models;
 - acquaintance with the purpose of virtual laboratory work;
 - acquaintance with the theory of each laboratory work;
 - acquaintance with the method of performing laboratory work;
 - acquaintance with the design of laboratory setups and their devices;
 - acquaintance with methodical instructions on laboratory work or demonstration of processes;
 - performing tasks and control of error correction independently;
 - automatic calculation of results and their assessment;
 - presenting the results of experiment in graph or in the form of a table;
 - storing the results of experiments, their analysis and processing;
 - changing language settings of virtual laboratory work (Uzbek or Russian) and background (color) of the screen;
 - checking the degree of learning topics by means of test system with its monitoring;
 - repeated performance of laboratory work or tests in case of obtaining negative results;
 - revision of the units of theoretical part or methodical instructions;
 - contacting the authors of the electronic training methodical complex through e-mail.

It is essential to note that while using electronic educational-methodical complex or doing virtual laboratory work, each learner should give the details: the title of educational institution, number or name of the group, full name of the user.

Thus, the electronic educational-methodical complex with virtual laboratory work on physics branch “Mechanical fluctuations and waves” contains a basic theoretical course which corresponds to the curriculum of the academic lyceums and colleges of the Republic of Uzbekistan. It covers all aspects of educational process, in particular: training and control with the possibility of error correction, self-checking and self-correction of learning activity, demonstration of visual learning materials, modeling and imitation of physical processes, demonstration of experiments and laboratory work in virtual reality.

This electronic complex is an open tutorial which undoubtedly gives a privilege. Flexibility and dynamism, possibility of changing parameters of physical process allows introducing corrections and additions in training process.

A special attention is given to the software for controlling knowledge of learners and an assessing the results of laboratory work. It also attends to the monitoring system which is achieved in order of accuracy of checking results of experiment and by the results of testing.

Approbation of this electronic educational-methodical complex during educational process in a number of academic lyceums and colleges has demonstrated positive results, such as: a substantial progress on subjects, heightened interest in physics and practical training. It has also made it possible to estimate real knowledge of pupils.

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