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USING COMPUTER MODELING AND ANIMATION IN TEACHING PHYSICS

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Abstract: This article discusses the advantages of using computer simulations and animations in teaching physics, their role in the educational process, application methods, and practical recommendations.
Keywords: simulation, animation, virtual laboratory, interactive education, information technology.

In modern education, the use of information technologies is becoming an integral part of the learning process. Since physics is based on complex concepts, abstract models and mathematical formulas, demonstration is of great importance in its explanation. Traditional laboratory experiments do not always give complete results, since expensive equipment, special conditions or safety measures are required to observe some phenomena. In such situations, computer simulations and animations can be an effective solution. The Resolution of the President of our country No. PQ-5032 (19.03.2021) on measures to improve the quality of education in the field of Physics and develop scientific research Today, great attention is paid to improving the quality of teaching physics in educational institutions, introducing modern teaching methods into the educational process, selecting talented students, preparing competitive specialists for the labor market, developing scientific research, innovations, and directing them to practical efficiency. A number of problems that have been solved indicate the need to implement measures based on improving the quality of education and the effectiveness of scientific research in the field of Physics[1].

Computer simulation is a program for modeling real physical processes and displaying their operation on a computer.

Animation is a sequence of images drawn or created using computer graphics to depict the change in physical phenomena over time.

Difference: Simulation is interactive (the student changes the parameters). Animation is used as a ready-made video or moving image.

Simulations and animations clearly illustrate abstract concepts, allow for dangerous experiments to be performed in a safe environment, save time and resources, allow for working without equipment, are interactive, meaning students actively participate, change parameters and see the results, and arouse interest - a source of motivation for students.

Popular simulation and animation programs:

PhET Interactive Simulations – free interactive simulations in all areas of physics. Founded in 2002 by Nobel laureate Carl Wieman, the PhET Interactive Simulations project at the University of Colorado Boulder creates free interactive math and science simulations. PhET simulations are based on extensive educational research and engage students through an intuitive, game-like environment where they learn through hands-on experiences. PhET (Physics Education Technology) is a software developed by the University of Colorado to create interactive simulations in physics, mathematics, chemistry, and other scientific disciplines. With the help of this software, students can put theoretical knowledge into practice and simulate various physics

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and mathematics phenomena. PhET simulations encourage students to be more active and independent in the learning process [4]. They virtually explore various mathematical systems, problems, and issues. PhET provides fun, free, interactive, research-based science and math simulations. Each simulation is extensively tested and evaluated to ensure educational effectiveness. These tests include interviews with students and observation of simulation use in the classroom. The simulations are written in HTML5 and can be run online or downloaded to your computer.

One of the reasons for the ineffective use of interactive whiteboards and interactive panels is that teachers ignore or are unaware of digital resources that are 100% "ready" for their use. These include interactive posters, ribbons, tables, diagrams, and many other resources where the teacher or student actively interacts with the screen. Simulators and training devices constitute a separate category of such resources. In these cases, students can independently practice learning skills, gain new knowledge, and engage in modeling. **Algodoo** – for 2D modeling of mechanical phenomena. Allows modeling of physical phenomena in a digital environment. Visualizing theory and conducting experiments safely is Algodoo's mission in education.

The Algodoo physics simulator has been around for a while now. However, its developers haven't lost interest and are constantly improving their brainchild. In many ways, this simulator surpasses similar projects that appeared much later. However, to my surprise, this amazing tool remains unfamiliar to many teachers, especially the new generation. Therefore, I'm updating my posts dedicated to this remarkable project with a new video review[5].

Algodoo is a free 2D simulation from Algoryx Simulation AB. Released on September 1, 2009, the program is presented as an educational tool and an open-source computer game. Animation tools and advanced engineering tools allow for experimentation, the creation of various mechanisms, and the simulation of situations in various physical environments. The program runs offline, meaning you must download and install it on your computer. This means internet access is not required during the simulation. Essentially, it's a digital “sandbox” for 2D modeling of physical processes. It allows students and teachers to easily create simulated “scenes” and learn physics using a user-friendly and visually appealing interface. With its user-friendly interface, Algodoo occupies a position between computer games and “serious” computer modeling. It's suitable as an entry-level modeling tool for students of all ages and can facilitate discussions about the role of computer modeling in physics.

Crocodile Physics – experiments in electrical circuits, optics and mechanics. Crocodile Physics. The Crocodile Physics software environment is a program that allows you to model physical processes and develop and observe experiments related to the mechanics, electrical circuits, optics and wave phenomena sections of physics. This program allows you to observe physical phenomena, conduct experiments and model processes of varying complexity. It allows you to carry out and observe experiments that are difficult to conduct in terrestrial conditions, calculate the values of physical quantities involved in the experiment with very good accuracy, create graphical relationships between physical quantities involved in a physical phenomenon and other physical quantities, save the created models and print them on paper[6].

In the preparation for the lesson, the teacher selects and tests a simulation appropriate to the topic, in the explanation process - launches the simulation to explain the basic physical laws or formulas. In practical exercises, students independently change the parameters, record and analyze the results. In the preparation for homework, students conduct experiments using online

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simulations and prepare reports, comparison with real experiments - the simulation results are compared with the results obtained in the laboratory.

Computer simulations and animations are modern, safe, and effective tools for teaching physics. They encourage students to deeply understand the subject, develop creative thinking, and engage in independent research. When teachers use these technologies wisely, the lesson process becomes more effective and interesting.

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