# Computer Models as a Means of Teaching Physics in Higher Educational Institutions

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**Abstract.** The article is devoted to the development and application of computer models in a course of laboratory works in physics. The paper contains the results of pedagogical experiment which aim was to develop student's skills to process the result of experiment.

**Keywords:** general physics, computer model, physics practical works, higher educational institution

## 1 Introduction

The problem of using computer models of physical phenomena is relevant in our time. Computer models allow students to observe the course of the physical process and its results while being outside the physical laboratory.

The researchers have substantiated the basic principles and methods of teaching students the modeling of physical phenomena (M.V. Dudyk, S.A. Khazina [1]), the choice of software tools for the creation of computer models of physical phenomena (S.O. Semerikov, I.O. Teplitsky [2]), was developed Computer models of physical phenomena (employees of the University of Colorado Boulder [3]), the requirements for training programs - computer models of physical processes (V.M.Bazurin [4]) have been substantiated, the peculiarities of the development of computer models and their application in teaching (Y. Xu, J. Choi [5], R. Alcarria, B. B. Sanchez, A. Sanchez-Picot, D. Sanchez-de-Rivera [6]).

Our study aims to determine the impact of a virtual laboratory experiment on the formation of research skills of students of non-physical specialties, namely the ability to process the results of an experiment. For this purpose, computer models of such experiments were developed: determination of resistivity of the conductor (OhmLaw), determination of the internal resistance of the current source (IntResistance), capacitor capacitance measurement by means of a ballistic galvanometer (Condensator), determination of conductor resistance using the Wheatstone bridge (WheatstoneBridge), research the laws of electrolysis (Electrolysis), the determination of the heat capacity of the solid (Teplo), the determination of the temperature linear expansion coefficient of the metals (Linear), and others.

In the experimental group there were 22 students, in the control group - 14 students.

The criterion for the development of research skills is the number of correctly performed calculations of the results of a laboratory experiment. Criterion Indicators: 0-4 - low level; 5-8 - middle level; 9-12 - high level.

Hypothesis: conducting a laboratory practice in physics on virtual computer models for students helps to develop the students' ability to perform processing of the results of a physical experiment.

## 2 Main Ideas

A laboratory workshop on physics can be implemented in two main forms: traditional (research on laboratory equipment); virtual (research on computer models).

Research in laboratory conditions has the following disadvantages: the need to have sufficient modern equipment; moral and physical obsolete equipment; high price of equipment; the inability to reproduce certain experiments in real conditions due to their harmfulness [7].

To implement a virtual laboratory experiment requires the availability of computer models of physical phenomena. Computer models need to be developed specially.

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## 3 Description of Materials and Methods

Laboratory Physics Workshop consisted of 12 works. In experimental groups, classes were conducted using developed computer models.

For example, using the OhmLaw program (fig.1), students first determined the resistance of the conductor (by the Ohm’s law). The length and diameter of the conductor were specified by the program. After determining the resistance students at the known values of the length and diameter of the conductor calculated the area of the cross-section, and then - the specific resistance of the conductor. Students entered the results of the experiment in the corresponding text fields of the program, after which the program performed a check of the correctness of the calculations.

In the control group, a laboratory workshop was conducted on laboratory equipment.

For each student, the number of correctly performed calculations was calculated based on the results of the laboratory experiment.

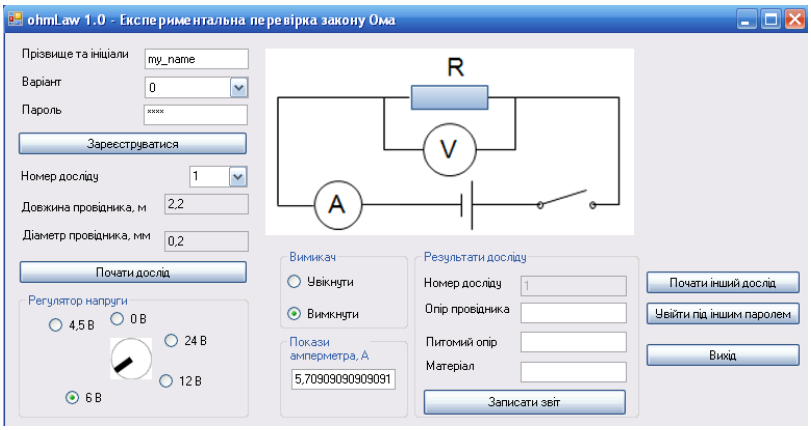


**Fig. 1.**

The results of the experimental study for the experimental and control group were compared using the Whitley Mann criterion.

## 4 Results

The level of formation of the ability to process the results of the experiment for students of control and experimental groups is shown in Fig.2.

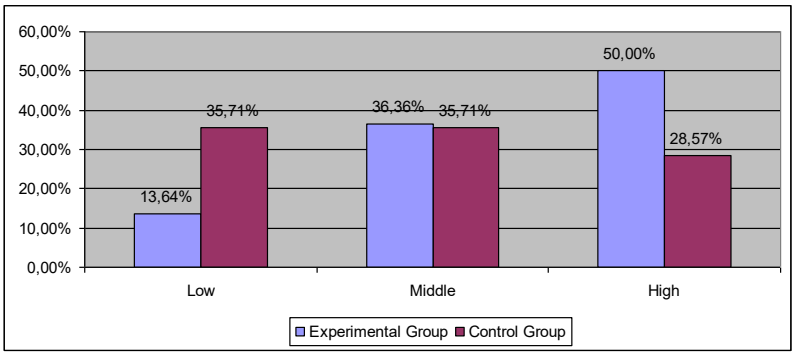


**Fig. 2.**

## 5 Discussion

The obtained data are important for the formation of the students' skills to process the results of the experiment. Subsequently, these skills will be used by students when studying disciplines such as material resistance, technical mechanics, theory of machines and mechanisms, as well as when writing bachelor's and master's theses.

Perspective directions of research are:

- development of web-oriented computer models that store the results of work in the database;
- definition of the optimal type of interface of computer models;
- determination of optimal program structure - computer model;
- construction of a laboratory workshop on computer models as a holistic system, development of software for distance learning and home laboratory experiment.

## 6 Conclusions

1. Laboratory workshop with using computer models of physical processes facilitates the formation of such an important component of research skills among students as the ability to process research results;

2. Development of computer models of physical phenomena has wide prospects for their application in the process of studying physics in higher education institutions.

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