Using of Information and Communication Technologies in the Teaching of the School Course in General Physics

Eshchanov Bakhodir Khudayberganovich, Matyakubov Kamaladin Kuronboyevich

Abstract : This article was written with the aim of to develop a technology for the application of information and communication technologies in the teaching of the school course in general physics. The following problems are considered in the article: study of the development of students' knowledge as an important pedagogical problem based on the study of the subject of general physics using computer technologies and resources. The hypothesis is verified: to use information and communication technologies when teaching physicists in high school, then - the interest of schoolchildren in science will increase, which will improve the quality of education in physics; whether teachers' interest in using information and communication technologies in physics lessons will increase. To achieve the goal of the study, the following tasks were verified: to analyze the state of the problem of using information and communication technologies in the educational process as a whole and in teaching physics in particular; to develop recommendations on the use of information and communication technologies in teaching physics; to offer effective directions for teachers to use ICT - technologies in teaching physics. The methodological basis of the study was the work on the theory, methodology and practice of teaching physics. and preparation of recommendations for their implementation in the educational process. The article analyzes the basic concepts of informatization and computerization of the educational process, develops recommendations and gives conclusions.

Keywords: general physics, multimedia resources, ICT, physics training, informatization, media resources.

1 INTRODUCTION

The development of information and communication technologies, their implementation in the educational sphere, opens up new prospects for increasing the effectiveness of the educational process. Currently, the issue of the effective use of information and communication technologies (ICT) in the educational process in educational institutions and, in particular, in teaching physics is relevant. Modern computer programs and telecommunication technologies provide students with access to such sources of information as electronic textbooks, educational sites, etc. This is designed to increase the effectiveness of the development of cognitive independence and provide new opportunities for the creative growth of students. The use of Internet resources, electronic textbooks, training programs in combination with traditional methods contributes to the successful achievement of the goal - the formation of a thinking person who knows how to use theoretical knowledge in practice, is able to independently obtain knowledge, ready for self-development and self-improvement. The use of information and communication technologies (ICT) in teaching has provided new opportunities for organizing independent work of students. Emphasis from memorizing information is shifted to its search, processing, analysis and presentation.

- *Eshchanov Bakhodir Khudayberganovich is a Professor, Head of Educational Quality Control Department, Chirchik State Pedagogical Institute, Tashkent region, Uzbekistan. Email: b_eshchanov@cspi.uz. He obtained his Higher Educational Degree in Physics & Economical Sciences from The Tashkent State University. He received his DSc degree from National university of Uzbekistan, Uzbekistan, 2018. He has published more 150 scientific works including 4 textbooks, 3 monographs, 70 Journals and 90 papers in both national and international conferences.*
- *Matyakubov Kamaladin Kuronboyevich is a Methodist of Monitoring and Internal Control Sector, Chirchik State Pedagogical Institute, Tashkent region, Uzbekistan. Email: k.matyakubov@cspi.uz. He obtained his Bachelors and Master's Degree in Mechanical Engineering from Tashkent Institute of Textile Industry, 2015. He has published more than 3 journals and papers in both national conferences.*

The ease of use of ICT allows on the one hand to individualize learning, and on the other hand, to make interpersonal communications an important part of the learning process. The use of ICT increases the effectiveness of educational activities by providing greater opportunities for its active forms, providing greater independence for students, and increasing motivation. Thus, the public interest in creating optimal conditions for identifying the makings and maximizing the abilities of all children leads to the need to use ICT in education. It follows from the task of society to satisfy the interests of man. To the same extent that a person is responsible to society for the quantity and quality of labor devoted to society, society is responsible for satisfying those interests of the person that do not contradict the interests of society.

2. MATHERIALS AND METHODS

The purpose of the study is to develop guidelines for the implementation of ICT technologies in physics education in high school. - substantiate the possibilities and determine the effectiveness of the use of modern information and communication technologies in teaching physics at school. Object of study: ICT - the technological development of the educational process in a modern school. Subject of study: the content of the activities of a physics teacher in senior classes of a comprehensive school on the implementation of ICT technologies

Research hypothesis:

- if you use information and communication technologies in teaching physicists in high school, then - the interest of schoolchildren in science will increase, which will improve the quality of education in physics;
- Teachers' interest in using information and communication technologies in physics lessons will increase.

To achieve the goal of the study, we formulate the following tasks:

- To analyze the state of the problem of using information and communication technologies in the educational process as a whole and in teaching physics, in particular.
- Develop recommendations on the use of information and communication technologies in teaching physics.
- To offer effective directions for the teacher to use ICT - technologies in teaching physics.
- The methodological basis of the study was the work on the theory, methodology and practice of teaching physics.

To solve the tasks used the following research methods:

- a theoretical analysis of the problem based on the study of psychological, pedagogical, methodical literature in physics and literature on the use of information and communication technologies in schools;
- study of the content of curricula in physics, textbooks, didactics, electronic educational resources in physics;
- the study of advanced pedagogical experience in the use of information and communication technologies at school;
- conducting pedagogical measurements (conducting observations, interviews, questionnaires, interviews with teachers and students, conducting an experimental survey).

Literature Review. The issues of using ICTs and computer tools in teaching physics were studied in the works of L.I. Antsiferova [2], VA Izvozchikov [31, 32], Kondratyev A.S. [40], Laptev V.V. [41], Eshchanov B.Kh. [9, 10, 11, 12, 13, 14, 42], Otadzhanov Sh. [42, 43], Isamatov A. [9, 10, 11, 42] and others. The methods of organizing an educational physical experiment using a computer are devoted to the work of Klevitsky V.V. [39], the methodology of using computers as a means of developing students' thinking in teaching physics - a study by M. Chekulaeva [5]. The methods of teaching physics using information technology are devoted to the study of Abrosimov P.V. [1]. Methods of using computer and physical equipment in a school laboratory in the study of physics was considered in the study A. A. Ezdov [15, 16, 17]. The theoretical basis of the study is the study of the use of information technology in teaching physics Belostotsky P.I. [3], Butikov E.I. [4], Gomulina N.N. [18, 19, 20, 21, 22, 23, 24, 25, 26, 27], Kavtrev A.F. [33, 34, 35, 36, 37, 38], Grigoriev I.M. [28], Chirtsov A.S. [7-8]). The analysis of scientific and methodological studies and the state of teaching the school physics course allows us to talk about the existence of a contradiction: between the possibilities of using modern computer teaching aids and the lack of a system for applying modern information and communication technologies in teaching physics at school. Theory and Discussion. Thus, the relevance of this study is due to: the increasing role of informatization and computerization at the present stage of development of education and their insufficient use in improving the quality of schoolchildren teaching physics in high school. The creation of curricula, teaching and methodological materials, as well as textbooks and teaching aids of a new type, focused on the active use of computer technology, is of particular importance for the teaching of physics, since it is here that the computer opens up fundamentally new possibilities both in the organization of the educational process and in research specific phenomena in cases where traditional methods are ineffective. This allows us to consider computer training one of the most important modern trends in the methodology of teaching physics. First of all, it is necessary to realize that the use of computer technology in education is justified only in those cases in which there is a significant advantage over traditional forms of education. One such case is the teaching of physics using computer models. It should be noted that by computer models we mean computer programs that simulate physical experiments, phenomena encountered in physical problems. Computer models make it possible to obtain dynamic, memorable illustrations of physical experiments and phenomena in dynamics, to reproduce their subtle details that can slip away when observing real experiments. Computer simulation allows you to change the time scale, vary widely the parameters and conditions of the experiments, as well as simulate situations that are not available in real experiments. Some models allow you to display on the screen graphs of the time dependence of the quantities describing the experiments, and the graphs are displayed on the screen simultaneously with the display of the experiments themselves, which gives them special clarity and facilitates understanding of the general laws of the processes under study. In this case, the graphical way to display the simulation results facilitates the assimilation of large volumes of information received. When using models, the computer provides a unique, not realized in a real physical experiment, opportunity to visualize not a real natural phenomenon, but its simplified theoretical model with the phased inclusion of additional complicating factors that gradually bring this model closer to a real phenomenon. In addition, the possibility of organizing the mass execution of a variety of laboratory work, and at the modern level, in the secondary school is very limited due to the poorly equipped physics classrooms. In this case, the work of students with computer models is also extremely useful, since computer modeling allows you to create a vibrant, memorable dynamic picture of physical experiments or phenomena on a computer screen [24]. At the same time, the use of computer modeling should not be considered as an attempt to replace real physical experiments with their simulations, since the number of physical phenomena studied at school that are not covered by real demonstrations, even with the brilliantly equipped physics classroom, is very large. The somewhat conditional nature of the display of the results of computer modeling can be compensated by demonstrating videos of field experiments, which give an adequate idea of the actual course of physical phenomena. A significant number of computer models that cover such sections of physics as mechanics, molecular physics, and thermodynamics quite adequately are contained in the first part of the multimedia computer course "Open Physics 1.0" [31]. Some course models allow, simultaneously with the course of the experiment, to observe in dynamic mode the construction of graphical time dependences of a number of physical quantities describing the experiment. Such models are of particular value, as students, as a rule, experience significant difficulties in constructing and reading graphs. Computer models of the course "Open Physics 1.0" easily fit into the traditional lesson and allow the teacher to organize new, non-traditional types of educational activities of students. Let us cite as examples two types of such activities that we have tested in practice:

1. The lesson is research. Students are encouraged to independently conduct a small study using a computer model and get the necessary results. Moreover, many models allow literally in a few minutes to conduct such a study. In this case, the lesson approaches the ideal, as students receive knowledge in the process of independent

creative work, because they need knowledge to obtain a specific result visible on a computer screen. The teacher in this case is only an assistant in the creative process of mastering knowledge. Of course, such a lesson can only be taught in the computer lab.

2. A lesson in solving problems with subsequent computer verification. The teacher offers students for independent solutions in the classroom or as homework tasks, the correctness of the solution of which they can verify, then setting up computer experiments. The possibility of independent subsequent verification in a computer experiment of the obtained results enhances cognitive interest, makes the work of students creative, and often brings it closer to scientific research in nature. As a result, many students begin to come up with their tasks, solve them, and then check the correctness of their reasoning using computer models. The teacher can consciously induce students to such activities, without fear that he will have to solve a “heap” of problems invented by students, which usually does not take enough time.

Indeed, to verify the correctness of the answer obtained, it is enough to conduct a computer experiment, which usually takes less than one minute, in addition, such experiments are conducted by the students themselves. Moreover, tasks left by schoolchildren can be used in classwork or offered to other students for independent study in the form of homework. At the same time, task authors can become active teachers' assistants, helping classmates solve their copyright problems, as well as checking work and setting grades. It should be noted that it greatly complicates the work with the computer course "Open Physics 1.0" a limited number of tasks and questions that the authors accompany the model. Experience shows that each model should be accompanied by at least a dozen tasks of varying complexity, then working with the course gives a really high educational effect. It would be ideal if a task book was attached to the computer course with questions and tasks, the contents of which would be consistent with the functionality of the models. The presence of such a problem book would greatly simplify the teacher’s work on using this course in physics classes and would allow him to actively recommend it to students for homework. Nevertheless, even today, the computer course "Open Physics 1.0", of course, is extremely useful in the study of physics both in the classroom and in individual work. But how to effectively use this course in lessons, as well as how to make assignments for computer models to inform them of laboratory work, we will consider in the next chapter. So to summarize. Can physics be taught using computer models? Yes, of course. Moreover, the role of computer modeling in the educational process will increase with the advent of new computer programs. However, a quantum leap in this area will be possible only when computer programmers realize that in order to get really effective programs, they need close contact with teachers who are familiar with computer technologies and actively use these technologies when working with students. The use of information and communication technologies (ICT) in teaching has given new opportunities for the organization of independent work of students [24]. Emphasis from memorizing information is shifted to its search, processing, analysis and presentation. The ease of use of ICT allows on the one hand to individualize learning, and on the other hand, to make interpersonal communications an important part of the learning process. The use of ICT increases the effectiveness of educational activities by providing greater opportunities for its active forms, providing greater independence for students, and increasing motivation. Physics is an experimental science, and for its full study it is necessary to use experiments. But modern physics has also become the science of “computer science”: an experimental physicist uses a computer as an integral part of a research setup, a theoretical physicist works with him to model the phenomena studied, both of them turn to computer databases. Therefore, now a full study of physics involves the inclusion of a computer in the educational process. Let's pay attention to the traditional means of illustrative computer graphics. This is a demonstration of pictures and videos illustrating various phenomena and processes during training. This allows not only to intensify cognitive activity, but also to increase the level of assimilation of educational material, increase the speed of information transfer, and contribute to the development of figurative thinking and intuition. Consider the mechanism of the impact of graphics on the development of imaginative thinking. Scientific creativity requires the perception of the world in its entirety. Therefore, the most promising direction in the development of interactive computer graphics is one that allows you to activate the inherent human ability to think in spatial images. To do this, focus on:

- the creation of such models of knowledge representation in which it would be possible to represent objects characteristic of logical thinking in the same way, as well as image images with which figurative thinking operates;
- visualization of human knowledge for which it is not yet possible to select textual descriptions;
- the search for ways to move from observable image images to the formulation of a hypothesis about the mechanisms and processes that are hidden behind the dynamics of the observed images.

The use of computer graphics implements, first of all, the pedagogical aspect - the principle of visibility. Particularly effective are illustrative blocks that include a full-scale image in combination with circuits that carry a significant didactic load. The realization of computer capabilities in training is carried out using computer programs for educational purposes. These programs and software tools are called digital educational resources. Digital educational resources are created and used to achieve pedagogical goals and learning objectives. They include educational material that must be learned by the student, and the control part that determines the sequence of study of the educational material. The most significant goals realized with the help of the center in the system of school physical experiment:

- Individualization and differentiation of the learning process.
- Monitoring with feedback, with diagnosis and evaluation of results.
- Providing the possibility of training and its implementation through self-training.
- Visibility, strengthening the motivation of learning (due to the dynamics of visual means).
- Modeling and imitation of the studied or investigated processes and phenomena.

However, a physics teacher who has decided to use new information and communication technologies in his teaching practice faces a rather large list of general and educational software, types of computer laboratories and other new

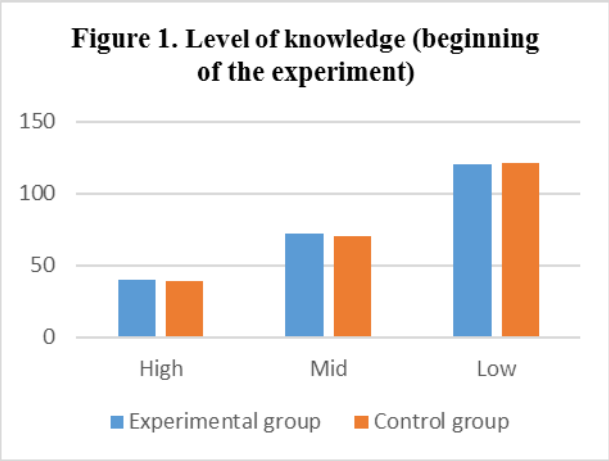
equipment. As you know, the specifics of the computer industry is such that new versions of software products appear approximately once a year. The problem of selecting the necessary software teaching methodology becomes difficult, requiring a lot of time and special knowledge.

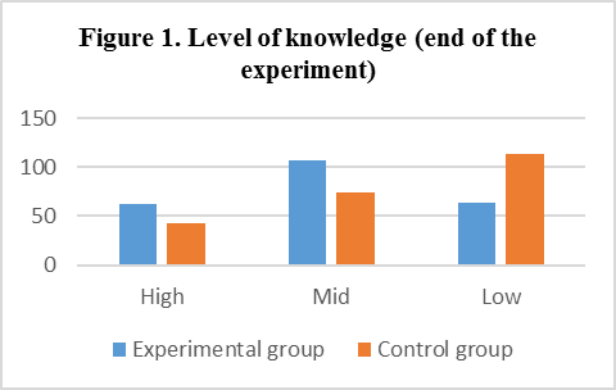
3. EXPERIMENTAL RESULTS

The study reflects on the goals and organization of the pedagogical experiment, diagnosing students' knowledge, skills and abilities before and after applying ICT in the educational process. For the experiments, school number 18, 20, 24 of the Chirchik district of Tashkent region was selected. In experimental trials participated 462 students.

Table I. *Dynamics of the level of formation of students' knowledge and skills at the beginning and end of the forming experiment*

Groups Number of respondents	Arithmetic expression	Level indicators					
		At the beginning			In the end		
		High	Mid	Low	High	Mid	Low
Experimental n_i =232	X_i	40	72	120	62	107	63
Control n_i = 230	Y_j	39	70	121	43	74	113





The level of mastering the requirements of the experimental group is higher compared to the level of the control group, which indicates the effectiveness of the study. Thus, using the mathematical-statistical method it was confirmed that the training methodology recommended by us is more effective than the traditionally conducted training methodology. Studies have confirmed the validity of the promoted scientific hypothesis about the need to use ICT in physics classes.

4. RECOMMENDATION.

With the help of ICT, the following didactic tasks are solved:

- improving the organization of teaching;
- increasing the individualization of training;
- increasing the productivity of students' self-training;
- individualization of the teacher himself;
-acceleration of replication and access to the achievements of teaching practice;
- Strengthening the motivation for learning;
- intensification of the learning process, the ability to attract students to research activities;
- ensuring the flexibility of the learning process.

Thus, we can distinguish the following aspects of the implementation of the educational potential of ICT in the modern lesson:

In relation to educational activities:

• increasing the motivation of the learning process;
• activization of students in the lesson.

On the organization of the educational process:

• differentiation and individualization of the educational route;
• additional opportunities to create problem situations;
• systematization of the educational search process;
• quick testing of student hypotheses;
• quick diagnosis of the effectiveness of the learning process;
• The transition from qualitative to quantitative research.

By role in the development of students:

• students' understanding of the purpose of computer technology;
• display of modern means of cognition;
• increasing the scientific level of presentation of the material;
• the possibility of different presentation of information about the same process (tabular, graphical, etc.);
• additional opportunities for the development of model concepts, clarification of the concepts of the model;
• acquisition of skills of independent modeling of processes and phenomena.

According to technical capabilities:

• modeling of processes that are impossible or difficult to reproduce in a real experiment;
• additional features of visibility; expanding the range of research;
• measurement and visualization of fast processes;
• a detailed study of the "delicate" moments of the experiment;
• reduction of time for performing routine work (processing and processing of results).

5. CONCLUSION

In this work, the problems of analyzing the state of the problem

of using information and communication technologies in the educational process as a whole and in teaching physics, in particular, were solved. Development of recommendations on the use of information and communication technologies in teaching physics. Definitions of the main directions of the teacher's activity on the use of ICT - technologies in teaching physics. As a result of the study, the following results were achieved:

1. The analysis of existing works and the results of their application in the educational process in the field of the integrated use of information and communication technologies in the teaching of physics, which showed that in modern education, considerable experience has been gained in their effective use in the educational process, is carried out.
2. A comparison is made of existing computer science laboratories, compiled their methodological characteristics.
3. A classification of the types of educational activities that are invariant with respect to specific educational environments in the physics course, based on the use of information and communication technologies.
4. The methods of the formation of general educational skills and the achievement of interdisciplinary goals as part of a physics course using ICT are described.
5. The analysis and generalization of pedagogical experience, on the basis of which a classification of the types of independent educational activities of schoolchildren in the study of physics, using ICT.
6. The pedagogical feasibility of the developed methodology for the use of ICT for the organization of independent activity of schoolchildren in teaching physics is shown.

The results of the study allow us to draw the following conclusions in accordance with the purpose and idea of the study:

1. The integrated use of information and communication technologies makes it easier to organize students' independent learning.
2. The use of the technique obtained forms the ability of students to conduct physical research and independently search, process, analyze and present educational knowledge. Information and communication technology (ICT) is a generalized concept that describes various devices, mechanisms, methods, information processing algorithms. The most important modern ICT devices are a computer equipped with appropriate software and telecommunication facilities along with the information posted on them.

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