

PEDAGOGY AND EDUCATION

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FORMATION OF ICT COMPETENCE OF STUDENTS OF TECHNICAL SPEZIALNOSTI ON THE BASIS OF PROJECT-BASED LEARNING (FOR EXAMPLE, APPLICATION PROGRAMS)

***Abstract.** Education should develop in parallel with the development of science and technology. Currently, in terms of active penetration of information and communication technologies in the education system, and nearly continuous accumulation of educational resources on the Internet, is becoming urgent task of rethinking the theory of the organization of educational process and education management, the process of transmission of systematized knowledge, skills and abilities, create new methods and learning technologies. The introduction of new technologies in the educational process is an important condition for intellectual development of students, pupils and socio-economic development of society. The article discusses an example of the use of project learning technology for students studying in the field of ICT using the example of developing a software application designed to familiarize and solve combinatorial problems.*

***Keywords:** technology project-based learning, combinatorial, innovation development, higher education, design of software applications.*

Introduction

Currently, in the context of the active penetration of information and communication technologies into the education system, and the almost permanent accumulation of educational resources on the Internet, the urgent task is to rethink the theory of the educational process and the process of education management, the

process of transferring systematic knowledge, skills and abilities from one generation to other, and creation of new teaching methods and technologies.

The introduction of new technologies in the educational process is an important condition for intellectual development of students, pupils and socio-economic development of society.

The era of the information society, the basis of which knowledge production, transmission and assimilation, makes new demands on the education system, its models, methods, and forms that allows at a qualitatively new level to prepare students for future employment. Information becomes the main subject of human labor changing the content of the labor process, expands the participation of workers in decision-making.

The system of education in higher education institutions traditionally lags behind the needs of society. Therefore, the need to develop innovative technologies in training does not lose relevance.

For an innovative breakthrough, a country must have a quality education system at all levels. The decision of the President of the Republic of Uzbekistan “On approval of the Concept of development of the public education system of the Republic of Uzbekistan until 2030” ID-1746 says, that, the concept defines the main directions of development of the public education system in the long term, ways and forms of expanding the competitive environment among educational institutions, further modernization, technical and technological re-equipment of public education institutions, active attraction of private and foreign investments, further improvement of the law agencies for the development of public education.

In the country, there is a staff shortage of good specialists, as most of them do not have sufficient knowledge and skills after years of training. That is why we have to wonder who trains. Unfortunately, not all universities receive timely information about innovative technologies and progress that are hindering development and personnel performance.

Today there is opportunity to learn from international experiences and approaches in the education system. In addition, as noted by experts, it is necessary to pay great attention to the practice, but the issue of interns is the lack of control.

The innovative development of the economy and growing competition in the labor market are forcing us to radically revise approaches to training personnel. In a competitive environment, universities are forced to improve their activities, offering the market not just new, but better educational programs. Although traditional teaching methods are still preserved, modern education is focused on practical applicability so that graduates can begin their career as quickly and efficiently as possible. Previously, the basic requirements for graduates were sufficient theoretical training, knowledge of the fundamental foundations of the specialty, but now we focus primarily on the wishes of the employer, and try to give the graduate more practical skills.

With combinatorial tasks people were dealt with in ancient times. The long ages of combinatory evolved in the depths of arithmetic, geometry, algebra. As a branch of mathematics, it originated only in the XVII century. Application of combinatorial methods is biology, chemistry, physics. With the advent of computers, combinatory has evolved into the field, located on the main branches of scientific development. Mathematics is the Foundation of any modern scientific discipline. Not a secret that almost all methods of modern data science (including machine learning) are based on certain mathematical calculations. Sometimes, being a specialist in the processing and analysis of data (or junior analyst) should know basic math to properly apply its methods.

Methodology

At present, in the system of higher education, along with innovative educational technologies, credit, modular, project systems are used in practice. Project education, however, embraces the learning process and acts as a methodological basis for the educational process. The idea of project development is becoming more and more popular in the university environment. Many authors of the project are developing a model of higher education, with proposals to integrate students into department projects or work on an individual approach.

The use of project activities in the learning process has been covered in the research work of V.P.Bespalko, G.B.Golub, N.F.Maslova, V.G.Navodnov, N.Y.Pakhomova, E.S.Polat, S.A.Smirnov and ways to effectively develop the

professional competence of future professionals. The most effective way to develop the professional competence of a future specialist is to develop their project-based competence.

A graduate of the university must possess the skills to carry out the project activities at a professional level. According to scientists, the process of effective formation of project competences of future specialists is possible in the application of the project-oriented didactic technology and in the observation of a number of pedagogical conditions: the combination of psychological, pedagogical, scientific and methodological knowledge; the creation of an exemplary state of participation in the design process (the emergence of the idea of); the methods and use of various organizational forms of organization of independent, educational activities of students and their support.

According to M.A.Smironova, the formation of project competence among students takes place in three stages: "motivational-orientation", "formative", "I-consensus". The achievement of the priority objectives of the first stage (the creation of a positive point of view and the formation of a constant interest in the design of the professional sphere) is carried out with the help of Information projects; the second stage (the formation of readiness for design in professional activity) - scientific and practical projects; the third stage (formation of a point of view on design in professional activity, understanding of design skills) - research and creative projects

In an article "Project-Based Learning for Sustainable Development" of Marcia L. Nation Project-based learning is teach students how to find approaches and ways of solving problems with theoretical and practical knowledge, perspectives and solutions. Despite of these, it was given the process of presenting this course underlined the difficulties of interdisciplinary work as well as the opportunities and challenges inherent in involving students in authentic research with communities.

In the research, work of Murat Genc described that, the purpose of this study is to investigate the effect of project-based learning on students' attitudes toward the environment. In the study that was performed with 39 students who take the "Environmental Education" course, attitude changes toward the environment were

investigated in students who developed projects on environmental problems. A mixed-method explanatory design was used to flesh out study results. After being informed about basic environmental concepts and project-based learning, students engaged themselves in-group work to develop projects regarding environmental problems. The developed projects were presented with the aim of informing students. According to research results, although a significant gender difference in environmental attitudes was not found, project-based learning had a positive effect on students' environmental attitudes. Students defined project-based learning use in environmental education as an approach that is beneficial, enhancing creativity, encouraging research and providing permanent learning. Students believed this practice helped them define environmental problems more clearly and take on more active tasks in the solution process.

In project-based learning the educational process is organized in such a way that not only all students are involved in the learning process through the discovery of creative abilities but they have the ability to understand and reflect on about what they know, I think and you can make.

For a more complete understanding of the nature of project-based learning, we presented a comparative characteristic of traditional and project-based learning (Table 1).

Table 1

Comparative characteristics of traditional and project-based learning

Criteria	Traditional training	Project-based learning
The purpose of training	Knowledge transfer and exercises	Students will be able to identify the solution to a given problem in a way that is appropriate for the innovative society
Activity of the teacher	Active aimed at knowledge transfer	Active, aimed at developing approach that is beneficial, enhancing creativity, encouraging research and providing permanent learning
Activities student	Passive (listens, writes, answers questions)	Active aimed at finding and implementing a new
Forms of learning	Front and group	Collective and individual

Table continuation 1

Teaching methods	Verbal, visual	Problem-based, project-based, research
Learning tools	The textbooks and manuals	Information and communication technology
Evaluation of activity	Doing by teacher	Self-assessment and self-reflection

As the table shows, project-based learning play a big role in ICT. D. Akhmetov, L. Gore [21], GA Score [22], B. S. Gershunsky [23], M. V. klarin [24], L. M. Mitina [25] also note the importance of using ICT in education.

Approach to the development of the program for the study of the combinatorics tasks.

Probability theory and mathematical statistics are two closely related mathematical disciplines. Currently, their knowledge is essential to the specialists of various professions. The ability to formulate the purpose of their activities and take steps to achieve it – the hallmark of the competent, competitive expert, and the theory of probability and mathematical statistics, as no other discipline, promote positive personality changes. The knowledge of regularities of mass random phenomena (the subject of probability theory) and the most important methods and techniques of observational studies (studies of mathematical statistics) is important for a modern programmer in the development of algorithms for solving practical problems. The study of the theory of probability and mathematical statistics is impossible without a preliminary acquaintance with the basics of combinatory. With combinatorial tasks, people were dealt with in ancient times. The long ages of combinatory evolved in the depths of arithmetic, geometry, algebra. As a branch of mathematics, it originated only in the XVII century. Application of combinatorial methods is biology, chemistry, physics. With the advent of computers, combinatory has evolved into the region, located on the main road of scientific development.

Today, combinatorial methods are used to solve problems of information theory, problems of linear programming for solving transportation problems and much more. Combinatorial problems represent a wealth of material for learning basic structures, techniques and programming techniques allow showing the possibilities of

new computer technologies in solving practical mathematical problems. Objectives discrete mathematics is often reduced to the enumeration of various combinatorial configurations of the objects and choosing among them the best, from the point of view of conditions of the given task. Therefore, the knowledge of the algorithms of generating the most common combinatorial configurations is a necessary condition for the successful solution of the task in General.

In our time, the role of databases has changed significantly. If the combinatory is often perceived only as an entertaining part of the mathematical science, after the advent of the computer and associated with the flourishing of finite mathematics combinatorial methods have become much more popular, they are applied today in the theory of random processes, computational mathematics, design of experiments.

The selection of learning technologies

For software product development on the introduction of the combinatorial tasks were chosen educational technology project-based learning.

The goal of project-based learning: create the conditions under which students:

- independently and willing to acquire the missing knowledge from different sources;
- learn to use acquired knowledge to solve cognitive and practical tasks;
- acquire communication skills, working in different groups;
- develop research skills (the ability to identify problems, collect information, observation, experiment, analysis, build hypotheses, generalization);
- develop systemic thinking.

Basic theoretical positions of project-based learning:

- the center of attention – the pupil, development of his creative abilities;
- the learning process is based on the logic of the activities that have personal meaning for the student that enhances his or her motivation in teaching;
- individual pace of work on the project ensures that each student at their level of development;
- an integrated approach to the development of training projects contributing to the balanced development of the basic physiological and mental functions of the pupil;

– deep, conscious assimilation of basic knowledge is provided through the universal use in different situations.

The essence of project-based learning

The essence of project-based learning is that the student in the process of working on a training project comprehends the actual processes, objects, etc. It involves the accommodation of a student in specific situations, the initiation of its penetration deep into the phenomena, processes and design of new facilities.

Using technology project-based learning for conducting disciplines and the ICT required to pass the following stages of project development. Fig. 1.

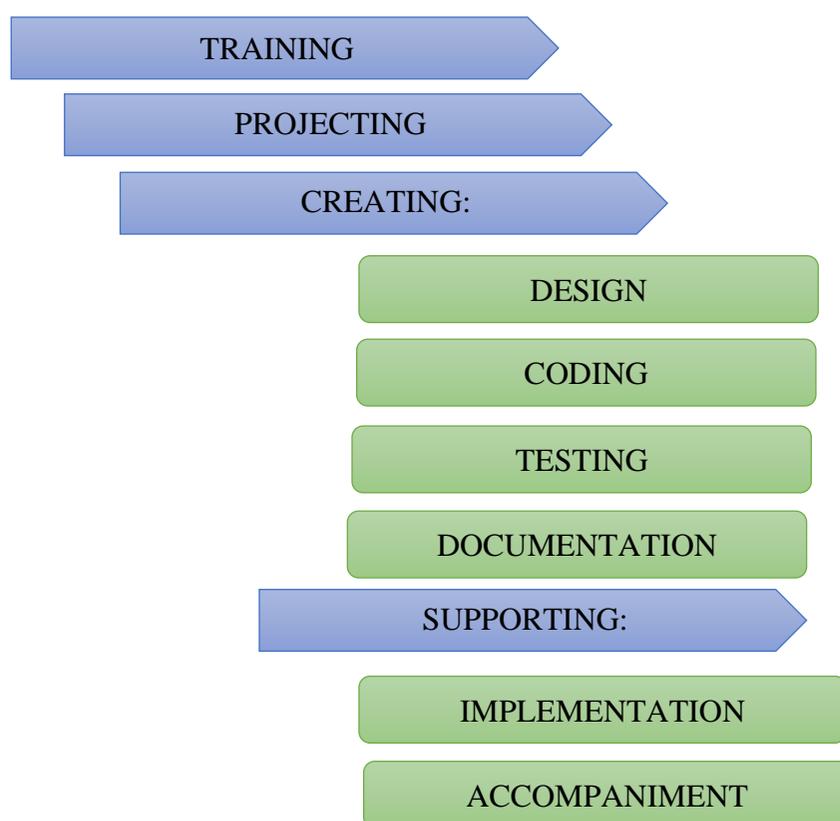


Fig.1. Universal system of levels to create a project-based learning

In this sequence the following actions occur:

– Preparation and design of software. This stage requires a lot of time and a careful approach, as it depends on him for all further work. In addition to setting goals at this stage, a work plan for creation.

– Design the second important component of the product after the technical characteristics affecting the efficiency and speed of user interaction with it.

– Code - that part of the work, which is usually associated with software development as such. It is important that the code is sufficiently optimized, concise and understandable.

– Testing is conducted at each stage of development, includes a variety of tests in the test plan.

– Documentation - procedure, fixing the plan, the process and outcome of software development.

– The implementation of the software. At this stage begins the process of user support, and programming have been completed. Most often, this phase involves installing a program on computers in the local network.

– Informational support. This includes warranty service, identifying problems and errors, and monitoring programs for the presence of faults, etc.

An example of the result of the use of technology project-based learning is a software product that requires knowledge of combinatorial problems and their realization as a software product.

To solve this task, the student must develop a mathematical model and solution algorithm the main tasks of combinatorics Fig. 2.

<i>Перестановки с повторениями</i>	$\overline{P}_n = \frac{n!}{n_1! \cdot n_2! \cdot \dots \cdot n_k!}$
<i>Сочетания с повторениями</i>	$\overline{C}_n^k = C_{n+k-1}^k$
<i>Размещения с повторениями</i>	$\overline{A}_n^k = n^k$

Fig. 2. The major tasks of combinatorics

– The COMBINATION of n elements connections for k elements ($k = n$ or $k < n$). These compounds differ from each other only by the elements.

– ACCOMMODATION $A = n! / (n-k)$ create connections that differ from other elements or order of their location.

– PERMUTATION $P = n!$ A set of n elements. We simply rearrange them. The main thing - the order of the elements

In the process of working on the project, the student studies the combinatorial problem and solve them on their own, which leads him to build a program for solving combinatorial problems. For the implementation of the project software product showing the solution of problems of combinatory.

In the process of creating the program, students must develop a user-friendly interface and program design. Figure. 3.

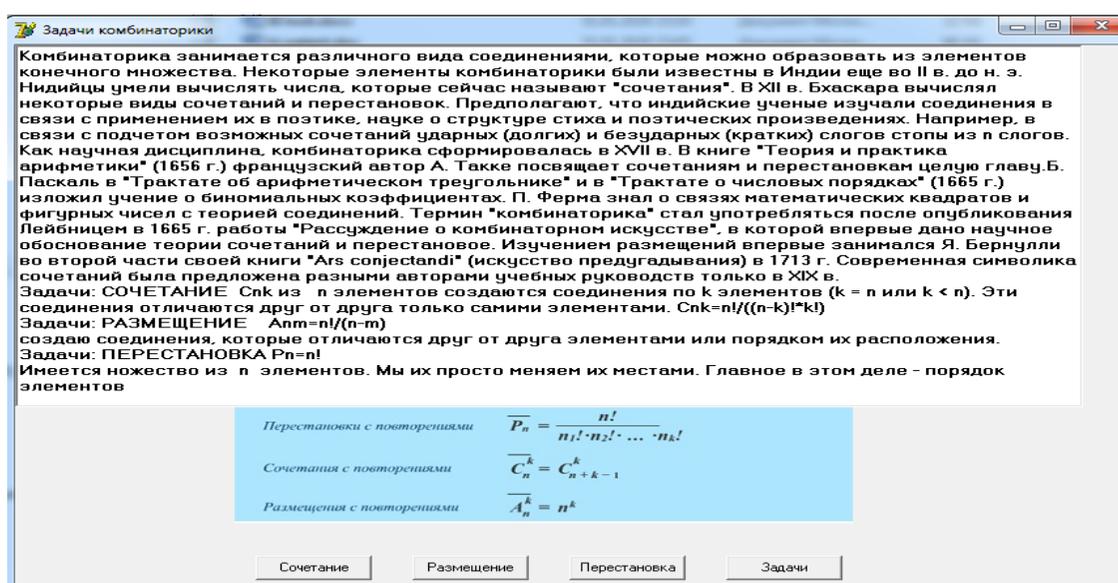


Fig. 3. The main window of the program

In the program for each task is a separate window showing the formula. Fig.4.

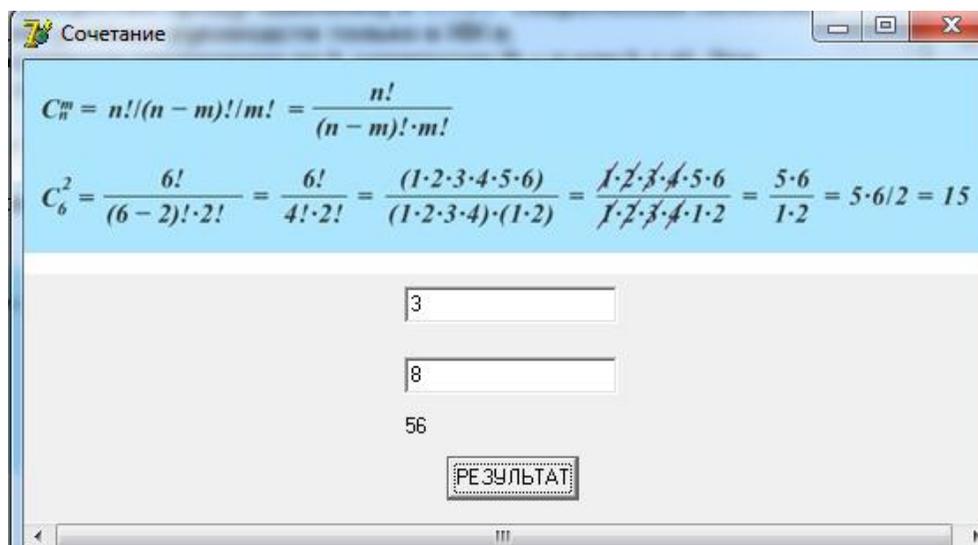


Fig. 4. Execution of the program for calculating the number of combinations C of n elements creates connections of k elements

Program users can also test their knowledge by solving 10 combinatorial problems. Fig. 5.

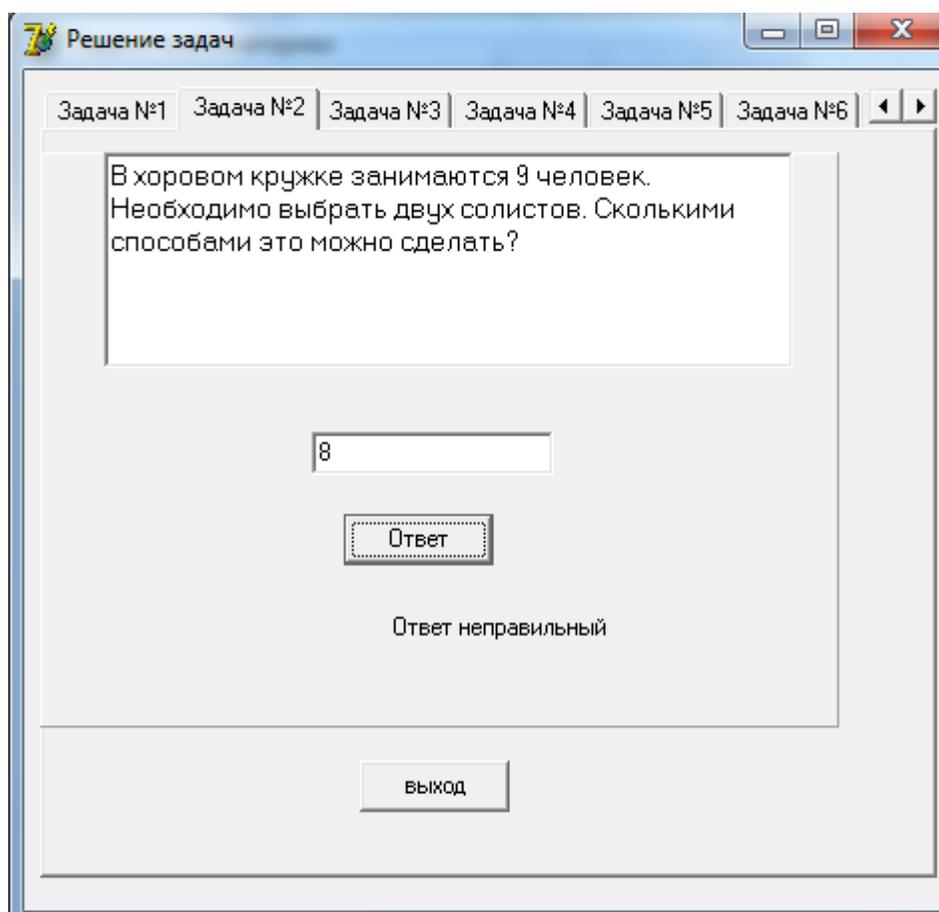


Fig. 5. The window of solving problems

Results

Project method we use at all stages of training - pre, profile, specialized, complementing other technologies and methods in terms of training activities. The essence of project method in the study of combinatorics is to stimulate students' interest in certain issues involving the possession of a certain amount of system knowledge, and through project activities that address one or a number of problems, to show practical application of knowledge, i.e. from theory to practice connection of theoretical knowledge with pragmatic while respecting the appropriate balance at each stage of learning.

The result of the execution of the software product "Combinatorial problem" using technology project-based learning is:

- gaining knowledge about combinatorics;

- the solution to combinatorial problems;
- to develop the ability to analyze and interpret data presented in various forms, to test simple statistical hypotheses;
- mastering the skills to solve problems related to specific life situation;
- the expansion of cultural horizons and to develop logical thinking of students through interdisciplinary connections;
- the formation of the ability to determine the relationship of combinatory with practical needs;

Expected results

After the course students should know:

- To know the basic concepts of combinatory, probability theory and mathematical statistics.

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