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 **Research Article**

PROJECT-BASED LEARNING AS AN INNOVATIVE APPROACH TO DEVELOPING PRACTICAL SKILLS AND PROFESSIONAL COMPETENCES IN STUDENTS OF TECHNICAL UNIVERSITIES

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ABSTRACT

This article is devoted to the study of project-based learning as an innovative approach to developing practical skills and professional competencies in students of technical universities. The paper analyzes the advantages of project-based learning, considers various project models, and presents the results of empirical research. The authors emphasize the importance of project activities for the formation of such competencies in future engineers as creativity, teamwork, and the ability to solve complex problems. In addition, the article discusses the challenges and prospects for introducing project-based learning into the educational process of technical universities.

KEYWORDS

Project-based learning, technical universities, professional competencies, practical skills, innovations, education, engineering education.

INTRODUCTION

In the modern conditions of rapid technological development and digitalization, the need to train specialists who are able not only to theoretically acquire knowledge, but also to apply it in practice is

becoming increasingly urgent. This is especially true for students of technical universities who will work in high-tech and rapidly changing industries. One of the most effective ways to form professional competencies and



develop practical skills is "project-based learning". Project-based learning is an innovative educational approach aimed at solving real problems and tasks through the implementation of educational projects. Unlike traditional methods, where passive perception of information dominates, this approach involves students in the active process of research, planning and implementation of projects. This allows not only to consolidate theoretical knowledge, but also to develop important skills such as teamwork, creative thinking, time management and solving complex problems. For students of technical specialties who will work in interdisciplinary teams and solve problems in conditions of high uncertainty, project-based learning is especially useful. It allows them to delve deeper into the process of creating technical solutions, analyze problems from different perspectives, and adapt their knowledge to specific practical situations [1-3].

The purpose of this article is to consider the main advantages and features of project-based learning in the context of training students at technical universities, and to analyze how this approach contributes to the development of their professional competencies and skills that are in demand in the modern labor market.

METHODS

Project-based learning has deep roots, and its modern form developed starting from the ideas of classical educators such as John Dewey and William H. Kilpatrick [4,5]. John Dewey is an American philosopher and educator, considered one of the founders of project-based learning. In his work *Democracy and Education* (1916), Dewey emphasized the importance of active learning through experience. He believed that students should learn through activities that make

sense in their daily lives, rather than simply memorizing facts. This approach consisted of learning through solving real problems, which became the foundation for the project method.

William Heard Kilpatrick, a student of Dewey, developed his teacher's ideas and published *The Project Method* in 1918. Kilpatrick proposed that project-based learning is not just a method, but a way of organizing learning activities in which students work on specific tasks or projects. He believed that students learn better if they are involved in the process of research, planning, and completing a task. This method was aimed at developing the ability to think independently and make decisions. The evolution of project-based learning was successful in the 1920s-1940s. During this period, the project method began to be actively used in US schools. However, its popularity declined after World War II, when more attention was paid to traditional forms of education and the preparation of specialists for an industrial society. In the 1970s-1990s, project-based learning was revived due to new approaches to education and an increased interest in developing critical thinking and practical skills in students. The project method has become especially relevant in engineering and technical education [2, 5]. In the 21st century, project-based learning is integrated with new educational technologies. The widespread use of active learning methods, such as STEM (science, technology, engineering and mathematics), continues to develop project-based learning. Particular attention is paid to the skills of teamwork, creativity and solving interdisciplinary problems. Thus, project-based learning, starting with the works of Dewey and Kilpatrick, has become one of the most effective methods of active learning, which is used in many



countries to prepare students to solve real problems in their professional activities [6]. Successful use of the project method in the educational process allows you to apply theoretical knowledge in practice to successfully solve specific problems, taking into account many factors. Modern researchers are unanimous in the fact that the project method is a multifunctional pedagogical tool. It not only contributes to the formation of key competencies, but also develops personal qualities in students, such as independence, creativity, communication skills and responsibility. The use of the project method makes the educational process more interesting, effective and practice-oriented [7].

RESULTS

In modern education, the issue of the relevance of pedagogical support, its adaptation and evolution in the context of accelerating digital transformation is one of the primary ones. A project is a unique process consisting of a set of coordinated and managed activities with start and end dates, undertaken to achieve a goal that meets specific requirements, including time, cost and resource constraints. General features that distinguish a project from other activities:

- 1) focus on achieving specific goals with a defined beginning and end;
- 2) limited duration in terms of time, cost and resources;
- 3) uniqueness and originality (to a certain extent);
- 4) complexity - the presence of a large number of factors that directly or indirectly affect the progress and results of the project;

5) legal and organizational support - creation of a specific organizational structure for the duration of the project.

Any project is implemented through a number of phases, has a beginning and an end. The project life cycle is a sequence of phases from the beginning to the end of the project, set in accordance with the needs of project management. All projects, as a rule, have the following phases within the framework of the international project management standard [4,7]:

- 1) initiation: defining the problem situation, developing the project charter, identifying stakeholders, creating a team;
- 2) planning: developing a plan, defining the project scope, creating the structure and composition of works, assessing resources, defining the organizational structure and sequence of works, assessing the duration of works, developing a schedule, estimating costs, developing a budget, identifying and assessing risks, developing a delivery plan, developing a quality plan, developing a communications plan;
- 3) execution: direct work on the project, managing stakeholders, developing the project team, forming an attitude to risks, ensuring quality requirements, selecting suppliers, disseminating information;
- 4) Management: Project work management, Change management, Project scope management, Resource management, Project team management, Schedule management, Cost management, Risk management, Quality management, Contract administration, Communications management;



5) Closure: Closing a phase or project, as well as lessons learned, formulating key findings and analyzing the success of the project [6, 10].

Project activities always have a number of constraints, which include the duration of the project; Availability of the project budget; Availability of resources for the project; Factors related to the health and safety of the project team; The level of acceptable risk in the project; Potential social or environmental impacts of the project; Laws, regulations and other legal requirements necessary for the implementation of the project [11].

We have developed a number of interactive methods that include the integration of project-based learning with the digitalization of education at the teacher-student level. The digital era, marked by rapid technological progress, has accelerated the change in the scientific concept in educational methods, which required a reassessment of traditional pedagogical approaches. One of these interactive methods is called "Optimization of Cloud Computing Resources". The objectives of this method are: - familiarizing students with the methods of identification, modeling and optimization, developing students' project-based learning and problem solving skills; - raising students' awareness of the importance of optimizing resources in cloud computing, etc.

Steps of conducting a lesson using the project method:

Step 1. Identification

- Students collect data on the use of resources in the cloud environment, including the use of computing resources, memory and storage.

- Analyze the data to identify patterns and anomalies in resource use.

- Use cluster analysis and regression analysis techniques to create models that describe the dependence of resource usage on various factors such as application type, time of day, etc.

Step 2. Modeling

- Build a detailed model of the cloud environment in cloud modeling tools.

- The model includes various types of cloud resources (virtual machines, databases, storage), as well as modeling the behavior of applications in the cloud environment.

- Use the model to simulate various resource usage scenarios and assess their impact on the performance and cost of the cloud environment.

Step 3. Optimization

- Develop various optimization strategies to reduce resource usage in the cloud environment.

- Strategies may include choosing the optimal resource types, scaling resources on demand, using automated tools for resource management, etc.

- Use optimization tools to find the best combination of strategies that maximize resource efficiency and reduce costs.

Step 4. Project Presentation

- Students present their projects to the class or committee.



- Presentations include a description of the analysis performed, the model developed, and the optimization strategies implemented.
- Projects are assessed for originality, validity, and practicality.

Expected Outcomes:

- Students will acquire practical skills in identification, modeling, and optimization.
- Students will develop critical thinking and problem-solving skills.
- Students will increase awareness of the importance of resource optimization in cloud computing.
- Students will create practical solutions to reduce resource usage and costs in cloud environments.

CONCLUSION

In conclusion, we can conclude that project-based learning is a powerful tool for preparing students for real-world professional activities. This approach allows developing both practical and cognitive skills, improving critical thinking, collaboration, and problem solving. Project-based learning provides students with the opportunity to apply theoretical knowledge in real-world projects, which contributes to their professional development. Interactive and interdisciplinary projects that students complete during their studies stimulate innovative thinking and prepare them for the demands of the modern labor market. The introduction of project-based learning into the curricula of technical universities requires teachers to use flexible methods and technologies, which makes the learning process more adaptive and responsive to the needs of both students and modern production. Project-based

learning helps to develop sustainable professional competencies necessary for a successful career in technical fields. Thus, project-based learning not only improves the quality of education, but also stimulates the development of skills necessary for effective professional activity in the rapidly changing world of technology.

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