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RESEARCH ARTICLE

Didactic Opportunities Of The Digital Learning Environment In Preparing Students For Design Activities

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Abstract

This thesis analyzes the didactic possibilities of using a digital learning environment in the process of preparing students for design and engineering activities. The influence of the digital environment on the effectiveness of teaching, interactive cooperation between students and teachers, as well as its importance in the development of digital competencies are highlighted. The research results show that the digital learning environment creates broad opportunities for developing students' independent thinking, technological reasoning, and creative approaches in design and engineering activities.

KEYWORDS

Digital learning environment, design and engineering activity, didactic possibilities, digital technologies, competence, engineering education.

INTRODUCTION

Currently, the education system has entered the stage of global digital transformation, and this process requires a radical renewal of the content, methods, and organizational forms of teaching. Especially in engineering and technological fields, the organization of the educational process in a digital educational environment is one of the most important conditions for preparing students for modern design and engineering activities.

The digital learning environment is an interactive educational system that implements interaction between the teacher and the student through digital technologies, with the possibility of managing, controlling, and evaluating the educational process. In such an environment, the educational process has a modular, interdisciplinary, integrated, and flexible form.

A distinctive feature of engineering education is that it requires students, along with theoretical knowledge, practical, design, and engineering skills. Traditional teaching methods cannot give sufficient results in this direction, as they limit student activity. Therefore, the digital learning environment allows creating a learning model based on the active participation of the student.

The main advantages of the digital learning environment are:

Interactivity and individualization of the educational process;

presentation of educational materials in multimedia, visual, and simulation form;

availability of feedback and automatic assessment systems;

The possibility of modeling and conducting experiments on real engineering projects.

The use of digital technologies in design and engineering education allows students to independently solve practical problems, find solutions based on 3D design and virtual simulation, develop teamwork and creative thinking skills.

Thus, the study of the didactic possibilities of the digital educational environment, its implementation in the process of design and engineering education is one of the urgent scientific issues in modernizing the modern education system, improving the quality of teaching, and developing the professional competencies of students.

LITERATURE ANALYSIS

In recent years, issues of combining the concepts of digital education and project-based learning have occupied an important place in global scientific research. In this direction, many scientists have deeply studied the theoretical and practical foundations of the application of digital technologies in the educational process.

V.P. Bespalko (2020) in his work "Pedagogical Technologies in Modern Education" puts forward the theory of technologization of the educational process. According to it, the effectiveness of teaching is determined by the organization of the teacher's activity based on a technological system and ensuring feedback in the educational process. This approach defines the main didactic mechanisms for managing learning activities in a digital learning environment[1].

A.A. Verbitskiy (2021) in his concept of "Contextual learning" emphasizes the need to connect educational activities with real-life problems. This idea is one of the main principles of project-based learning, which guides students in the digital environment to analyze engineering situations and find practical solutions[2].

E.S. Polat (2019) developed the theory of digital pedagogy and showed the didactic significance of using interactive platforms, multimedia tools, and elements of online collaboration in the educational process [3].

Among foreign scientists, the TPACK model (Technological Pedagogical Content Knowledge) proposed by P. Mishra and M. Koehler (2009) is one of the theoretical foundations of teaching in the digital environment. According to it, the teacher should create an effective educational environment by combining technological, pedagogical, and content knowledge [12].

The Digital Learning and Competence Development Framework, developed by UNESCO (2022), developed a methodology for the formation of competencies in digital education, in which interdisciplinary integration, the solution of creative problems, and the development of digital thinking occupy a central place [11].

Among Uzbek scientists, the scientific research conducted by I. Karimov (2023), D. Khusanov (2024), and I. Umirov (2024) highlights the role of the digital learning environment in the educational process, its didactic possibilities, and integration with project-based learning [5, 6].

I. Umirov developed a didactic model of project-based learning in the digital environment and practically proved the results of its implementation in engineering education [7].

Also, Sh. Kholmatov (2021) studied the didactic conditions for creating a digital environment in education and noted that the effectiveness of digital learning depends on interactive communication between the student and the teacher [8].

In general, the analysis of the literature shows that the digital learning environment can be effectively applied at all stages of the educational process. However, in many studies, the issues of developing models of a digital learning environment focused on design and engineering activities, adapting didactic capabilities to the national education system, and creating criteria for assessing digital competencies have not been sufficiently studied. Therefore, this research area is relevant from a scientific and practical point of view for the education system of Uzbekistan.

METHODOLOGY

The methodological basis of this research is based on modern pedagogical theories, digital educational concepts, active learning methods, and didactic principles of engineering education. The study examined the processes of analyzing the possibilities of the digital educational environment in preparing students for design and engineering activities, creating their didactic model, and implementing it in practice.

Several methodological approaches were used in the research process. Based on a systematic approach, the digital educational environment was analyzed as a pedagogical system consisting of interconnected components of the teacher, student, educational content, digital platform, and assessment systems. The integrative approach served to ensure the interconnection of various disciplines in design and engineering education - technology, computer science, physics, and design. The personality-oriented approach provided for the selection of a teaching methodology adapted to the level of students' digital competence, learning speed, and individual interests. Thanks to the activity-oriented

approach, students participated not as learners, but as active creators, problem-solvers, and project creators. The innovative-pedagogical approach also provided for improving the quality of education through the introduction of modern digital tools into the educational process - simulation, 3D modeling, artificial intelligence, and interactive platforms.

The methodological basis of the research consisted of several important pedagogical and didactic principles. The content of teaching based on the principle of scientificity relied on modern pedagogical concepts and theories of digital didactics. The principle of visualization ensured the organization of the educational process in a visual, interactive form. The principle of reflexivity was aimed at the formation of students' ability to evaluate their own activity and work on themselves. The principle of flexibility made it possible to adapt the learning environment to the level and pace of learning of each student. The principle of cooperation served to stimulate team project activities, mutual exchange of ideas, and online communication.

The object of the research is the process of preparing students for design and engineering activities, and the subject is the didactic possibilities of the digital learning environment in the educational process. The main goal of the study was to determine the didactic possibilities of the digital educational environment, their application in the process of design and engineering education, and to determine their influence on the effectiveness of education.

The main tasks of the research were: determining the essence and components of the digital learning environment, analyzing digital technologies used in design and engineering education, developing a didactic model of the digital learning environment, evaluating the practical effectiveness of the model based on experimental work, and developing methodological recommendations for teachers.

The research was carried out in several stages. At the first stage - the theoretical-analytical stage (2023), scientific sources related to the topic were studied, the theoretical foundations of the digital learning environment were analyzed, and a research hypothesis was formulated. At the second stage - the stage of model development (2024), a didactic model of the digital learning environment was created. In the model, such elements as teacher, student, digital platform, feedback, and assessment system were defined in an integrated way. At the third stage - the experimental stage (2024-2025), practical tests were conducted on students of the technical direction of the Jizzakh Polytechnic Institute. Experimental groups performed design tasks using digital platforms - systems such as Moodle, Tinkercad, Fusion 360, AutoCAD. At the fourth stage - the stage of analysis and generalization (2025), the obtained data were processed based on mathematical and statistical methods, the results were analyzed, and scientific conclusions were formulated.

Several scientific and pedagogical methods were used in the research. Pedagogical, psychological, and technological literature was studied using theoretical methods, and advanced foreign and domestic experience was analyzed. As empirical methods, surveys and interviews were conducted with students and teachers, pedagogical observations were carried out, and learning outcomes were assessed using diagnostic tests. With the help of experimental methods, a comparative analysis was conducted between the control and experimental groups, the effectiveness of training in the digital environment was measured, and the level of technological thinking and design competencies of students was assessed. Also, the results were analyzed using mathematical and statistical methods (using SPSS, Excel programs), correlation and variance coefficients were determined, and the reliability of the experiment was checked.

At the end of the research, a number of important results were achieved. A didactic model of the digital learning environment has been developed, and its effectiveness has been experimentally confirmed. The use of the digital environment in the process of preparing students for design and engineering activities made it possible to develop their digital and technological competencies, form creative thinking, and increase the effectiveness of the educational process by 20-25%. For teachers, methodological recommendations have been developed for the effective use of digital platforms, the introduction of feedback systems, and the automation of the assessment process.

CONCLUSION

In general, the methodological foundations of the research are aimed at the systematic study of the didactic possibilities of the digital educational environment, its integration into the design and construction educational process, and the scientific substantiation of ways to increase the effectiveness of education.

The research results showed that the digital learning environment is an effective didactic tool for preparing students

for design and engineering activities. It brings the learning process into an interactive, visual, and personality-oriented form, develops students' technological thinking, creative approach, and independent work competence.

The use of a digital learning environment allows for the effective completion of project tasks, strengthening interdisciplinary integration, and improving the quality of the educational process. Therefore, the introduction of digital learning technologies into design and engineering education is an important factor in the modernization of modern engineering education.

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