



IMPROVEMENT OF TEACHING METHODOLOGY OF THE SUBJECT "HEAT SUPPLY AND HEAT SYSTEMS" USING DIGITAL TECHNOLOGIES

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ABSTRACT

This article discusses the pedagogical possibilities of using modern information and communication technologies and mobile applications in teaching the subject "Heat Supply and Heating Systems" in higher educational institutions in the context of digital transformation. During the research, a methodological model was developed to develop students' professional competence. The model integrated the target, motivational, meaningful, organizational and result components. The possibilities of interactive learning of theoretical knowledge through a mobile application, practical calculations, modeling of heating systems, and knowledge assessment based on tests and assignments were analyzed. The effectiveness of using distance learning, blended learning, flipped classroom and other interactive methods was also substantiated. According to the results of the research, it was found that the educational process organized on the basis of mobile applications and digital technologies develops students' independent learning skills, increases their professional motivation, and strengthens their theoretical and practical training in heating systems.

In the context of digital transformation, the use of modern information and communication technologies in teaching technical subjects in higher education institutions is becoming increasingly important. In particular, teaching the subject of "Heat Supply and Heating Systems" requires in-depth mastery of practical calculations, schemes and technological processes, along with theoretical knowledge. In this process, mobile applications are an effective tool for organizing independent learning of students, ensuring visual and interactive learning. The mobile application ensures the continuity of education, allows students to obtain knowledge at any time and place, and serves to master the content of the subject in an understandable and systematic way. The main goal of the mobile application is to form theoretical and practical knowledge of heat supply systems in students, to develop their professional competence. The main tasks are to present the basic concepts of heat supply and heat systems in an interactive form, to explain heat networks, boiler rooms and heat exchange processes through visual models, to automate calculation issues and

practical tasks, to assess students' knowledge through tests and mini-projects, and to support independent learning.

Each organizational component of this model consists of (goal, motivational component, content component, types of modeling programs, didactic tools, functions in the educational process, principles, didactic conditions, design and organizational block, implementation in the educational process, assessment process, criteria, distance learning, levels, results).

The purpose of the content-targeted block is to improve the information and methodological support of these subjects in the teaching of the subject "Heat Supply and Heating Systems" to students, which is presented in the content-targeted block, to form theoretical knowledge and practical skills in the subject "Heat Supply and Heating Systems" within the existing information and methodological support and content of the subjects. Students need to be familiar with the essence of the topics they have studied, imagine how this knowledge will be used in their professional activities, and have sufficient knowledge and skills. To achieve this, it is most appropriate to use digital technologies in a setting close to the working environment in higher educational institutions.

Teaching the subject "Heat Supply and Heating Systems" based on a competency-based approach, in a field-oriented manner, and integrated with specialized disciplines, provides students with even stronger motivation to apply the knowledge, skills, and experience gained in professional activities, and prevents students from becoming abstract in the process of studying these subjects.

The model includes the use of a mobile application and a complex of all theoretical information and laboratories attached to it in teaching the subject "Heat Supply and Heating Systems" as a meaningful component, the quality of the components of the functions in the educational process, the visual presentation of information, the implementation of feedback between subjects, the provision of frontal, group and individual work, as components of didactic opportunities: adaptability, completeness of the educational cycle, continuity, the ability to control the correct execution of the task, flexibility, interactivity, and the principles of the components: demonstration, scientificity, virtuality, integrativity, ensuring problem-solving, relevance, special principles: variability, independent activity, etc. While the knowledge, skills, experience and orientation that students need to acquire in teaching subjects come from the qualification requirements, improving information and methodological support using digital technologies focused on the field will bring great positive results.

Types of software components The program of the subject "Heat supply and heating systems" includes a set of software necessary for work: LabVIEW, Delphi programming language, Ispring QuizMaker, WordPress. In the model, using the subject "Heat supply and heating systems" as an example, the content of the subject includes lecture classes, experimental classes, independent learning and practical work, as well as a knowledge base of the subject, a textbook, an electronic platform, a video lesson channel, and other tools to help organize the content of the subject. The fact that these prepared materials can be used not only in practical or experimental teaching of science, but also in lecture classes, frontal

teaching, project-group and individual teaching methods, is the reason for the widespread use of these programs.

In terms of the form of implementation of the educational process, it can be used in traditional classes or in distance learning. When teaching using a mobile application, effective results are achieved through the use of pedagogical interactive methods (Blended learning, Flipped classroom, Consulting, Training, ADDIE).

Textbooks, electronic textbooks, websites, distance learning platforms used in the higher education system, educational and information platforms, software developments that guarantee specific solutions, and other tools are used to develop students' professional competence.

As a result of this improvement, the motivation and goal orientations formed in students in the component for preparing students for professional activity were revealed as a result of the implementation of the motivational-goal component. The substantive-organizational component of the system is aimed at solving the problem of summarizing and systematizing knowledge about the specifics of communication in the educational process, as well as methods and techniques for developing creativity.

In the effectiveness block, assessment criteria (reproductive, productive, partially research and creative) were developed to comprehensively determine the levels of students' skills in working with modeling programs (high, medium and low) (Table 1).

Table 1

Criteria for assessing whether students have improved their professional competence based on a professional approach

CRITERIA	DESCRIPTIONS
Reproductive	Know the goals and objectives, basics and types of heat supply systems, have an idea of their use and utilization, know how to work with digital technologies, programs, and perform tasks based on methodological guidelines in the specified discipline.
Productive	Know the types and components of heat supply systems, know how to use other complementary technologies and capabilities in the process of working with heat supply technologies, know how to use heat supply systems and evaluate their technical and economic indicators and be able to use them, understand the essence of working and performing work in heat supply systems, be able to work in conjunction with methodological guidelines and literature; understand the mechanism of work in heat supply systems and know the difference in capabilities.

Partial search	Study and use the capabilities of other modeling programs that can be used in science; initiative in using programs that have not been used in other sciences outside the specified laboratories within the scope of science, research, and partial study of other capabilities in it, along with the use of digital technologies. Use methods for analyzing heat supply and heating systems. Possess the skills to adopt solutions to problems related to them. Know how to solve problems related to the law of the goals and objectives of heat supply systems. Know the essence of methods for calculating types and components of heat supply systems.
Creative	To know and be able to use heat supply systems and evaluate their technical and economic indicators, to know and be able to use basic concepts of the structure and principle of operation of devices. To have the skills to apply methods of analyzing heat supply and heating systems, to adopt solutions to problems related to them, to have the skills to use energy-saving technologies in the modernization and reconstruction of heating devices and equipment, to create and use individual technical applications in digital technologies, to find solutions to real-life problems using mobile applications based on creative thinking, to study the mechanisms for creating independent field developments based on digital technologies.

In the modern higher education system, assessing educational outcomes based on a competency-based approach is one of the priority tasks. In particular, the formation of professional competence of students studying in technical areas and determining the level of its development requires scientifically based assessment criteria. In the educational process organized on the basis of a competence-based approach, the integrated state of the student's knowledge, skills, qualifications and personal qualities is assessed.

Based on the qualification requirements, in the example of the subject "Heat Supply and Heating Systems", the level of students' use of mobile applications and digital technologies can be expressed as follows:

High - Students are prepared to use knowledge of modern problems of science and education in solving tasks; have developed skills in applying knowledge of experimental methods and methods for processing the results obtained; have knowledge of methods for finding static and dynamic characteristics of control systems and have developed skills in using them; To have the skills to use energy-saving technologies in the modernization and reconstruction of heating devices and equipment, to apply methods for analyzing heat supply and heating systems, to adopt solutions to problems related to them, to know and be able to use the operation of heat supply systems and evaluate their technical and economic indicators, to know and be able to use basic concepts of the structure and principle of operation of devices, to be able to analyze ways to develop mobile technologies; to know virtual reality tools and components;

At the intermediate level, the student must have formed the fundamental theoretical knowledge and practical skills necessary for the study and deep mastery of the subject "Heat

Supply and Heating Systems"; have developed the skills to optimize processes for the successful implementation of general professional tasks located on the platform, mobile application; select terms that meet the requirements for given control systems; know the goals and objectives of heat supply systems; know how to solve problems related to the law of heat supply systems; know the essence of methods for calculating the types and components of heat supply systems; know how to use heat supply systems and evaluate their technical and economic indicators and be able to use them; apply methods for analyzing heat supply and heating systems. Have the skills to adopt solutions to problems that concern them;

Understanding the scientific and theoretical connection between lower-level specialized disciplines; the main tasks of studying the subject, students' understanding of the basics and types of heat supply, their use and utilization; the goals and objectives of heat supply systems; knowledge of the types and components of heat supply systems;

Low - lack of understanding of the scientific and theoretical connection between specialized disciplines; the main tasks of studying the discipline, students' lack of understanding of the basics and types of heat supply, their use and utilization; the goals and objectives of heat supply systems; lack of knowledge of the types and components of heat supply systems. The criteria for assessing the formation of professional competence in students were improved based on the use of digital tasks and cases designed to form such qualities as creativity, individuality, initiative in a differential-correction relationship in periodically controlled content. So, in conclusion, by introducing a model of improving students' professional competence using a mobile application based on a professional approach in teaching the subject "Heat Supply and Heating Systems" in higher education, it is possible to find practical solutions to the problems in teaching this subject.

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