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USING THE POSSIBILITIES OF MODERN INFORMATION TECHNOLOGIES IN TEACHING SPECIALIZED SUBJECTS

Prof. DSc. S. Yu. Ashurova

Prof.,DSc., J. A. Hamidov

PhD, O. A. Hamidov
Associate Professor

ABSTRACT

On the context of the rapid digital transformation of education, the use of modern information technologies in teaching specialized subjects has become an essential condition for improving the quality and effectiveness of professional training. The integration of digital tools such as virtual laboratories, learning management systems, simulation software, and interactive multimedia platforms enhances the teaching and learning process by creating an active, student-centered learning environment. Applying these technologies allows future specialists to acquire practical skills, develop analytical and creative thinking, and form digital competencies relevant to their future professional fields. This approach also facilitates the transition from traditional knowledge transmission to interactive, competency-based education. The study analyzes the didactic and methodological foundations of implementing information technologies in teaching specialized disciplines, identifies pedagogical conditions for their effective use, and provides recommendations for integrating digital tools into higher education curricula. The results demonstrate that systematic and purposeful use of modern IT resources not only increases students' motivation and engagement but also contributes to the development of flexible, adaptive professionals capable of functioning in the digital economy.

Keywords: Modern information technologies; specialized subjects; digital education; interactive learning; professional training; virtual learning environments; competency-based approach; innovation in education; higher education; digital transformation.

INTRODUCTION

The spectrum of academic subjects taught in professional education in higher education institutions is very wide. In particular, the main attention is paid, first of all, to the humanitarian preparation and economic literacy of students. In connection with the globalization of information processes, interest in the sciences of the earth, nature and man has also begun to grow. The scientific worldview of future specialists is formed mainly in the process of teaching fundamental sciences in the physics and mathematics cycle. In the formation of their professional training, along with the above-mentioned academic subjects, general technical subjects provided for in the curricula are also of great importance. Specialized subjects include such subjects as "Drawing geometry and engineering graphics", "Fundamentals of metrology, standardization and interchange", "Hydraulics and hydraulic transmissions", "Heat engineering", "Materials science and technology of structural

materials", "Resistance of materials", "Theory of machines and mechanisms", "Machine parts", "Fundamentals of electrical engineering and electronics". This is the subject of study of sciences, which is the theoretical basis of all possible technical and devices. The basis for their study is mainly theoretical knowledge acquired in the process of studying mathematics and physics courses. The task of teaching is to ensure the transition from the most general abstract concepts in mathematics and physics courses to the study of various real technical devices and systems. Teaching the above-mentioned general technical subjects has its own complexity, which is conditioned by the following factors:

- many students are not familiar with real technical devices and systems by the time they start studying specialized subjects. Because students are introduced to them later, that is, during the study of special subjects;
- the high complexity of idealized technical objects, the diversity and complexity of real technical systems and devices and their operating modes;
- the large volume of theoretical concepts used, their logical interrelationships and a high level of hierarchical structure of these concepts.

It is known that an idealized technical object is sufficiently complex compared to an idealized physical object, therefore, the direct application of physical laws to solving technical problems is an exception. An idealized physical object is a simple structural unit of an idealized technical object. The description of the process of operation of any technical object requires the simultaneous consideration of several physical phenomena (unlike the physics course, where each phenomenon is studied separately). In this case, the change in the ratio between the significance of one or another physical phenomenon in the operation of identical technical objects depending on their operating mode creates a number of significant difficulties for the learner. In many cases, the complexity of the information presented to the learner is so high that the learner cannot perceive (master) it to the required extent in the prescribed time. Therefore, the implementation of the didactic principle of convenience in teaching is of great importance in studying specialized subjects. When studying specialized subjects, students need to form in their memory a sufficiently large number of theoretical concepts, taking into account their interrelationships. The difference between the system of concepts of specialized disciplines and the system of concepts of other disciplines is its high level of hierarchy and the high level of logical interrelationship of the components of this hierarchy. Each new concept studied in specialized disciplines includes previously studied, that is, concepts familiar to the student. Therefore, the study of new educational materials in general technical disciplines can be carried out only under the condition of solid mastery of the previous ones. This can be achieved by creating and introducing into the educational process computer-based educational programs that provide:

- convenient presentation of educational materials of sufficient complexity, conditioned by the complexity of idealized technical objects and the variety of real technical systems and devices and their operating modes;
- reflection of a large volume of theoretical concepts used in the study of specialized disciplines, their logical interrelationships and a high level of hierarchy of these concepts;
- a large volume of various control exercises and exercises.

Today, there are different opinions on the use of modern information technologies in the educational process in teaching specialized disciplines. Such diversity of opinions is explained by the fact that each opinion speaker has his own limited subjective view and experience in this new area. Assessment of the feasibility of using modern information technologies in the educational process in specialized disciplines should be carried out on the basis of various data, comparisons.

The use of modern information technologies in the teaching of specialized subjects of higher educational institutions has shown that there is no generally accepted rule for studying, analyzing and comparing the data collected in the professional education areas, and for dividing the computer educational programs used in the educational process into types. This, in turn, requires the development of criteria for the classification of computer educational programs intended for use in the process of teaching specialized subjects. We tried to divide such computer training programs into types according to the purpose of use.

We have divided the computer training programs used in the teaching of specialized subjects into the following types according to their goals:

- pedagogical software tools (PST);
- information-search program system (ISPS);
- system of educational programs (SEP).

Pedagogical software includes service, control, training, modeling, demonstration and other similar single-purpose computer programs. The information-retrieval information program system includes, first of all, a database and a knowledge base. The difference between the educational program system and these programs is that it includes an automated learning system, an electronic textbook, an expert learning system, and artificial intelligence learning systems that provide the user with complex opportunities.

Let's consider the possibilities of each of the mentioned computer training programs in teaching specialized subjects.

Service software

They are mainly intended for automating traditional calculation methods, formalization of educational documents, and processing of experimental research data. They can be used in organizing and conducting laboratory and practical classes in specialized disciplines, organizing independent work of students, and designing course and qualification final projects. It should be noted that the initial introduction of modern information technologies into the educational process of educational institutions began with the use of such service software.

Software designed to monitor the level of knowledge of the student and organize and conduct tests. Such tools are widely used in the educational process due to their ease of creation. Today, there are instrumental (hardware) systems - "shells" with the help of which even teachers who do not know the basics of programming have the opportunity to place a list of questions and answers on one or another topic. In this case, the main task of the student is to choose the correct answer from the set of proposed answers. Such programs free the teacher from performing a number of traditional functions, such as giving individual theoretical assignments to the student and checking the correctness of their implementation. In addition,

the subjectivity of assessing student knowledge is limited. The opportunity is created to repeat knowledge many times and often, which in turn stimulates the repetition and consolidation of educational material.

Monitoring and testing programs fit very well into the rating system for assessing the level of student preparation. Since it allows the student to accumulate rating points accumulated over a certain period of training in a number of subjects.

The main disadvantage of monitoring programs is that with their help the assessment of student knowledge is carried out at a reproductive (unproductive) level. Therefore, today there is a need to create more advanced monitoring programs that are capable of setting creative tasks for students.

Control and test programs can be used in laboratory and practical exercises in specialized disciplines, as well as in conducting intermediate and final controls.

Simulators. These software tools are designed to form skills and qualifications. In particular, they are a very effective tool for forming practical skills, for example, for teaching a student how to behave in difficult, even emergency situations.

Simulators can be used to form skills and qualifications in solving practical problems in teaching specialized disciplines. In this case, they provide a brief theoretical introduction, practice at various levels of independence, control and self-control.

Software tools for mathematical and simulation modeling. These programs expand the boundaries of experimental and theoretical research, complement the physical experiment with a computational experiment. In one case, the object of study is modeled, in another, the measuring device is modeled.

The cost of purchasing modern laboratory equipment is reduced, the level of safety of work in educational laboratories is reduced.

To create modeling software tools, universal application packages such as MathCAD, MathLab, Evrica, MacroCap, pSpice, PCAD and others are currently used. The versatility and high quality of such application packages have shown that they can be widely used in organizing and conducting the educational process in various fields, including general engineering disciplines. For example, the MathCAD package is designed to solve mathematical problems. The advantage of this package is its ability to accept and process the problem statement and its solution in a form that is almost natural for a person, using conventional mathematical rules and generalizations. With its help, various computer-aided learning programs are currently being created for teaching specialized subjects.

Working with such universal packages does not require the user to have knowledge of programming languages. Another advantage of such universal packages is that they provide the user with many specialized functions. The wide range of specialized capabilities in them, in turn, requires a lot of time to master them and creates additional problems in using the allotted training time. Therefore, before using these packages in classroom exercises, it is advisable to create several sets of training tasks, several "models of laboratory stands".

Modeling programs also include object-oriented environments that provide the opportunity to rely on models of objects belonging to a certain class. They are based on the principle of "constructivism". This idea was created by S. Papert. According to S. Papert, a computer is a

tool with which you can make teaching more interesting and simplified, especially if it is based on a model of the real world.

In this environment, all objects and phenomena are represented in the form of elementary models of real objects and processes in the form of bricks, cubes. These objects do not live alone, they interact with each other. When creating a model of complex systems that the user can easily modify, he can resort to models of elementary objects as constructive materials.

Information-retrieval information system. This system is designed to enter, store and present various types of information to the user. This includes various hypertext programs that provide hierarchical organization of educational material and quick search for information by one or another attribute. Hypertext consists of many pages that contain references to each other. At the beginning of working with hypertext programs, a main page appears on the screen, which contains the title of the hypertext. Due to the presence of intersecting references, it is possible to move from section to section in a convenient way for the user, as well as to widely use all possible databases in the educational process, including in teaching general technical subjects.

The database was originally conceived as a computer tool for storing documents to replace the paper document system. Each record in the database is divided into fields according to the type of information stored in it. Data management systems provide information search and organization, as well as the creation of new fields. Databases can be used to present the content of educational materials in general technical subjects and organize their analysis. In addition, they can be used to organize independent work of students in order to search for and analyze the necessary information.

If the database is created by students, then this allows the student to have a deeper understanding of the material being studied, its structure and the relationship between its individual components. In this case, the database can be used as a tool for learning.

Automated educational systems

These systems are interpreted in some sources as educational software systems. For a long time, automated educational systems have been understood as voluntary computer programs designed to achieve educational goals. However, significant changes in the methods and tools of information technology require further clarification of the essence of this concept.

From our point of view, today an automated educational system is understood as a fairly large-scale educational program that provides familiarization of the learner with theoretical materials and some level of practice, as well as control over the level of his knowledge.

The word "automated" itself indicates that efforts to automate teaching are not yet complete.

Electronic (computer) textbooks. There is still no exact definition of the concept of "electronic textbook". Initially, an electronic textbook was understood as a methodological complex that provides independent mastering of a particular course or a large part of it.

However, such a definition of an electronic textbook does not fully reflect its current capabilities. An electronic textbook, from our point of view, should provide for the implementation of all the main functions, such as presenting theoretical materials and the application of initially mastered knowledge, and controlling the level of mastery, without any paper carriers, only with the help of computer programs. Such an electronic textbook should

also be easy to edit if necessary. It should fit well into the distance education system and automatically ensure the completeness and continuity of the didactic cycle of the educational process.

As is known, a didactic cycle is a structural unit that has all the qualitative characteristics of the educational process, ensuring the maximum organization of mastering the educational content in the form of a lesson. The didactic cycle consists of 5 links, the first link provides the question of knowledge, the second link provides the content of the educational material, the third is the application of the previously acquired knowledge, the fourth link is the organization of this feedback, that is, the control of the student's activity, and the fifth link is the preparation for future educational activities. Carrying out all the mentioned links of the didactic cycle without referring to paper carriers of information by means of a single computer program simplifies the organization of the educational process, reduces the time spent on teaching.

Based on the above, we have formulated the following working definition for an electronic textbook. An electronic textbook is a system of complex purposeful educational programs that ensure the completeness and continuity of the didactic cycle of the educational process, provide theoretical materials, provide training, educational activities and control over the level of knowledge, as well as information-search activities, mathematical and simulation modeling with computer visualization and service functions in the conditions of feedback and interactive communication. The creation of such electronic textbooks requires a lot of effort. The study of the listed functions within the framework of one educational program is a very difficult to achieve goal, but it must be achieved and is one of the urgent problems of today.

Expert educational systems. Such systems are studied on the basis of the idea of artificial intelligence, they model the activities of experts in solving sufficiently complex problems and are capable of assimilating new knowledge.

Expert systems are complex programs that manipulate knowledge in order to obtain satisfactory and effective solutions in narrow subject areas. They are primarily aimed at solving complex practical problems based on the knowledge of experts in mainly informal areas (nature, agriculture, management, electronics, etc.). This creates the opportunity to obtain comparable, and sometimes even superior, solutions to those that a human expert could achieve.

When working with expert systems, the user enters his own data reflecting a sufficiently complex situation under study, formulates a problem, and then receives a solution from the expert system.

Typical expert systems consist of the following components:

1) a database that stores a set of rules;

2) a working memory that stores the database;

3) an interpreter that solves the problems presented to him based on the existing knowledge system;

4) a linguistic processor that provides interactive interaction with the user in a language that is natural to him (natural language, professional language, graphic language, tactile effect, etc.);

5) a knowledge acquisition component;

6) an explanatory component that explains the actions of the system and answers the question of why certain conclusions were made or not.

There are also ideas about considering expert-training systems as a new type of system created on the basis of the practical use of artificial intelligence elements to model the activities (actions) of an expert in the methodology and didactics of teaching a particular subject.

Recently, expert-training systems have begun to be applied to newly studied and formalized subject areas that use a constantly or occasionally changing database. Creating expert-training systems is a very complex task.

When working with expert-training systems, stages 1 and 4 of the didactic cycle are not implemented.

Intelligent learning systems. Such systems belong to the highest level of systems and are studied on the basis of the idea of artificial intelligence. E. I. Mashbits indicated the following important features of intelligent learning systems:

1. An intelligent learning system can be implemented not by the result, but by the process, that is, at all stages, starting from the formulation of the educational problem and the search for the principles of its solution and ending with the assessment of the optimality of the solution, taking into account the characteristics of the learner's activity.
2. They, as a rule, provide interactive interaction in a language close to natural language. During the interaction, not only the correctness of this or that action is discussed, but also the strategy for finding a solution, planning actions, control methods, etc. can be discussed.
3. It implements reflexive control based on the learner's model. This learner model is clarified in the learning process.
4. This system can improve its teaching strategy based on the accumulation of a large amount of data.
5. The system does not store ready-made basic and auxiliary teaching actions, but generates them.

In other words, an intelligent teaching system should provide educational interaction with the user at the level of individual work of an experienced teacher. Therefore, in the most general case, an intelligent teaching system is not only a teaching program, but also a teaching system. There are occasional reports of the creation of intelligent teaching systems for the field of natural sciences and specialized subjects. Because in intelligent teaching systems, along with the problem of independent navigation of the learner in the knowledge base, the problem of achieving the goal of teaching also arises. The basis of the intellectual teaching system is the knowledge base of the subject area, theoretical knowledge (content of the subject) and subjective knowledge, that is, expert knowledge (teaching methodology, teaching experience).

In conclusion, it can be noted that in the field of specialized disciplines, the capabilities of modeling and control software tools and automated teaching systems are widely used. The capabilities of information retrieval systems and simulator software tools are used very little. Electronic textbooks, expert teaching systems and intellectual teaching systems have not yet been sufficiently developed, and the existing ones do not meet the requirements imposed on them.

Today, in order to ensure the completeness and continuity of the teaching process in specialized subjects, to provide theoretical material, to provide training activities, to control the level of knowledge, and to perform a number of similar functions, it is capable of performing the role of a didactic tool, organizing training sessions of various types.