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Features of training and retraining specialists in the technical sphere in higher educational institutions

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Abstract. This article describes the process of teaching students in a technical sphere in higher educational institutions. Characteristic features of their training are revealed. It is necessary to take into account current conditions of the educational process in higher education institutions where the tendency to success is increasing. Therefore, it was demanded to search for innovative ways of organizing the training process at a high level. Thus, the aim of the article is to identify features of this process in order to provide competent training. The authors point out the need to develop special teaching techniques for each discipline that will help students to learn better. Students are expected to study the subject profoundly and consolidate the content. This article describes the process of teaching students in a technical sphere in higher educational institutions. Characteristic features of their training are revealed. Current development of educational process in higher education institutions tends to reduce classroom time allocated to collaborate with teachers. Thus, special attention is paid to students' independent work and the necessity to provide them with fundamental education in the technical field.

1 Introduction

Constantly increasing amounts of information that students need to master studying technical subjects at the university, reduction in classroom pressure and increase in the share of independent work encourage teachers to search for effective training approaches and suitable ways to work with information. Training of students in a technical sphere is based on fundamental sciences. It is the basis of all training as it is impossible not to provide students with this knowledge despite the changed goals of education, its forms, methods and the role of the teacher in this process due to the changing meaning of educational paradigm. Today, students should be able to solve problems independently and creatively, be able to apply their knowledge in practice. It is aimed at the competence approach which is an integral part of modern higher education. The implementation of the competency-based approach makes it possible to form a competent, well-trained graduate. However, in this process, there are many features that need to be identified and taken into account when teaching students of technical universities.

As we have already said, the share of independent work of students is increasing, however, students who are considered by us need to be supervised by the teacher (this is especially important during the first years of study). Therefore, e-courses including open online courses are being actively introduced into the training process. Today, they are incorporated into education to implement the requirements of the Federal State Educational Standard which, in turn, provides students with academic mobility, freedom to exercise their creativity and develops their independence.



Consequently, we cannot but take these factors into account when training and retraining technical students.

2 Methodology

In the article we consider the process of teaching students in a technical sphere with the help of electronic tools in higher education institutions. We worked with students whose majors are «Construction», «Land transport and technological complexes», «Operation of railways». We designed e-courses for each subject to provide high-quality basic training for full-time students and retraining of students who study online.

As practice shows, students master the content deeper and more confidently using electronic technologies. The results of the final tests arranged with the use of electronic courses revealed higher results and showed further interest in studies compared to traditional approaches of students' training.

3 Results and discussions

To carry out the experiment we chose students whose majors are «Construction», «Land transport and technological complexes» and «Operation of railways». It is worth noting that graphic training is extremely important for these students [1]. It should take place throughout the entire learning process. The acquisition of basic graphic competencies occurs in the first and second years when students study technical and mathematical courses [2]. Graphic competence is the basis for acquiring professional competence of future engineers, technicians, designers and technologists [3]. Graphic disciplines are necessary for students to acquire professional knowledge and skills to perform, design and deal with design documentation. The block of graphic disciplines includes:

- descriptive geometry [4];
- engineering graphics;
- graphic means of PC;
- geometric modeling [5].

They are studied from the first until the fourth semesters and there are connections between them. Each stage involves the solution of certain pedagogical problems.

The first stage is «Descriptive Geometry». Here, students learn basic methods of obtaining images, theoretical rules, form presentation and transformation skills [6]. The course of descriptive geometry was created in order to provide students with theoretical foundations of drafting. This course is designed to develop creative thinking:

- figurative [7];
- spatial;
- logical;
- algorithmic [8].

It is important to say that traditional learning can be complemented by e-courses and blended learning. The use of such approaches in high school showed good results and proved to be efficient [9].

After completing the study of descriptive geometry, a student must learn how to:

- read the drawings [10];
- perform geometric constructions;
- be able to imagine the spatial image of an object according to its projections [11];
- draw up drawings according to established standards [12].

Here the student must learn to recreate three-dimensional images of an object from its flat images [13]. At this stage visualization is important. For better understanding of tasks the content must be presented on the screen [14]. These manuals require constant access so that students can refer to them at any time and recall something if there is a necessity. E-courses provided by educational platforms will help to solve this problem. It can act as an auxiliary tool for full-time study and the main one to retrain correspondent students.

The second stage is «Engineering Graphics». Its goal is to form students' competencies related to the development and execution of documentation. Engineering graphics provides the basis for studying other general engineering disciplines: materials resistance, the theory of mechanisms and machines and machine parts [15]. If students study an e-course in the classroom environment, both the teacher and students can refer to it. The course provides necessary tools to analyze learning tasks, illustrates the application of theoretical rules to solving practical problems and provides content to master skills. These tools include:

- video lectures [16];
- simulators for practicing skills with the help of theoretical material [17];
- test tasks to check the degree of gained knowledge [18];
- laboratory workshops in computer graphics.

The third stage is «Graphic means of a personal computer» and «Geometric modeling». Students master a lot of specialized software systems for engineering modeling, design and engineering [19].

Students become familiar with industry standards in drawing design and the basics of spatial modeling.

The aim of the course is to teach students to develop models of information systems, models of databases and human-electronic computing interfaces, components of hardware-software systems and databases using modern tools and programming technologies.

When studying these courses, visualization is important. For better understanding of tasks, materials must be presented in the monitor screen [20]. These manuals require constant access so that students can refer to them at any time and recall necessary elements.

We believe that in order to master basic courses (graphics courses) better it is necessary to develop additional electronic courses that would serve as a supplementary element when teaching in the classroom [21].

Each topic should be provided with lecture content, presentations and analysis of tasks.

Some topics should include laboratory work, test questions and assignments that allow students to be certified. Each topic must be accompanied by a video [22].

In the training of engineers, as we have already mentioned, visualization is important. Therefore, 3D models, electronic posters and presentations can provide electronic platforms and should be used by students alongside courses developed by teachers [23]. The advantage of computer models is the ability to reproduce not only geometric shapes but also physical and mechanical characteristics (hardness, plasticity, bending, reflectivity, torsion), as well as animation of movement and interaction. As a result, students acquire a correct visual image of spatial forms.

In addition, 3D-visualization allows you to contribute to students' desire to self-master the technology of three-dimensional modeling. In order to achieve it, students have to study the objects independently and thoroughly being able to understand their properties and to work through the content of the topics more deeply. Nowadays students need the support of electronic courses which are available and accessible at any convenient time. Open access allows the learner to allocate time to do extracurricular work most effectively. Some of the materials can be placed locally, in computer classrooms for example, and some tasks can be found on the Internet.

Electronic technologies allow students to conduct experiments independently or with minimal help from a teacher. For example, when studying the topic «Surface formation», a student can conduct an experiment in which the impact of the surface shape on the shape of determinants in the kinematic method of surface formation is revealed and established.

In our opinion, in addition to e-courses developed by teachers for university use, massive open online courses should be included. However, teachers must, first of all, pass such courses themselves and evaluate their usefulness and effectiveness before involving students into working with it.

4 Conclusions

We have reviewed the process of teaching students in a technical sphere in higher educational institutions, the study by future engineers of the disciplines of the graphic cycle.

We found out that control and support from teachers are extremely important for such students because they have to deal with huge amount of tasks independently. To solve the problem we suggested creating e-courses for each discipline that will support both students and teachers. As practice shows, this type of training is of great interest among students. They can independently carry out experiments, have self-testing and they are engaged into extracurricular activities in the electronic environment, since the training content is publicly accessible. The results of the final testing at the end of the course are higher than without the use of electronic courses. Another reason that proves the importance of developing such courses is the need for clarity of examples to visualize information. Electronic platforms provide enough tools to complete this task. Future engineers acquire a correct visual image of spatial forms. As a result, high educational institutions contribute to teaching competent and independent specialists in the technical sphere.

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