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## **ANALYSIS OF FORMATION METHODS OF GRAPHIC COMPETENCE OF FUTURE ENGINEERING TEACHERS**

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### **Article**

The article substantiates the need to improve the formation methods of graphic competence of future engineering teachers by means of digital technologies. To achieve the goal of the article the analysis of normative documents of training of future engineering teachers in the field of digital technologies, methods of teaching graphic disciplines in Higher Education Institutioni, prospects of improving graphic training of future engineering teachers by means of digital technologies are determined. Based on the analysis of work programs of the cycle of disciplines of graphic training, we conclude that today the method of formation of graphic competence in future engineering teachers in the field of digital technologies needs to be improved.

It is established that the most effective way to reform the system of training future engineering teachers in the field of digital technologies is the use of modern learning

technologies, which include design, research, integrative technologies that provide personality-oriented learning and graphic competence of future engineering teachers in the field digital technologies. It is determined that it is necessary to improve the teaching methods of the discipline "Engineering Computer Graphics", which will include the study of two-dimensional graphics, three-dimensional spatial modeling, 3D printing technologies and the creation of 4D objects in KOMPAS-3D.

**Key words: graphic competence; teaching methods; professional education; engineering teachers; digital technologies.**

**Statement of the problem in general and its connection with important scientific or practical tasks.** The current concept of training future engineering teachers in Ukraine focuses on global trends in higher education, which involves training professionals with competencies that allow them easily adapt different types of professional activities. Therefore, given the specifics of higher education by future engineering teachers in the field of digital technologies in modern conditions, there is a need for a different from the unified form of their training.

When studying the disciplines of the cycle of professional training, students need to master professional skills and creative thinking, given the rapid development of modern digital technologies. The formation of competencies involves the replacement of the model of learning to operate with the acquired knowledge on the humanistic model, which involves the development of a person who actively cultivates creative potential and professional skills [1]. It is the competence approach that is actively implemented in the teaching process of higher education institutions, as such an approach makes it possible to clearly identify his professional functions from the existing model of the specialist.

Therefore, we think that the most effective way to reform the system of training future professionals in the field of digital technology is the use of modern learning technologies, which include design, research, and integrative technologies. They allow providing personality-oriented training and formation of graphic competence of future engineering teachers in the field of digital technologies.

**Analysis of basic research and publications on the issue.** Planned in 2012–2021 in the National Strategy for the Development of Modern Educational Processes in Ukraine in the Context of Professional Training of Future Specialists in Higher Education Institutions, the main key areas of state educational policy should be [4]:

- updating the structure, content and methods of organizing the educational process based on the competence approach, changing the direction of the content of education taking into account the areas of sustainable development;

- introduction and provision of opportunities to implement in the educational process different educational models, institutions of various types and forms of ownership and ways of obtaining educational services;

- creation of the current system of the state educational, developmental process of youth;

- providing an accessible and continuous educational process throughout life;

- increasing scientific and innovative activities in the field of education, increasing the quality of education based on innovative learning;

- development of the process of informatization of the educational process, improvement of the library, information and resource fund of education and science; - providing state monitoring of the education system;

- formation of innovative material and technical support of the modern system of educational process.

Based on the analysis, we conclude that improving the training of future engineering teachers in the field of digital technologies and, accordingly, increase their competitiveness in the labor market is possible subject to certain conditions, namely:

- formation of modern state, branch standards of professional education aimed at the formation of professional competencies;

- creation of a unified state system for measuring the quality of education;

- approval of qualifications in accordance with the European system of educational standards;

- systematic application of modern technologies of education;

- coordination of education standards and training programs with the educational and qualification requirements of employers (stakeholders);

- orientation of curricula to increase the implementation of the practical component;

- providing an opportunity to develop a system of "lifelong learning";

- improvement of the legislative base on diversification of sources of financing of education, introduction of autonomous work of the higher educational institution of educational, scientific, financial and economic activity;

–the presence of higher educational institutions of Ukraine in the list of international rankings of the best universities [ 5 , p. 31].

**The purpose of the article is to** substantiate the need to improve the method of formation of graphic competence of future engineering teachers by means of digital technologies.

**Research methodology.** To conduct the study, an analysis of normative documents for the training of future engineering teachers in the field of digital technologies, methods of teaching graphic disciplines in freelance, identified prospects for improving the graphic training of future engineering teachers by digital technologies.

**Presenting main material.** Today there is no single method of teaching disciplines related to the study of computer-integrated technologies (personal computers, computer network technologies, automation and design, etc.) taking into account the pace of their development, the requirements of modern society and the future teachers in the field of digital technologies. Therefore, one of the ways to improve the quality of the organization of the educational process is the introduction and application of new teaching methods in higher education institutions (HEIs), their constant updating and transformation. Modernization of teaching methods in higher educational institutions provides an opportunity to both deepen and intensify the educational process, to shape the learning process in terms of content, technological component, structural foundations. Teaching methods are constantly updated, particular, in structural and organizational technologies, with innovative trends in the development of the free economic system of Ukraine with action programs implementing the provisions of the Bologna Agreement of European countries.

Analyzing the educational programs of future engineering teachers in the field of digital technologies, we can identify the following main reasons for the lack of quality of educational and cognitive activities of students:

- there is a violation of the order of sequence of study of disciplines;
- lack of substantiated repetition of the passed educational material;
- there are shortcomings in the logical connection between the topics of classes and the means used.

Analyzing the existing methods of teaching computer cycle disciplines in the Free Economic Zone, no single system of teaching methods was found, which would take into account the content of disciplines and the purpose of training future professionals. This encourages the need to create and justify the use of certain learning tools based on the main factors of the competence approach using modern digital technologies (DT).

According to M. Zhaldak, "the introduction of ICT in the educational process of higher education institutions should not be in the form of automatically filled classes with hardware and curricula." The priority direction of development of the modern education system is the use of innovative teaching aids and competency approach [3].

Today, changes in the educational process are not only in the content aspect of education, but also in the improvement of learning technologies. The basis of education is not only the provision of students with educational materials, but also the ability to manage the educational process, plan and model their professional activities. Therefore, the education obtained in the Free Economic Zone becomes the main factor of continuous professional training and self-development of future specialists.

The training of future specialists in this field should be based on a thorough theoretical and practical training, taking into account the modern development of science and technology, the formation of professional competencies, including graphic competence. Therefore, we consider it necessary to analyze the methodology of formation of graphic competence of future engineering teachers in the field of digital technologies in order to improve it.

Based on the analysis of work programs of the cycle of disciplines of graphic training, we conclude that the analyzed disciplines are the basis for the formation of graphic competence of future engineering teachers in the field of digital technology. However, not enough academic time is allocated for the formation of their graphic competence, as students study only the basics of work in different software environments, and do not study the technology of 3D printing, 3D scanning. Therefore, we can say that today the method of forming graphic competence in future engineering teachers in the field of digital technologies needs to be improved.

In addition to the analysis of work programs, for a full study of traditional methods, we analyze a number of universal software (software) to create graphic 3D-objects and models, which today are the most popular and most in demand in the labor market .

Determine the rating of software based on the standard ISO 9126: 2001 to describe the quality of software, taking into account the parameters, where each characteristic is described using several attributes included in it [2]. In this case, it is functionality, usability, performance, program interface, as well as the quality of rendering (final image after processing). Since these criteria are not equivalent, therefore, for each of them are determined by the coefficients of importance in accordance with the task (table 1) [6]. However, each of the analyzed software is used in different directions and has different parameters (Blender, 3D Max, Archicad, KOMPAS-3D, SolidWorks, Arcon 3D Architect).

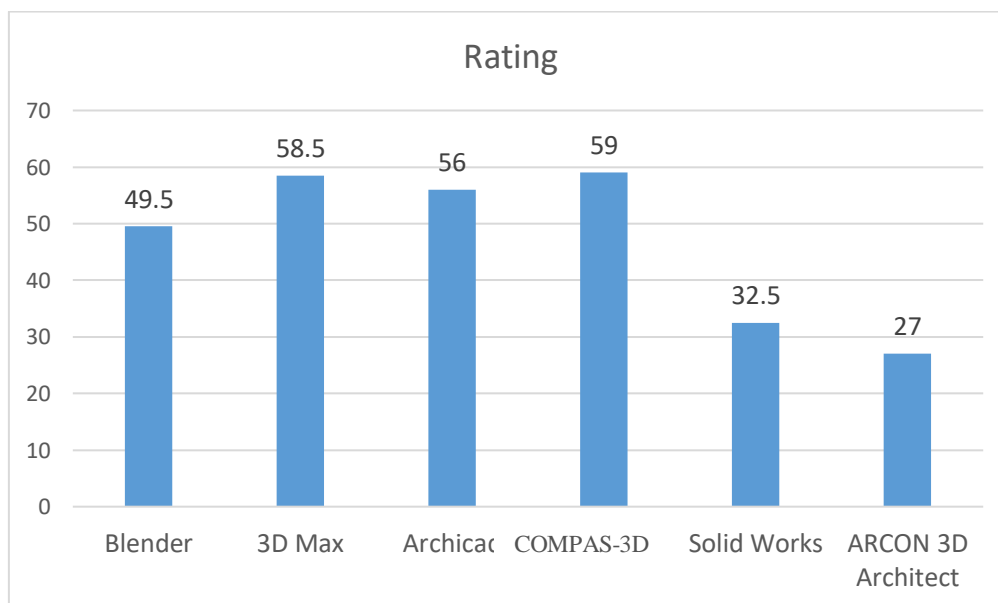
Table 1

### Software evaluation parameters

Parameter	Coefficient of importance
Functionality	3
Ease of use	2
Productivity	2.5
Program interface	1.5
Number of libraries	4
Export to STL format	+ / -

Evaluation was carried out in a system of 1 to 10 points for each parameter based on experience with graphics software, analyzed scientific literature, surveys and subjective judgment. The overall rating is equal to the sum of points for each parameter multiplied by the corresponding coefficient. The results of the comparative analysis are presented in Pic.1.

After analyzing and evaluating these software on the five main parameters, the most convenient and effective for student learning today are the first 2 software: 3DSMax and KOMPAS-3D , which work is convenient and efficient over time. Given the rating and demand for specialists with skills in this software in the labor market, for the formation of graphic competence in future engineering teachers in the field of digital technology chosen KOMPAS-3D environment. It has all the necessary tools to object-oriented approach 3d-modeling, rendering of high realistic quality and the ability to export the model to STL-format for further printing.



Picture 1. - Software evaluation indicators

In the content of the curriculum "Engineering Computer Graphics", which is studied by bachelors majoring in Professional Education (Digital Technology) in the first year (1-2 semesters), is the basis for studying computer graphics, and hence the formation of their graphic competence. In this course, future engineering teachers study the technologies of spatial modeling in the software environment COMPASS-3D.

The structure of the program of the discipline "Engineering Computer Graphics" provides, for the most part, the creation of two-dimensional images, work on the design of textual and graphical information, construction and processing of raster graphics, technology for creating 3D objects. Analyzing the content of the discipline, it should be noted that the main focus is on working with two-dimensional graphics. The content reflects the instrumental approach to working with the graphical environment. This indicates that it is not aimed at the algorithm of professional activity of future engineering teachers in the field of digital technologies, but at studying the tools of the software package, that reflects the content of previously analyzed textbooks.

It should be noted that the analyzed work programs do not provide innovative teaching methods that could be used to create educational projects combining engineering and graphic activities and skills in 3D printing, to obtain realistic three-dimensional images, animated videos and 3D layouts. From the point of view of the concept of graphic competence, it does not fully meet the requirements for qualified engineers-educators in the field of digital technologies. Thus, the programs do not disclose the sequence of activities that are implemented in the professional activities of future professionals.

**Conclusions from the study and prospects for further research.** Thus, the analysis of graphic training methods allows us to say that it is mostly focused on acquainting students with the software, functionality, and individual stages of work in it. We consider it necessary to highlight the problem of forming graphic competence of pedagogical engineers in the field of digital technologies due to the predominance of theoretical content of graphic disciplines in relation to the current state of CT development, the need for appropriate textbooks, guidelines, integration of technical disciplines. This highlights the need to improve the methodology of formation of their graphic competence with the introduction of new goals, theoretical content, methods and tools, organizational and pedagogical conditions, diagnosing the quality of the educational process.

Therefore, we consider it necessary to propose to improve the teaching methods of the discipline "Engineering Computer Graphics", which will include the study of two-

dimensional graphics, three-dimensional spatial modeling, 3D printing technologies and the creation of 4D-objects in KOMPAS-3D.

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