

SCIENTIFIC AND THEORETICAL JUSTIFICATION OF TEACHING
COMPUTER GRAPHICS

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Abstract

The problems of teaching computer graphics in the field of information technology teaching have become the subject of a multifaceted discussion among specialists from various fields, including artists, psychologists, educators, methodologists, sociologists, and information technology professionals. The relevance of this topic is driven by evolving educational objectives and the necessity for continuous professional development within the sector. The results of various studies conducted in this field are presented in the scientific and scientific-methodological literature, addressing both the theoretical foundations and the specifics of practical application.

The main provisions of the research have a tangible applied value in the field of secondary vocational education (colleges). Accordingly, the system of creative and performance tasks of the computer graphics course in the field of information technology has been presented, which can be used in the educational process, stimulating the creative approach of students. A methodology for integrating computer graphics has also been developed, combining it with the main graphic and professional subjects of the curriculum. The findings of this study contribute to pedagogical practice by confirming the framework's applicability and effectiveness in modern educational environments. Thus, in order to solve the problems arising in the educational process, it is necessary to deeply study the peculiarities of the application of computer graphics models in the context of colleges. Such a study will allow to identify effective methodological approaches in the field of information technologies, contribute to the modernization of the educational process and ensure the balanced development of students' professional abilities.

Keywords: Information technologies, computer graphics, learning model, colleges, students.

Introduction

In the modern world, new information technologies, including computer graphics, are widely used in various fields, from industrial design to architecture, graphics, and engineering design. The rapid

pace of changes in living conditions, the changing worldview and professional requirements of modern society create serious challenges in the field of education. In this context, certain contradictions emerge: on the one hand, the growing demand for education, and on the other, the slow pace of qualitative improvement of the educational system. The purpose of this article is to substantiate the theoretical activity of teaching information technologies in colleges using the example of computer graphics.

To achieve the goal, the following main tasks are set:

1. To study the main issues of teaching computer graphics to college students, based on psychological, pedagogical and scientific-methodological literature.
2. Define the role and place of computer graphics in colleges within the context of the overall system of professional education.
3. To create appropriate pedagogical conditions that will promote the effective teaching of computer graphics within the framework of secondary vocational education.

The scientific novelty of this article is expressed in the fact that the theoretical and methodological foundations of teaching computer graphics have been substantiated and a pedagogical model for teaching computer graphics has been formulated.

Accordingly, the following fundamental proposition is put forward: the theoretical and methodological foundations of computer graphics should be scientifically substantiated and systematically introduced into the educational process of colleges. The research was conducted using combined methodological approaches, which include: theoretical analysis and empirical methods.

The approaches developed during the research are applicable to improving the quality of computer graphics teaching in secondary vocational education. Special emphasis is placed on the opportunity to gain creative experience as a dynamic field of art, contributing to the student's development as a future educated specialist.

The theoretical basis of computer graphics. Computer graphics is one of the most important areas of information technology, which deals with solving various image problems using a computer. Computer graphics is the most popular direction among personal computer users.

Without computer graphics, no modern program can function. In the environment of programmers, graphic work occupies about ninety percent of the actual working time. During this period, various design programs of mass application are released. The main labor cost in editorial and publishing work is also artistic and design work with graphic programs. With the development of the Internet and Artificial Intelligence (AI), the need for widely used graphic software tools has become significantly tangible among the public. The need for new approaches to teaching computer graphics in the field of information technologies is becoming especially relevant, which is due to the reassessment of the accumulated knowledge system in line with the requirements of modern society.

This process leads to a rethinking of the traditional educational system, aiming to ensure the individual development of the learner and the opportunities for full participation in public life. In this regard, the development and application of modern models of teaching computer graphics are becoming essential, especially in colleges, since there is an acute lack of competent use of new information technologies among students. “It turned out that the majority of students have unmet interests and needs: they lack the knowledge on how to use the latest devices in education” [Avetisyan, 215].

It should be noted that the effective organization of computer graphics education in colleges faces a number of systemic and practical obstacles. These obstacles are due to both internal organizational problems of the educational sector, as well as socio-economic and technological factors. In particular:

- The lack of high-quality teaching staff, which arises as a result of inadequate social conditions, low salaries, and difficulties in attracting specialized personnel to the field.
- The limited use of modern pedagogical technologies, which hinders the effective integration of computer graphics teaching into the teaching process of other graphic subjects.
- The lack of modern methodological programs and textbooks in the native language, which would be in line with both technological progress and the requirements of a given educational level.
- Incomplete understanding of the role of computer graphics, which often leads to a decrease in the appreciation of the subject due to limited inclusion in educational programs or insufficient attention.
- Insufficient level of funding, which hinders the technical re-equipment of educational institutions, the acquisition and modernization of computer equipment, and the development of new information technologies.
- The scarcity of international programs for training specialists, which limits the application of innovative experience and the transfer of modern knowledge in the educational process.

All of the listed problems require a comprehensive and systematic approach, including improving educational policy, restructuring financial flows, developing new programs for the training and retraining of specialists, as well as updating educational content in line with the requirements of modern society. The scope of application of computer graphics is not limited to artistic effects. In all areas: science, technology, medicine, commercial and management activities, computer-generated tables, graphs, diagrams are used to visually display various types of information. Initially, computers were used only to solve scientific and production problems. In order to fully understand the results obtained, they were subjected to graphic processing. Graphs, diagrams, drawings of designed structures were created. For the first time, graphics on machines were obtained in the character printing mode. Then special devices appeared - plotters, for depicting drawings and drawing on paper with an ink pen. During this time, a number of branches of graphics were formed, which included:

- Scientific graphics that enable computational experiments with outstanding results.

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- Practical graphics, which is the branch of computer graphics designed to visually present the performance of various indicators in institutions.
- Design graphics, which are used in the work of design engineers, architects, and inventors who create new technology.
- Illustration graphics, which is considered computer-based freestyle drawing and painting, the simplest software tools for which are called graphic editors.
- Artistic and advertising graphics, which uses appropriate computer programs to create various advertising videos, cartoons, games, video lessons, slides, etc.
- Animation and Multimedia, which is the combination of high-quality images on a screen accompanied by sound, is most popular in the fields of education, advertising, and entertainment [Bajracharya, 3].

The most effective and convenient way to perceive information has been, is, and will be graphic information for the foreseeable future. Thanks to these features, the images being examined are instantly connected to images encountered throughout life and are recognized.

There are three types of computer graphics: raster (dot), vector (linear), and fractal. They differ from each other in the principle of image formation: reflection on a monitor screen or printing on paper. The basic element of raster graphics is the dot. In computer graphics, a dot image is an array of pixels, geometric figures of the same size and shape, arranged on a regular grid. Each pixel is assigned a unique color.

In vector (linear) graphics, the basic element of the image is the line. In computer graphics, a vector image is a more complex and diverse set of geometric bodies. The most important feature here is that the regulating characteristic quantities are determined for each object. Almost always, vector images are converted to point images before output. This process is called rendering, which is a key part of computer graphics courses. As a result, in the final list of subjects and percentages of introductory computer graphics courses, rendering makes up a significant share - about (75%). The rest is summarized by modeling (14%), animation (7%), fundamentals (3%) and visualization (1%) [Balreira et al., 1].

A fractal is an image made up of interconnected elements. Fractal images are created by an algorithm or by automatically generating images using a specific formula. It is a separate section. Three-dimensional graphics, which contain many elements of vector and point graphics. It is used in interior design, architectural structures, video shooting, advertising, jewelry, and computer educational programs. Three-dimensional computer graphics allow you to create three-dimensional three-dimensional scenes by modeling conditional lighting and viewing points [Żyła, 2]. Such compositional means as the display of space, the laws of environment, light and shadow, linear, aerial, and color perspective have obvious advantages here, in contrast to vector and point graphics.

The educational model of computer graphics in colleges: The development of the educational model of computer graphics makes it possible to bring the organization of the educational process in colleges in the professional field as close as possible to real conditions. This is an important condition for the formation of a high-quality specialist, fully applying his creative abilities in both teaching and artistic creative activities. Modern challenges present fundamentally new personal qualification and other professional requirements for the modern computer graphics specialist.

In connection with the rapid development and improvement of the computer graphics educational model, its renewal and the availability of a large amount of information, the development and improvement of the professional abilities of the lecturer in his field, adequately and quickly responding to the changes of the times, is gaining importance. Computer graphics teaching technology can provide future specialists with high professional training, implementing training in the use of computer tools, stimulating the artistic interests of students, including the development of personal qualities and abilities. The specialist must be able to monitor and best adjust the educational process, taking into account the individuality of each student.

Effective organization of the computer graphics teaching process in colleges is easy for an experienced lecturer who not only knows how to teach computer programs, but also can analyze the results of these programs used in the teaching process, make changes to them, and make additions, taking into account the peculiarities of students' perception of the material. The characteristic of computer resources in the teaching process is the visualization of information, which is an effective means of a person's creative thinking. New information technologies make it possible to present not only individual objects in their existing form, but also the logical connection between the tasks set. Thus, unlike the information presented in the literary text, images make it possible to master its real volume, focusing attention, having a more active and emotional impact on perception. They also make it possible to more fully use the mechanisms and functions of visual memory. Moreover, compared to textual information, images contain more information. They reflect the specific properties of the object, which are well remembered and maximally focus the learner's attention.

In the process of teaching computer graphics, it is necessary to pay attention to the features of the visual representation of information. The results obtained by some experimental researchers have shown that a literary description, as a description of an object, is always less effective than the presentation of the object. The method of depiction contains more information than a sound description. It should be taken into account that visual thinking underlies spatial thinking, which is of great importance in graphic work. The visual representation of educational information can also be effective when teaching computer graphics. The presentation of a graphic image, information in the form of a graphic image, affects the development of sensory perception and abilities. From the above, it follows that when teaching computer graphics, it is desirable to combine different forms of information presentation, the source of which can be not only text, teacher's explanation, manuals,

but also new information technologies: the Internet, educational animations, multimedia, interactive graphics, etc.

For the development of visual thinking, the information presented in the learning process of students, along with the shortcomings of the current data and a certain amount, should be combined with the corresponding stages of computer graphics work. Students in the learning process can have the right to freely choose proportions and use various sources of obtaining the necessary information. The latter help in the formation of the individual creative qualities of a person. This is relevant at the time and at those stages of learning when the student is able to independently perform creative work and freely use the capabilities of computer graphics during learning.

A complete theoretical system of computer graphics teaching can adequately present the essence of the problems it covers only if the most important pedagogical, psychological and didactic regularities related to the organization of educational activities using computer resources in specific conditions are taken into account when building it. In the famous work “Computer Graphics: Principles and Practice”, the authors emphasize the fact that new information technologies in teaching can be viewed as a methodology of the educational process, using the latest electronic means, primarily computers: “Since computer graphics are actually used around us, we are forced to make concessions to the widespread practice, which, in general, has developed because it gave fairly good results at the time of its development. However, after discussing the widespread practice, we will often also have separate criticism of it, so that the reader can begin to understand the limitations of different approaches to graphic problems” [Foley et al., 12]. Some researchers (T. Boubekur, Ch. Schlick, P. Barla, J. Thollot, F. Sillion and others) also point to the computer as the most important element of the information sphere of an educational institution, since we consider a drawing to be a digital image consisting of a series of vectorized two-dimensional lines [Boubekur & Schlick], [Barla et al]. This is explained by the functional versatility of the computer, which has become evident in recent years with the availability of powerful personal computers of the latest generations in the educational process. Such means of information technology as multimedia, virtual reality, artificial intelligence, etc. have appeared in pedagogical activity. It is legitimate to expect that didactic opportunities based on such computers will grow rapidly in the conditions of the use of information technology means. Information and communication technology means include software-based hardware that operates on the basis of microprocessor technology, as well as modern information exchange tools and systems that provide the context for collecting, processing, storing, protecting, processing, and exchanging information used in computer vision. In a sense, computer graphics and computer vision are the opposite of each other. Computer graphics takes a digital description of a scene and displays it, while computer vision analyzes images to create digital representations of the scene. Thus, when performing computer vision tasks in graphics hardware, graphics hardware is used in a “reverse” way [Chan & Durand, 40.1].

The introduction of information technologies in education is one of the most complex tools for positive change in education. It should be noted that the first concept of computerization of education was mainly developed by BF Skinner in the 1950s-60s. Skinner proposed the idea of programmed learning, which included step-by-step provision of learning materials, constant assessment of student response, and immediate feedback. This approach later became the basis of computer-assisted instruction (CAI) [Skinner, 43]. The importance of information technologies in colleges is due to the fact that the active informatization of production defines a similar process in the education sector. The analyzed scientific and methodological works reveal the reason for the relevance and expediency of the use of information technologies in educational processes. Among them, the fact that the general technical preparation of students should correspond to the rapidly changing requirements of production is of primary importance, in addition, experimental data confirm the increase in the activity of students, the effectiveness of independent work in conditions of information comfort. The justification of the problem of introducing information technologies into the educational process examines the origin of the question: does pedagogy need a computer after the understanding of the concept of computerization of education, the introduction of personal computers into the educational process, the development of computer technologies for education, and the evaluation of the effectiveness of pedagogical software training? It should be noted that software and its role in the design of the learning process require the student to communicate with the following pedagogical software tools. The introduction of personal computers into education can be viewed, on the one hand, as a general process of computerization that is spreading everywhere, and on the other hand, as a means of efficiency. It should be noted that new information technologies are a powerful tool in the education of the learner and the development of various abilities, especially creative, which in this sense has a clear advantage over all other traditional means. According to the work “Digital Modeling of Material Appearance”: “Artists themselves conceived the form and selected materials to build such objects in the physical world. A purely artistic approach could be used to digitally paint shades of light and dark on digital forms to create the illusion of translucent stone or shiny golden metal” [Dorsey et al., 4]. In this context, we note that while the main attention in the research of specialists from the post-Soviet region is traditionally paid to the pedagogical perspective, in Western practice there is a certain tendency towards the technological direction, in which information technologies are viewed as a pedagogical software tool. The term pedagogical software should be understood as those application programs that are designed to organize and support an educational dialogue between the user and the computer. Their functional role is to provide educational information and guide learning, taking into account the individual capabilities and preferences of the student. Pedagogical software tools are created and used to achieve certain goals and objectives of pedagogical training.

Conclusion

Thus, having comprehensively studied the current topic, we came to the conclusion that for the effective organization of information technology, in particular computer graphics, teaching in the college educational system, simultaneous methodological, organizational, and technical solutions are necessary, which include:

1. Designing a new pedagogical model that combines the teaching of computer graphics with artistic and professional subjects.
2. Integration of innovative information technology tools: multimedia, virtual reality, artificial intelligence, which increase the effectiveness and interest of learning.
3. Continuous development of the professional skills of lecturers to apply modern software and methodological tools.
4. Modernization and language localization of educational content, which will increase the accessibility of education and the compliance of national educational programs with technological requirements.

The introduction of innovative technologies into the educational process requires high pedagogical skills of the lecturer, the search for the development of certain pedagogical methodologies aimed at the formation and development of technical thinking of students. In general, our research showed that the theoretical substantiation of information technology, especially computer graphics, teaching can provide a new level of education quality, as it contributes to the formation of students' creative self-expression, professional self-awareness and technological literacy, in line with modern educational requirements.

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