

DEVELOPMENT OF INFORMATICS COMPETENCES OF COMPUTER SCIENCE TEACHERS DURING THE TRAINING COURSE “COMPUTER GRAPHICS”

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***Abstract:** Learning of computer graphics by the students of information specialties in pedagogical universities is related to the modern trends of information and communication technologies (ICT) development. The article substantiates the necessity of introducing this course in the educational process of training of future computer science teachers. It is indicated that learning of the course contributes to formation of important interdisciplinary and disciplinary professional competences needed for modern ICT experts and future computer science teachers.*

Keywords: computer graphics, training of future computer science teachers, competence approach.

INTRODUCTION

Informatization of education makes demands on the modern teacher to master computer technologies. The growth of the modern society sets absolutely new tasks for education system. First of all, this requires forming of the personality that effectively responds to the technologies upgrading. Now the society needs the pedagogy on the base of which the components of creative style of human thinking is formed.

The main feature of the thinking style is the ability to analyze any problems, establish systematic relations, identify contradictions and find ideal solutions to them, and predict possible options of the solutions development. People with such thinking style are ready for the changes in technologies. They consider these changes an opportunity to gain moral vital satisfaction from solving current intellectual problems. Formation of such qualities in young people is provided by using the competence approach in education.

Similar research is substantiated by many theorists and practitioners of using the competence approach in the experts training, including the training of future teachers (Zhaldak, Ramskyi & Rafalska 2009; Smyrnova-Trybulska 2007; Bibik, Ovcharuk 2005; Kuzmina, Strutynska 2011; etc).

Changing of social conditions constantly improves educational concepts. Now the main priorities in the education system are not only skills and knowledge, but also the personality of the student with his/her individual characteristics and abilities. Thus, there is a task to define training time as student creative work aimed at active scientific and educational activities and the use of modern information technology. The view concerning the self-education and the content and methods of the disciplines varies under the influence of new information technologies. The process of informatization of education allows teachers to use in teaching a wide range of information technology, one of which is computer graphics.

Computer graphics is a relatively new area of human activity, which is a set of hardware and software for the creation, saving, transmission, processing and visual presentation of graphic data.

The purpose of the article writing is the justification of necessity in the training of computer graphics for the students of pedagogical universities. If the computer science teacher masters the basics of computer graphics design, he/she will actively use a variety of computer tools in the professional activities. This will expand the choice of materials and forms of educational work. Also it will make possible to independently create own training materials that are fundamentally different from traditional ones. This will help to make lessons more vivid and exciting and give the impetus to the pedagogical creativity on the basis of the modern techniques and technologies.

1. THEORETICAL BASIS OF LEARNING COMPUTER GRAPHICS BY FUTURE COMPUTER SCIENCE TEACHERS

Computer graphics is considered a set of methods and techniques for converting data into graphics presentations (and vice versa) with the use of a computer.

The student which masters the basics of computer graphics may present the training material through computer visuals. Wide expansion of multimedia technologies requires preparing of future computer science teachers with including a necessity of them taking a computer graphics course. For this purpose educational course “Computer Graphics” is created. The main requirement for prior training of students is gaining of basic computer science course.

The purpose of the course is systematization of knowledge on modern graphics programs, mastering the skills of using basic software tools for working with raster and vector graphics, and forming practical skills related to software products of raster and vector graphics at the expert user level.

This purpose is realized through **the goals and objectives of the course “Computer Graphics”**:

- Providing the students with strong and conscious mastering of knowledge about principles and processes of creating and processing of graphic images;
- Forming of the students holistic understanding of the principles for working with programs of raster and vector graphics;
- Learning of formats of graphic files and the practicability of their use while working with different graphics programs;
- Training of the students for gaining by them the skills of creating and editing of their own images with the use of graphics software tools;
- Training of the students for gaining by them the skills of making graphic data exchange between programs;
- Forming of the students’ practical skills of working with modern graphics software;
- Training of the students for gaining by them motivated development of designing task and choice of the optimal algorithm of actions;
- Development of the students’ creative thinking;
- Mastering the skills of individual and team activities while the developing and implementing of the object models projects;
- Forming and developing of the students’ motivation to learn environmental, mathematical and technological sciences based on the use of modern computer design;
- Developing of the skills of conscious and rational use of software tools in their training activities to solve specific problems.

The course consists of 72 learning hours, 54 hours of them are class exercises, 18 hours are dedicated for the students’ individual work, 18 hours are lectures, and 36 hours are laboratory works.

After studying of the course, students should **know** the following:

- features, advantages and disadvantages of raster and vector graphics;
- methods of describing colors in computer graphics (color models);
- how to obtain the screen and printer colors;
- how to save image files in raster and vector formats;
- graphic data compression methods;
- problems with graphics file format conversion;

- purpose and functions of various graphics programs.

As a result of gaining of the practical part of the course, students should **be able to**:

1) *Create their own graphics with the use of basic tools of the vector graphics editor, namely:*

- create drawings from simple objects (lines, arcs, circles, etc.);
- perform basic operations with objects (deleting, moving, scaling, rotating, mirroring, etc.);
- form their own color shades in various color models;
- paint drawings with the use of different types of fillings;
- work with the paths of objects;
- create drawings with the use of curves;
- create graphics with the use of methods of organizing and combining of objects;
- create three-dimensional images;
- use various graphical effects (volume, flow, figure cutting, etc.);
- create labels, titles and place text in a path.

2) *Edit and create raster images, namely:*

- highlight fragments of images with the use of different tools (area, lasso, magic wand, etc.);
- move, duplicate, and rotate selected areas;
- edit photos with the use of different decoration methods;
- save selected areas for further use;
- plot the photos (make multilayer documents);
- paint black and white sketches and photos;
- use different effects for the text;
- make tone correction of photos;
- retouch photos;
- make exchange of files between graphics programs.

3) *The basic system controls of objects animation and scenes visualization.*

Thematic scheduling of lectures.

1. *Methods of graphics presentation. Color in computer graphics. RGB color*

model. Forming of own color shades on the screen. CMYK color model. The interrelation between of RGB and CMYK color models. **HSB** (Hue - Saturation - Brightness) color model.

2. *Graphics files formats.* Vector formats. Raster formats. Methods for compressing of graphic data. Saving of images in standard formats as well as graphics programs formats. Conversion of files from one format into another format.

3. *Graphics creating. Vector graphics.* Basics of work with objects (objects operations). Drawing of basic geometric objects. Selecting of objects. Painting of drawings.

4. *Methods of organizing and combining of objects.* Methods of combining objects (grouping, combining, and welding). Excluding of one object from another object.

5. *The volume (three-dimensional) effect.* Flow. Work with the text. Saving and loading of images. Work with the drawings made in different program versions, importing and exporting of images.

6. *Work features of the programs for creating and editing of raster images.* The use of different selection tools: *Area, Lasso, Magic Wand*. Masks and Channels. Collage. Basics of work with layers.

7. *Editing of photos with the use of different decoration methods.* Drawing and coloring. Correction of tone and color. Retouching photographs. Color and tone correction. Retouching of photos. Work with the paths.

8. *Filters. Styles. Images optimization.* Saving on the web pages.

9. Animation designing.

A tentative list of laboratory works:

1. Graphics creating. Vector graphics. Drawing of basic geometric objects.

2. Objects highlighting. Painting of drawings.

3. Methods of organizing and combining of objects. Methods of combining objects (grouping and combining). Excluding of one object from another object.

4. The volume (three-dimensional) effect. Flow. Work with the text.

5. Saving and loading of images. Work with the drawings made in different program versions, importing and exporting of images.

6. Work features of the programs for creating and editing of raster images. The use of different selection tools: *Area, Lasso, Magic Wand*.

7. Masks and Channels.

8. Collage. Basics of work with layers.

9. Drawing and coloring.
10. Drawing and coloring correction.
11. Retouching of photos. Work with the paths.
12. Filters. Styles.
13. Images optimization. Saving on the web pages.
14. Designing and creating of animations.
15. Individual and team projects.

At the end of the course the team presentation of the implemented projects should be made.

2. TRAINING TECHNIQUES OF COMPUTER GRAPHICS FOR FUTURE COMPUTER SCIENCE TEACHERS

The conducting of laboratory works needs modern material logistics and software. There is no question concerning the material logistics, but the software should be chosen just by the teacher. There is no doubt that the characteristics of commercial versions of professional Adobe Photoshop or Corel Draw are wider comparing with other programs. But also other freeware distributed programs can be applied for performing of some tasks. Here are some examples of such software to work with raster graphics (Gurskiy, Bondarenko & Bondarenko 2007; Pavlyk, Shkitsa & Chaplinskyj 2005):

- 1) GIMP is a very popular graphics editor. The main functions of the two editors are very similar: almost every Photoshop tool has an analogue or alternative in GIMP, although implementation of specific instruments may have different individual characteristics.
- 2) The program PhotoFiltre includes filters which are similar to Photoshop. They are applied for rotating the images, changing the size, printing in various sizes, and adding the limits. Software tools have plugins.
- 3) PhotoScape is quite simple program for creating of different decorative frames for photos. Also this program is good for publishing of photos on the Internet or printing of photos. PhotoScape allows you to combine several photos into one photo, create an animated GIF, divide the photo into several parts, make a screenshot of your computer screen and record it to the disk, convert RAW format into JPG, rename a specific number of photos and so on. Software tool provides support of Adobe Photoshop filters. Also it is optimized for work with the slides.
- 4) Program PAINT.NET has an interface which is similar to Photoshop, including *History*, *Layers*, and *Palette*. There is support for work with layers, as well as a big library of filters and special effects.



Figure 1. Students' work (Anna Sheliia and Max Boner) performed with the use of raster graphics editor



Figure 2. Students' work (Anna Sheliia and Max Boner) performed with the use of raster graphics editor



Figure 3. Students' (Anna Sheliia and Oksana Mirgorodchenko) works performed with the use of vector graphics editors



Figure 4. Students' (Anna Sheliia and Oksana Mirgorodchenko) works performed with the use of vector graphics editors



Figure 5. Students' (Anna Sheliia and Oksana Mirgorodchenko) works performed with the use of vector graphics editors

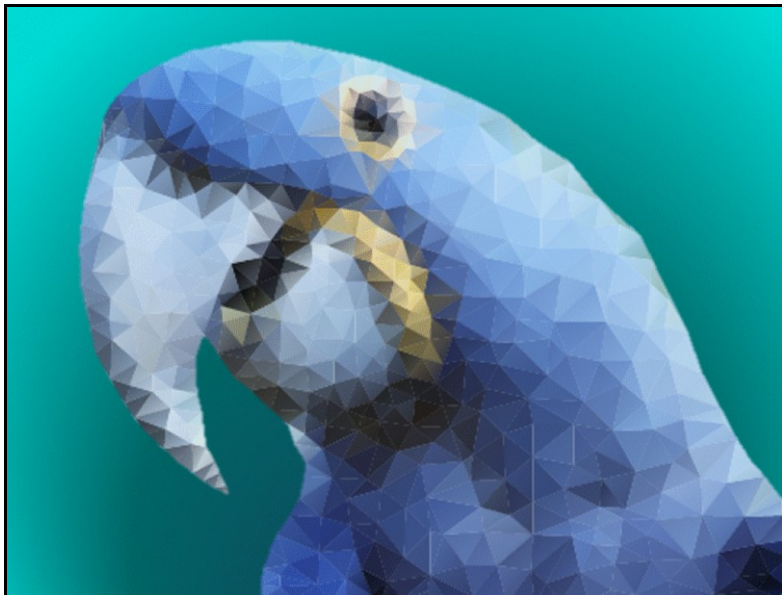


Figure 6. Students' (Anna Sheliia and Oksana Mirgorodchenko) works performed with the use of vector graphics editors

There are programs (e.g., Inkscape) that are similar to above-mentioned programs. Inkscape is the free vector graphics editor, which is functionally similar to

Illustrator, Freehand, CorelDraw, or Xara X. It uses the W3C standard called Scalable Vector Graphics (SVG). The software supports SVG tools such as figures, paths, text, markers, clones, alpha-channel, transformations, gradients, textures and grouping. Inkscape supports Creative Commons metadata, editing of units, layers, complex path operations, raster graphics vectorization, text on a path, text wrapped into the figure, XML-data direct editing and so on. It imports files of formats such as JPEG, PNG, TIFF, etc. and exports PNG files and files of some vector formats.

3. DEVELOPMENT OF INFORMATICS COMPETENCES OF COMPUTER SCIENCE TEACHERS DURING THE STUDYING OF COMPUTER GRAPHICS

Now there is enough experience and materials of traditional system of teachers training. However, this system is not fully consistent with the new paradigm of education and doctrine of Ukrainian education development in the 21st century, in particular with regard to the use of new information technologies for intensification of learning process, creative thinking of students, and forming of informatics competences.

According to N. Morze (2010), informatics competences include the following knowledge and skills:

- understanding of basic computer programs, including graphics editor, word processor, spreadsheets, databases, tools for creating of presentations, data saving and processing; education in the field which is based on the use of the Internet services etc.;
- understanding of the potential of information technologies for employment opportunities, support of innovation persons' activity, and involvement people into the society business;
- basic understanding of the reliability and validity of the data obtained and respect for ethical principles while the use of interactive information technologies.

These competences include the following skills and abilities:

- ability to search, collect, create, organize electronic data, systematize the data and concepts, skills to distinguish subjective from objective, real from virtual, relevant from irrelevant; ability to use the necessary tools (presentations, graphs, charts, and knowledge maps) for a comprehensive understanding and presentation of data;
- ability to search and find necessary websites, use the Internet services and Web 2.0 services;
- ability to use information technology with taking into account critical thinking about unfolding situation, innovation activity in different contexts at home, at

work (school) and leisure.

These competences include the following attitude to ICT: the habit of using information technologies individually and in teamwork, the ability to determine the value of certain data and information; a positive attitude to the rules of safe and responsible work on the Internet, including personal issues and understanding of cultural differences between people; interest in expanding of the horizons with the use of ICT by participating in various communities, including cultural, social, etc.

The professional competences of the teachers can be divided into three groups (Smyrnova-Trybulska 2007; Pidgorna 2012; Golovan 2007; Yashanov 2012):

- 1) Subject (related to the discipline, which is taught by the teacher);
- 2) Didactic and methodical (related to skills of teachers, especially, the use of active learning, i.e., project methods, training and collaborative, use of the modern didactic technologies);
- 3) Educational (related to different methods of influence on students and communication).

The content of the components of informatics competences for the teachers is closely associated with the content of subject and didactic and methodical competences.

The process of learning of “Computer Graphics” needs applying of different educational methods of teaching: verbal (lectures, conversations, explanations), visual (presentations, illustrations, observations), and practical (laboratory work, individual and team projects). Formation of subject competences in computer graphics is possible during the project activity of students in the learning process of the course.

The idea to include project activities in the educational process was offered by American teacher and philosopher John Dewey over a century ago. Defining of the project essence as a pedagogical phenomenon is very complex, because the project and educational process can be extremely complex. The word “project” is translated from Latin. This means “thrown forward”, “idea”, “plan”, etc.

The great advantage of the use of project activities in the educational process is forming of professional and informatics competences such as:

- to plan activities with previous predicting and considering of all possible results;
- to use a lot of data sources;
- to individually collect and analyze materials, correlate facts and argue opinions;
- to make decisions;

- to gain social contacts (allocate duties and interact with each other);
- to create the final product, i.e., material medium of project activity (report, essay, film, calendar, brochure, script, program, website, etc.);
- to present the developments to the audience;
- to evaluate themselves and others.
- Students have the opportunity to choose the project goal and the final result. The teachers, if necessary, can adjust this.

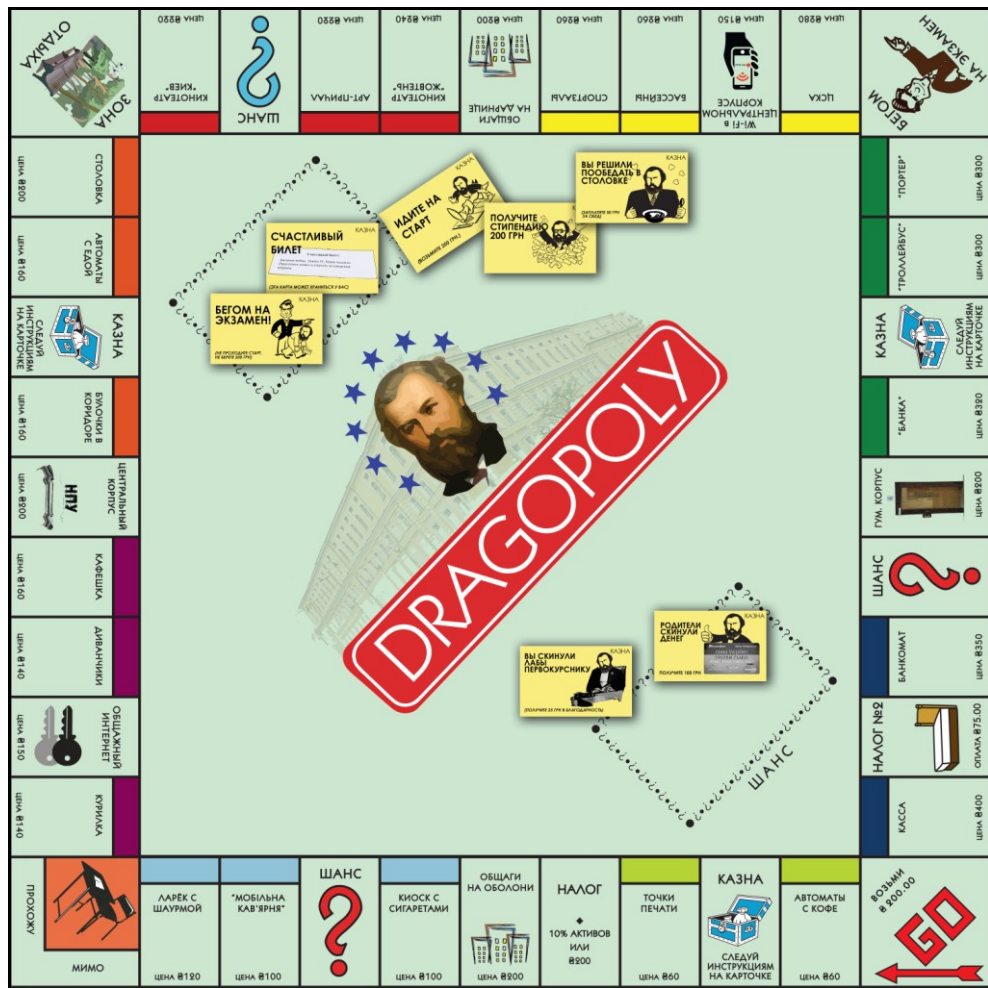


Figure 7. The fragment of the “Drahopoliya” project made by Volodymyr Karlash, Dmytro Danylov, Anna Sheliia, Anastasiia Prisiazniuk, Valentyna Usenko

As an example, it is possible to present the result of the “Drahopoliya” team project which is completed by 4th year students of the specialty “Computer Science*”

(Faculty of Informatics and Computer Science of the Dragomanov National Pedagogical University). A small group of five people has developed their own version of the popular tabletop game “Monopoly”. The playing field and over 100 cards have been created with the use of graphics editors. Also fictional tasks for all the game steps have been developed.

Each project participant was performing his/her part of the work during the semester. Due to this, the students have gained skills of using different software tools for working with graphics, team working, and presenting their activity results. Also they have improved their overall level of informatics competences.

4. CONCLUSIONS

Subject competences formed during the course “Computer Graphics” can be used by students for creation of printed materials, scientific visualization and applied research related to various subject fields (physics, chemistry, biology and others). Created images can be used in reports, articles, and multimedia presentations, placed on web pages or imported to the documents of the publishing system. Computer graphics competences, which are formed after taking the course “Computer Graphics” by students, can be basis for further improvement of skills in the field of three-dimensional modeling, animation, video editing, and creating of virtual reality.

Focusing on the competence approach in the process of computer graphics training at the pedagogical university contributes to forming of subject competences of future teachers. Besides that, it also furthers formation of the components of professional and cultural competences in general.

Thus, learning of computer graphics contributes to forming of the students’ scientific view, development of the creative potential of students, their constructive, imaginative, spatial, associative thinking that is a fundamental feature of professional education and a criterion of the learning process effectiveness.

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