European Journal of Innovation in Nonformal Education (EJINE)
Volume 3 | Issue 11 | Nov - 2023 ISSN: 2795-8612

Methodology of Using Graphic Programs in Developing Design Thinking of Engineers-Builders

S. X. Mardov, Ph.D
Tashkent University of Architecture and Civil Engineering Tashkent, Uzbekistan

Zoxidjonova E'zoza Zafar qizi
Master's degree, "Tashkent institute of irrigation and agricultural mechanization engineers" national research university Tashkent, Uzbekistan

A B S T R A C T
Today, the construction industry is developing rapidly. This, in turn, is aimed at forming the design thinking of engineers-builders, their graphic culture, as well as the creative potential of a person. There are many effective works on this front, especially in the teaching of construction drawing, educational efficiency is achieved using modern graphic software. The use of graphic programs designed for the field of architecture is an important tool for the development of future engineers-builders as a more perfect staff in the illumination of the subjects of the science of architectural construction drawing. Therefore, the importance of the application of graphic programs and their descriptions has a special place in elucidating the essence of design thinking.

A R T I C L E I N F O
Article history:
Received 16 Sep 2023
Received in revised form
17 Oct 2023
Accepted 18 Nov 2023

Keywords: design thinking, graphic education, construction drawing, graphic programs, graphics, information and communication, spatial imagination, architecture, drawing, didactics, engineering graphics.

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As we know, the rise of beautiful buildings all over the world, their design solution has motivated the beginning of a new stage in the culture of design thinking of engineers-builders in the field of beauty. Design thinking has gradually supplanted the skills of civil engineers, all their traditional forms of personal communication, and created an important foundation for mass education. The very concept of design thinking means design, so it is being used effectively in all areas. It is known that in today's developing era, design thinking is a very broad concept, and it is equally used for designing, running a business or any modern constructions, creating personal tasks. Therefore, it is appropriate to use design thinking as an effective tool in the subjects taught in higher educational institutions, especially in the process of graphic education, which is considered important for civil engineers (higher educational institutions in the field of architecture and technology).

The modern stage of the development of society requires new requirements for the scientific level and competence of a specialist. In the conditions of the increase in the amount of knowledge provided to students, the reduction of classroom training is the reason for the further improvement of the educational process. Increasing the efficiency of the educational process is one of the main tasks of higher education, which can be solved by using modern information technologies in the educational process.

Computer graphics tools have fundamentally changed the approach to teaching methods: visualization of invisible processes and phenomena, such as magnetic and electric fields, chemical reactions, etc., allows to improve their observation and understanding.

P.F. Anisimov, P.M.Bisirkin, A.V.Gololobov, Yu.F.Katkhanova, A.M.Leibov, A.V.Sobolova, F.Liarokapis scientifically proved the effectiveness of using computer technologies in education in their research.

Computer technology reduces the time required for mechanical repetition in the learning process. For example, instead of writing the theoretical statements of the lesson, students can copy the textbook to data carriers, and this helps to save a certain part of the lesson time. The guidance and advice of the pedagogue is necessary for the completion of graphic or course work, as well as course and diploma projects. Questions asked by students are repeated from year to year. If these questions are included in the e-textbook, the time allocated for referral and counseling will be reduced. If the written control of the test is organized using modern computer tools instead of the traditional method, this will save another part of the pedagogue's time.

The idea of design thinking was first formulated in 1969 by Herbert Simon, author of The Sciences of the Artificial. Later, this idea was developed by scientists at Stanford University, Stanford, which promotes the idea of design thinking the design institute was founded. The term "design thinking" has different interpretations. Best defined by the Interaction Design Foundation: design thinking is designed to explore user motivations and needs, challenge misconceptions, and find new solutions to problems. A p-step process is understood. Design thinking (from the English. “design thinking”) is a method that helps to find solutions to complex problems that meet the interests of users. This method is based on the principle of anthropocentrism, according to which the purpose of any research and work is the interests of the individual, and not the enterprise, leader, project managers and bureaucratic structures. The task of design thinking is to overcome existing stereotypes and standard ways of solving problems (“thinking outside the box”). This way of thinking is used almost everywhere: planning a trip, renovating an apartment, discovering new media, starting a business, developing a corporate identity and logo. Design thinking is a way of looking at the world and solving problems. It is a continuous process that accompanies an idea all the way to its realization: from the idea that came to the brain, from its testing and approval, to its embodiment in prototyping and its implementation.

A creative approach, teamwork, people orientation, curiosity and optimism are key components of design thinking. The main feature of design thinking is that, unlike analytical thinking, it is a non-critical analysis, a creative process in which completely unexpected ideas lead to the best solution to a problem. The traditional model of school education envisages the transfer of information from the teacher to the student. In this case, the student will have a lot of valuable knowledge in the future, but they will not help to solve a really important social problem. In educational institutions, students do not receive lessons in the form of practical problems that require solving and creation, their task is only to repeat the information received from the teacher. Tell students about a real-life problem and challenge them to come up with a solution using design thinking tools. This will increase the quality of education. Students do not acquire useful knowledge when the teacher provides the necessary information for them to remember. They only learn when they have a problem to solve that they can ultimately make the world even a little bit better. The thinking process built on the principles of design thinking turns students into socially active citizens who are ready to create and implement creative and at the same time viable ideas to solve local and global problems of people in society. Design thinking creates the innovative students that are lacking in our educational institutions. Design thinking methodology teaches how to introduce innovations to solve social problems, test the viability of ideas, check their relevance and demand in a potential target audience. The five core principles of design thinking are: empathy, radical partnership, ideation, prototyping, and iteration. Design thinking can also help make the world of people in your community better and more comfortable, or solve a problem for your potential users. In order to "please" them, you need to put yourself in the user's place, think from his position, implement your technological capabilities taking into account the results obtained, and clearly remember your business interests. Because creating a product that is in demand means double-checking its validity using hacks.

There are five main principles of design thinking:

- think unconventionally - add diagrams to boring tables, pictures, texts; search for template solutions to existing problems encountered in business projects;

- appeal not only to the emotional experience of the consumer, but also to logic and profit. For example, the integrated graphic interface of a smartphone there's no point in describing it in detail, even though it's really handy. Moreover, it should be emphasized that such a suitable and modern design will attract the attention of the buyer's friends and make it the star of any gathering;
- use of prototypes - this is especially important for businessmen when creating an innovative product, the prototype clearly shows its strengths and weaknesses;
- adhere to smart minimalism - remove all unnecessary things and constantly improve the product so that it becomes the best;
- Accept mistakes positively: any mistake is an experience of gathering the maximum amount of useful knowledge to improve the quality of a product or service.

The position and effectiveness of products and services offered in the world market is determined primarily by its competitiveness. In such a situation, it is not enough to use analytical thinking based on the analysis of available data. Innovation requires creativity, creativity, synthesis and the ability to create new products and services. Creative approach, teamwork, people orientation, curiosity and optimistic spirit are the components of design thinking, as well as the methodology used to find new solutions to existing problems. The main feature of design thinking, in contrast to analytical thinking, is not critical analysis, but a creative process in which sometimes the most unexpected ideas lead to a better solution to a problem. The principles of design thinking are applied in a variety of fields, from treating childhood obesity to crime prevention, from the rocket industry to climate change. Design thinking is no longer limited to the creation of new tangible products, but extends to various processes and services, as well as interaction, communication and collaboration. In the context of industrial production, manufacturers began to pay special attention to aspects such as the attractiveness and diversity of the appearance of goods and products, as well as the quality and ease of use of the product. As a result, there was a need for a special specialist who can not only create a product form with an attractive appearance that meets consumer requirements, but also has a good understanding of design issues and machine production technology. Practice shows that it is possible to create a competitive product only if engineering-technical and artistic issues are solved comprehensively. The world's largest companies such as Healthcare, Procter & Gamble and Philips Electronics, IBM, General Electric, Toyota, Samsung, LG are already effectively using design thinking in the organization of the management process and product production. Design thinking is the development of user-oriented products, services and services. Design Thinking - always puts user requests first and only then focuses on technical feasibility and economic feasibility. Design is problem solving. A designer is a problem solver. To solve a problem, to find an effective solution, first conduct research and clearly define the problem, then focus on specific "pain points", develop ideas and select the best among them, create a prototype and testing is required. The Design Thinking method describes how these steps are performed, what to focus on, and what tools to use at each step. The authors of the design thinking method, Hasso Plattner and David Kelly, are the founders of a design school that combines business and management practices with traditional engineering education. It's not like they invented design thinking, because design thinking is essentially common sense. Plattner and Kelly, however, put the principles into a conceptual framework, created a brand, and began to develop it as a practice. By exploring the stages of the creative process, he put the user at the center and represented business as a creative process. And creative individuals can better understand business tasks. At this point, it is worth quoting an opinion of the famous pedagogue, writer Dale Kornegie according to: "If you get a lemon, make lemonade out of it." Its meaning is becoming very relevant today. The main difference between design thinking and traditional thinking is not a critical analysis, but a creative approach to the process, where unexpected ideas can reveal the best way to solve a problem.

Design thinking is very important in the field of construction. This quality should be at a high level especially among construction engineers. The most important tool for engineers to demonstrate this feeling is graphics software, as many programs have functions that allow you to draw both 2D drawings and 3D model views at the same time. Especially in this regard, there are some BIM programs that are designed for the construction industry. These are ArchiCAD, Revit, Lira, Grasskoper and others. These programs are very convenient for civil engineers. This is based on the following factors:

- the ability to work even on computers with a graphics program that is not considered very powerful;
- easy operation of the program (it works equally well in 2d and 3d drawings);
- creating both a 2D drawing and a 3D view in the program;
- Connection of commands in the command panel to the construction field;
- It is possible to easily change parameters of conditional symbols;
- Availability of the function of changing ready-made 3d models in 2d state;
- Automatic execution of simple and complex cuts;
- Availability of easy connection of models taken from other places to the standard library and the possibility to change their parameters like the standard;
- Availability of the possibility to gather ready documents into one project album;

It is possible to see increasing the practical importance of the subject by introducing and increasing computer graphics topics in the subject programs in the higher educational institutions where the subject of construction drawing is taught. Today, science specialists are required to be computer literate and use the capabilities of graphic programs. Using computer graphics in educational processes:

- spatial imagination develops;
- mastery rates will be high;
- the duration of storage in memory increases;
- creative and logical thinking develops;
- new projects and opportunities for their creation are opened;
- Provides some convenience to students and makes it easier to perform graphic work related to construction drawing.

As we know, organizing construction drawing lessons using graphic programs and multimedia electronic textbooks has several advantages over traditional methods of teaching. They are:

- the quality of the lesson will be at the expected level;
- the information given on the subject is clear and understandable;
- drawings and objects that are related to science and need to be explained are made in front of students using computer graphics capabilities;
- will be able to see the 3D model of the constructed building in six views or four views at once and see the clear model from different angles;
- it is possible to make simple and complex cuts in the finished object and to see these cuts in one way;
- the possibility of explaining the lesson allocated for the subject in a short time;
- Lectures on the topic, sets of assignments, test questions of different levels, the availability of a glossary for terms in science can be used as an auxiliary tool. The use of graphic programs in the study of engineering graphics helps to develop the scientific research of students, to strengthen the use of theoretical and practical knowledge of future engineers. These are the main tasks facing higher education today.

Today, there are many different graphic programs that allow you to create electronic models of plans in construction drawings or a number of construction items. BIM and Autodesk companies have taken the lead among the companies that create graphic programs that allow creating such models. Modeling of such objects in engineering graphics disciplines helps them to be better understood by students and significantly increases visibility. Visibility is a very important link, especially for the science of construction drawing.

In all developed and developing countries, the use of an integrative approach in science is one of the main

pressing problems, so the role of computer graphics in the teaching process is changing significantly. Computer graphics is not only a source of learning for students and teachers, but it is also considered the main teaching tool. Because computer graphics is becoming the main tool of graphic preparation of students. The reason is that through computer graphics, spatial imagination of students is emerging as the main factor of effective and rapid development. All this is the main goal we have set before us to enliven the educational process, motivate students to understand the essence of the subject faster and perfectly.

In conclusion, the role of graphic education in attractively presenting design ideas to future engineers-builders is incomparable. In this regard, computer graphics can be used as a learning object for electronic drawing and as a tool for teaching geometry and drawing. This implies the formation of students from teachers of higher education institutions not only to work in an automated design system, but also to effectively use the capabilities of these software products in their future professional activities.

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