

**СЕКЦІЯ: ІННОВАЦІЙНІ ТЕХНОЛОГІЇ НАВЧАННЯ В ЗАКЛАДАХ  
ОСВІТИ**

**VISUAL EXPERIMENTATION WITH GEOMETRIC PRIMITIVES IN  
COMPUTER GRAPHICS**

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Technological operations of a computer object-oriented (vector) programs allow you to start working with standard objects (circles, rectangles, squares), the user can build composed objects and manipulate them as a whole. The second feature of the object-oriented package is that each standard class of objects is assigned a unique set of control parameters, or class attributes. An instance of a class is a geometric object (geometric shape) for which the values of control parameters are fixed.

In any graphic editor, you can create many forms in different ways. The main elementary object of vector computer graphics is a line that has the properties of shape, drawing, thickness, closure, color, etc. Due to the presentation of vector images using combinations of different lines and the mathematical description of lines as a single object, the vector format has the advantage that the size and shape of the drawing can be changed without losing image quality. The generalization of the concept of line is elementary graphic objects: open and closed circuits. The contour can have any shape: a straight, curved or broken line or figure. The main contour outline parameters that determine its appearance when displayed are: line color, line thickness, changing its thickness at different angles of inclination, line type, etc. All closed contours have the property of filling – filling the plane covered by them.

The object-oriented approach allows you to draw the contours of objects with their subsequent filling easily. Since the contours of objects are formed using a mathematical model, the components of which are formal descriptions of straight and curved line segments, it is possible to reproduce these contours by specifying any size accurately. The contour shape is changed by moving its nodes (support points), changing their properties or adding and removing nodes. Grouping, combining and merging operations can be performed on several contours.

The foundations of the psychophysiology of color perception and its aesthetic effect revealed by I. Goethe in his work «Essays on the Doctrine of Color» are being confirmed and developed with the advent of computer image processing technologies. First of all, this concerns the physiology of color image perception, which is based on

computer reproduction of color on a monitor, scanning and digital recording of color characteristics. Respectively, color management is as close as possible to human physiology. So, in the Painter program, color characteristics are managed using a color wheel, which is very reminiscent of the one developed by I. Goethe. CorelDraw has a similar circular color selection system with the option of selecting additional (complimentary) colors. In this case, the influence of the theoretical developments of the German school of color science of the 20 th century is felt [2].

We consider it expedient to practice visual experimental tasks during the study of geometric primitives in the «Computer Graphics» course, the solution of which will cover the following two aspects:

- shape and color;
- visual communication.

Visual perception, primarily artistic, is characterized by its orientation and active approach to the visual assessment of perceived objects and phenomena, since there is a huge distance between simple, superficial contemplation and perception. The image in this case is not only the result of perception, but also its condition, setting for further deeper visual-intellectual analysis and synthesis of the visible. The image is a reflection of the process of perception in material form and vice versa. That is why the ability to depict is inseparable from the ability to visually perceive and see. Thus, the whole process can be represented as a synthetic act of visual thinking. In modern psychology and its professionally oriented fields, this definition is found more and more often, therefore, in the process of forming visual culture, visual perception is an effective tool [2].

In this case, visualization (design) practice should be characterized by:

- refusal to divide the design of objects into artistic works and purely functional works;
- striving for every practical result (just a functional work) to also have the value of an artistic experiment;
- overcoming the gap between emotionally colored creative work (artistic experiment) and an intellectual approach (functional work) to solving the task.

The tasks we offer regarding flat and three-dimensional forms, as well as color, are based on the principles of Johannes Itten, who was a teacher at the Bauhaus school in the early 1920 s. He developed a basic course or fundamentals where flat and three-dimensional forms, color and composition were treated in a completely new way. It was a very modern way of looking at these ideas. J. Itten made it so that these basic principles are applied to fine arts, industrial and graphic design and to various practices. These ideas of the Bauhaus school about flat and three-dimensional forms, color and composition, although they are almost 100 years old, are still the basis of modern design practice and theory today. The basis for the foundations of the Bauhaus school was indeed the understanding and control of visual diversity [1].

Designers in graphic design also use such basic graphic shapes as circle, square and triangle. These shapes represent a kind of directional property that other shapes can have. The circle is represented in a round shape. A triangle is a more diagonal direction. The direction of the square is horizontal and vertical. Directional properties are easier to see if you convert shapes into lines. In essence, this is what forms the form.

This is a space delineated by a closed contour. If the contour is open, then in fact the circle becomes just a line that should be closed. A triangle consists of three strokes. A square is made of four strokes. But once we close those contours and maybe add color to give the shape a volume, we really stop seeing the line and start seeing the shape. And although here we use an abstract form, we will always try to learn something from it. We try to create known things even from abstract forms. Shapes have great potential whether they are used to represent something abstract or a real-life object.

From simple forms we can create signs, symbols and emblems. In general, graphic signs are devoid of any meaning, they do not have any connotation and are denotation, so they probably become the equivalent of a denotative graphic form. In other words, a circle, a square, and a triangle mean only a circle, a square, and a triangle. When the viewer tries to perceive these shapes, they only mean what the shapes are. Graphical elements can be a really powerful tool, even in the simplest forms.

Form is related to color, so let's look at color and how designers use it. This is a really complex field of study. Partly it is because color can be objective and subjective. We tend to read and use color differently for many different objects. Our primary response to color is emotional. There is a more scientific response as a reaction, and it can be seen as a more strategic way for a designer to use color. It is realistic to see which colors are combined with each other. Take less into account the mood and more – specific contrasts and parameters. Perhaps it would be better to call it a technical reaction to color.

How can one begin to think about color when there are so many colors to think about. A simple way or a starting point is to consider white light. Passing through the prism, it is divided into color ranges. We are all familiar with this color as the colors of the rainbow: red, orange, yellow, green, light blue, dark blue and purple. In the spectrum, these colors combine and merge with each other. So, even though we think of them as seven colors, there are actually many more. From a scientific point of view, color is divided by the difference in the wavelength of the color. So, red has the longest wavelength at one end of the spectrum, and violet has the shortest wavelength at the other end of the spectrum. When thinking about color, we mostly imagine a shade (fig. 1). Red, orange, yellow, green and blue. In fact, these are shades, and color has two other important parameters. Hue is probably the most useful and most noticeable characteristic of color. The second color characteristic: light or dark. That is, the color intensity (fig. 2). It can be thought of as a gray scale. At one end of the scale is 100 percent color (black) and at the other end is 0 percent color (white). And obviously the intensity works for any color. You can choose any color and consider it in a range of different intensities, take any shade and study its intensity scale. Saturation (fig. 3) is the third characteristic of color, the most difficult to understand. The simplest definition of saturation is if the intensity and hue remain the same, and the saturation changes, then the color will be very dull. For example, in Figure 3, where only the gray color remains until the saturated pure color [1].



Fig. 1. Tint Fig. 2. Intensity Fig. 3. Saturation

Now let's consider the color scheme. Imagine that you took the color spectrum, which is a band in the left-to-right direction, and folded it into a circle so that the red color at the beginning of the color spectrum connects the entire color spectrum, colliding with the violet color at the far end of the color spectrum. A color gamut came out instead of a separate linear spectrum. In the color scheme, colors located next to each other are called similar colors (fig. 4). And, essentially, these are colors that in a real spectrum would be gradations from one pure color to another. But here we divide them into more solid tones to limit the amount of information under consideration. These similar colors will be very similar to the colors next to each other. This representation is not very different from the color gamut line. The color scheme becomes more interesting if you divide it and rotate the parts of the circle. So imagine you cut out the center of the color gamut and rotated it 180 degrees. It turned out something similar to Figure 5, that is, a segment of each part of the color gamut is combined with its direct opposite. For example, we took the red segment, rotated it 180 degrees, and now it matches the green [1].

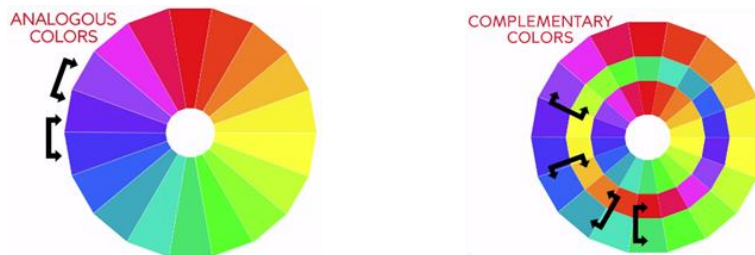


Fig. 4. Similar colors Fig. 5. Additional colors

While the green segment moved up 180 degrees and coincided with the red. Such matches of opposite colors are very difficult, such colors are called complementary colors. This means that two such colors in an effective combination practically neutralize each other. For example, if you take black and white colors, when combined, they will give a neutral 50 percent gray color. But these additional colors can be really useful as a starting point for thinking about color palettes. Even a simple color scheme that we create very quickly can be really useful in terms of color matching and being able to quickly assess how the sets of colors will work together. Which colors are combined with others, and which will be contrasting and complementary. By simply turning the segment, one can understand how cool colors are combined with cool ones and warm colors with warm ones, compared to what was discussed earlier, with something similar, that is, with more contrasting pairs of colors. Another useful function of the color gamut is to adjust it so that a series of shades of the same color is obtained. Again, this is useful for being able to mix and match different shades, spin the wheel and see what colors go together. This can be of interest and will allow us to

start thinking about color palettes you could use, or combining two or three different colors together, imagining how they might work. Not only in terms of shade, as we saw in the previous color scheme, but also in terms of intensity. Of course, there are many computer programs that have color tools where you can control and manipulate colors, and look at different palettes and work on creating them. But it's still quite interesting to just experiment with colors, the main aspects of intensity and shade. By simply analyzing the difference between them and creating your own palette, not just using what already exists.

How do color and shapes work together to form a picture? The action of the picture really depends on two parameters: rhythm and repetition. And these two parameters are interrelated. Therefore, rhythm is often created by repeating the form, forming an auxiliary and main space, or by bringing the object closer and further away with various kinds of contrasting colors [1].

Let's take a simple shape (fig. 6), experiment with it and see what can be done with color, shape and pattern. Let's start with the fact that instead of using the simple shape of the triangle, we will use its slightly modified outline. There is internal and external space. Therefore, you need to immediately think about two different colors. Again we can get some kind of zooming in and out effect between the secondary and main spaces. The first thing we might think about is how the form actually relates to itself. What pictures can you make by looking at this shape? If you use a simple shape overlay, you can form other shapes from the initial one. Depending only on the interaction of these two elements, you can begin to form some interesting interaction, which can become the basis, the basis for the picture. And once you have more elements in this design, for example three elements, then you can form different shapes, much more complex. We have created forms of various scales. We have built-in shapes, more open shapes, and now that you're getting started with drawing and shape, it's a good idea to experiment a bit. This can be the basis for designing logos, emblems and similar objects, as well as creating a usable image. But many graphic elements are really based only on visual experimentation with shapes and ideas of how they connect to each other and form other flat and three-dimensional shapes and drawings. You can use align, scale, rotate, repeat and create shapes from other shapes. Take the same shapes and scale them to create another part of the drawing or object. When you are working on creating such drawings, we recommend that you freely use any methods and experiment. This is a great way to learn how to create a picture and how to create a shape. Especially when we're not actually creating something specific for a specific purpose, a specific client, or anything like that. All we're doing is looking at how the shapes fit together. We look and learn by watching and doing, and that's really what graphic design is all about and the best way to learn it. This experimental approach also implies a low level of risk, so if we do something that fails, it doesn't really matter. We can just erase everything and start over.

Working with form and color in the process of learning computer graphics forms the basis of visual thinking. Visual experimentation with geometric primitives also develops visual communication skills.

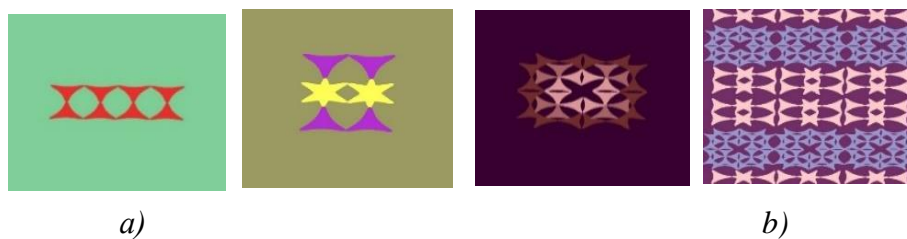


Fig. 6. Visual experimentation: a – shape and color (creating a sign), b – rhythm and pattern (creating a pattern)

### References

1. Fundamentals of Graphic Design. California Institute of the Arts. URL: <https://www.coursera.org/learn/fundamentals-of-graphic-design/home/info> (date of application: 02.04.2023).
2. Tsydylo I. I. Preparation of future designers for the use of computer technologies in professional activities : dissertation ... candidate ped. Sciences 13.00.04 / Tern. national ped. University named after V. Hnatyuk. Ternopil, 2015. 244 p.

## ПОРІВНЯЛЬНИЙ АНАЛІЗ ПЛАТФОРМ ДЛЯ ДИСТАНЦІЙНОГО НАВЧАННЯ

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У сучасному світі дистанційне навчання набуває все більшого визнання та швидкого поширення у навчальних закладах різного ступеня освіти (дошкільної, середньої та вищої освіти). Попри популярність дистанційної освіти в Україні, виникають незручності у використанні наявних навчальних платформ через певні недоліки.

Починаючи з 11 березня 2020 року, коли був випущений указ президента України про закриття усіх навчальних закладів України на карантин, відбувся перший дотик українського населення із дистанційним навчанням. На той момент, невелика кількість людей була ознайомлена із таким способом освітнього процесу, адже навчання за допомогою технологій та без фізичної присутності осіб було незвичним явищем, як для учнів, так і для вчителів, викладачів.

Основною перевагою такого способу навчання є можливість фізичної відсутності осіб. Суттєва економія часу створює передумови для створення більш продуктивних умов для здобувачів та надавачів освіти, адже з'являється можливість працювати, не покидаючи домівки.

Повноцінне впровадження технологій для дистанційного навчання бере початок восени 2020 року. Саме тоді у швидкому темпі набираються