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INTERACTIVE DATA VISUALIZATION AS ONE OF THE LEARNING TECHNOLOGIES IN EDUCATION

The article is devoted to the technology of interactive visualization of the presentation of educational material, which is widely used in the educational process.

The article also discusses STEM-components of this technology. We are considering infographics as one of the effective means of interactive data visualization. The use of infographics is relevant because it allows us to present a large amount of information in a compact, systematic and easy to understand form.

The article reveals the concept of visualization categories and infographics. The classification of infographics is considered. The stages of creating infographics are defined.

The article presents tools for creating infographics, among which preference is given to free online services. Describes the creation of infographics using the Canva constructor. Relevant conclusions have been made.

Key words: data visualization, interactivity, visualization categories, infographics, classification, online resource.

Information and communication technologies are widely used for modern learning in educational institutions. Accordingly, the means of teaching, the ways of presenting educational information are changing. Modern teacher tries to change the technology of presenting educational material to avoid overloading with information material. The technology of interactive data visualization is one of the most effective. Such educational material is presented in a compact form, much clearer and more interesting, therefore, it is easily perceived and remembered by pupils and students as a rule.

Data visualization is often used in infographics and can even completely create it. There are many types of visual images that can be used to display a single dataset. That's why, it is very important to determine the appropriate visualization method for the dataset and infographics, taking into account graphical functions such as position, size, shape and color.

Let's consider STEM-components of this technology. Initially there are 5 types of visualization categories – time series data, probability distribution, maps, hierarchy and network [5].

Time series data is one of the most common forms of data visualization. It displays a series of estimates after a certain time. Examples of graphs in this category include index diagrams, compiled graphs, small composite diagrams and horizontal charts. Index charts are ideal for use when raw values are less important than relative changes. Bar diagrams are plane charts that are superimposed on each other and represent aggregate relationships. They allow viewers to see common connections and individual patterns. Horizontal charts are a spatially efficient method to increase the density of time series data while maintaining their resolution. This is the scientific component.

The probability distribution reflects trends based on how the numbers are distributed. Popular examples: histograms and «box-and-whisker» diagrams, that convey statistical features such as mean, median, and probabilistic emission. In addition to this popular infographic, alternatives include distribution series, Q-Q plots, matrix plot diagrams (SPLOM), and parallel coordinates. We can use a «stem-and-leaf» diagram to evaluate the set of numbers and focus on the frequency distribution. The numbers are written in cells, based on the first value of the digits and in each column, arranged again based on the second value of the digits. On the other hand, the Q-Q plots compare two probability distributions, displaying the quantiles against each other. This allows the viewer to see if the values of the plots are the same and if they are linearly related. SPLOM is a technique that reflects the relationships between many variables. It uses several scattered diagrams to represent paired relationships between variables. There is another approach to statistical distribution to the visualization of multidimensional data. This is a parallel coordinate approach. Data is repeatedly displayed on parallel axes and corresponding points connected by a line instead of representing each pair of variables in two dimensions. The advantage of parallel coordinates is that they are relatively compact and allow to display many variables simultaneously. This is the mathematical component.

Maps are a natural way to present geographic data. Space and time we can represent using of streaming maps. The lines we can use have different widths and colors for data encoding. Background maps, which encode data by color and geographic region, are also often used.

Hierarchy. Many datasets can be organized in a natural hierarchy. Link diagrams, contiguous diagrams and body diagrams are types of infographics that effectively convey hierarchical data. Link schemes are a popular method due to spatial results. The link scheme is similar to a tree, where each node branches into several separate subdivisions. As an alternative is a contiguous diagram, which is a spatially filled version of the diagram of the link node (link).

Network visualization considers relationships. There are three main types: directional power layout, semicircular diagrams and matrix mappings. Directional power layouts are a common and intuitive approach to network location. Links are used to connect related nodes together. Semicircular diagrams are one-dimensional layouts of nodes with circular arcs that connect each node. When used properly with well-ordered nodes, groups and bridges are easily identified on this layout. Let's note that mathematicians and computer scientists use matrix mappings more often. Each element has its own value (x, y) in the matrix that corresponds to the node. By using color and saturation instead of text, we can perceive the values associated with the links faster. But this method makes it

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difficult to view the paths of nodes where there are no lines of transition. This is the engineering component.

Although all of these visual images can be used effectively separately, many modern infographics combine several types into one graph, as well as other features such as illustrations and text. Some modern infographics do not even contain data visualizations and are simply a colorful and concise way of presenting knowledge instead of this.

Let's the technological component be all the software for working with interactive data visualization.

Thus, an effective means of interactive data visualization is *infographics* or *information graphics* (eng. *Information graphics; infographics*) – it is a graphical visual representation of information, data or knowledge which is designed to display complex information quickly and clearly. Infographics can improve the perception of information through graphics. Its purpose is also to improve the ability of the human visual system to see patterns and trends. We can consider the process of creating infographics as data visualization, creation of information schemes and models of information presentation [5].

Infographics have been distributed for many years and rapid growth in the number of free tools for creating infographics today, which are easy to use, has made it more accessible for wider use in the educational process.

With the help of infographics, we can present a large amount of various information in an organized form that will be easy to perceive.

In [1], the authors identified the following reasons to use infographics based on observations:

- Easy to perceive. High-quality, structured, not overloaded infographic makes even the most complex and boring information clear and easy to understand.
- In formativeness. We can put several pages of text information in one picture.
- Attention attraction. If we provide the infographic with original tools or ask a topic for discussion, it is guaranteed to get feedback.
- Persuasiveness and internationality. Quality infographic usually do not require translation.
- Active distribution. Beautiful infographic is actively shared because it contains valuable information and interesting design.

In [2] the authors provide a classification of types of infographics and analyze each in detail and note also that the classification of infographics by the method of display is quite common.

In this case, the infographic is divided into the following kinds:

- static infographic – image with text without animation elements;
- dynamic infographic – infographic with animation elements.

Dynamic infographic we can divide into two types: video infographics and interactive infographic. Video infographic is a video series that reflects the main facts, which are presented in the form of infographic with offscreen text. Interactive infographic allows the user to interact with the information display system and monitor the reaction of the system. The authors also note that interactive infographic is the most popular.

We can get acquainted in [3] with the classification of infographics by types, with the functions and principles of infographics. The authors also identify areas for the use of infographics in education.

Let's consider what are the stages of creating an infographic.

Step 1. We must define the purpose of creating infographics (why we need it).

Step 2. We need to gather information for the infographic. We may use our own data or search for information on the Internet.

Step 3. Data visualization for infographic. We need to select the appropriate chart type in this step.

Step 4. Creating an infographic design layout. Most software offers ready-made templates, so we can choose one of them.

Step 5. Adding style to infographic design. We need to choose fonts for the text, add graphic elements, and choose colors to highlight important infographic elements in this step.

Of course, we can create infographics manually using such simple tools as pencils, markers and rulers. But there are quite a number of computer programs today for creating infographic. Free online resources deserve special attention among these programs.

The authors in [4] identify such popular Internet services that we can use to create infographics:

- Visualize (creation of resume in the form of infographic);
- Google Developers (creation of different graphs and charts);
- *Easel.ly* (using a set of templates with the ability to edit them);
- Piktochart (creation of infographics and schemes for presentations);
- Infogr.am (creation of interactive infographics).

Also there is a method of creation of infographics using one of the online services *Easel.ly* in [4]. This is certainly extremely useful.

At the same time, a simple infographics designer such as *Canva* may deserves our attention.

First of all Canva [6] is a convenient graphic editor with which we can create a beautiful and very beautiful design of many information materials: booklets, business cards, presentations, avatars, video screensavers, blog illustrations, posters, books and others. In addition, the service contains many different templates for creation of colorful meaningful infographics.

If it is difficult for us to create infographics from a blank sheet, then we can use ready-made templates. This is one of the advantages of the service. Another advantage of the service is the presence of a Ukrainian-language interface.

Canva has a wide range of templates and thousands of illustrations, so with this simple and free infographic designer we can depict facts from any field.

We can see in the *image 1* sequence of steps how to create infographics using this service.

Creation of infographic begins with choosing a template, which is placed on the page by simply dragging the mouse from the proposed set (*image 2*). We can fill the template by simply editing of any element. We can also download pictures and videos. Using the Download command,

we can save the created infographics in pdf format for printing, as well as in other available formats: png, jpg, gif, mp4.

Thus, interactive data visualization is widely used for learning as one of the technologies of STEM education. Infographic is one of the effective means of interactive data visualization. The use of infographics is relevant because it allows the presentation of a large amount of information in a compact, systematic and easy to understand form.

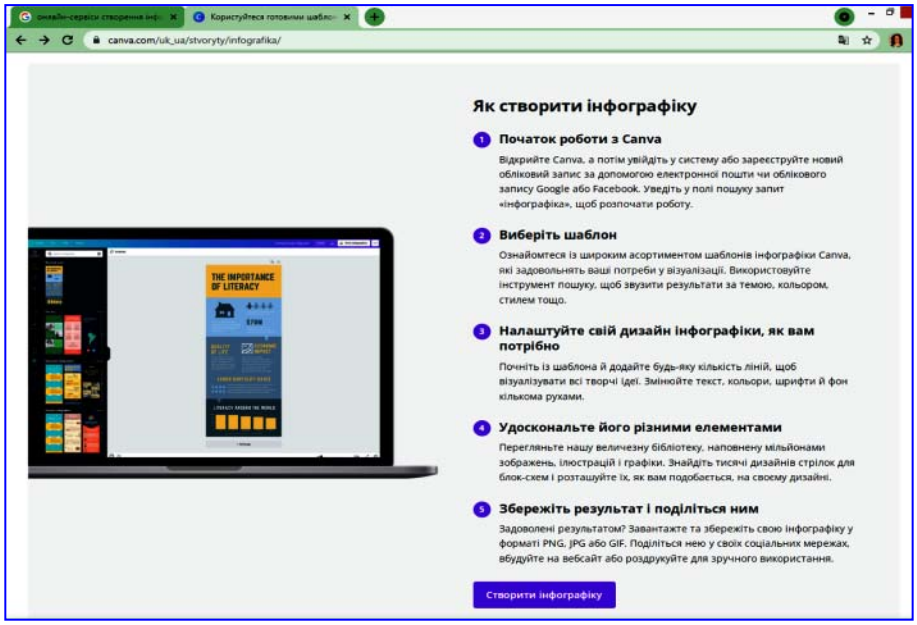

Image. 1. *Sequence of steps how to create infographics using Canva*

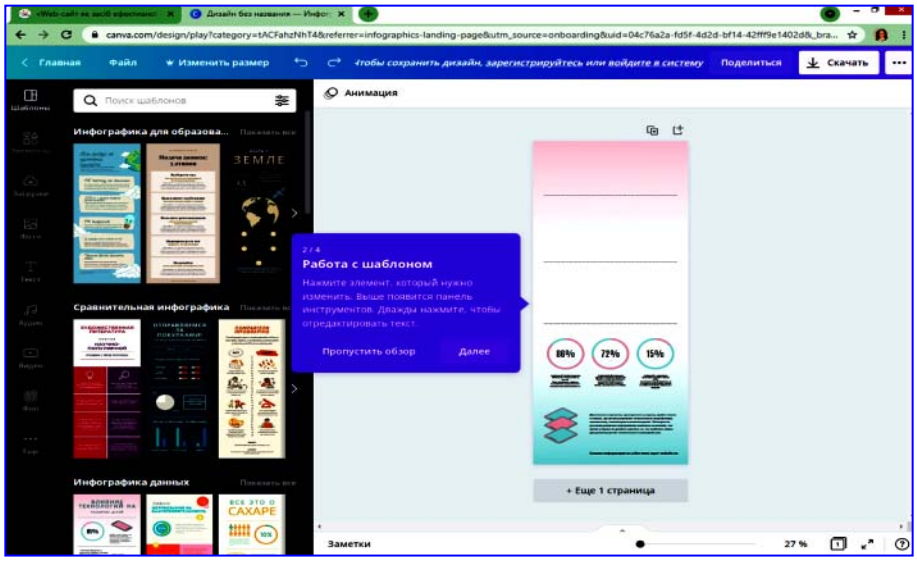

Image 2*. Template selection and tools for editing infographics*

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ІНТЕРАКТИВНА ВІЗУАЛІЗАЦІЯ ДАНИХ ЯК ОДНА З ТЕХНОЛОГІЙ НАВЧАННЯ В ОСВІТІ

Стаття присвячена технології інтерактивної візуалізації подання навчального матеріалу, яка широко застосовується в навчальному процесі. У статті також визначаються STEM-складові даної технології.

Одним з ефективних засобів інтерактивної візуалізації даних представлено інфографіку. Використання інфографіки є актуальним, оскільки уможливлює представлення великого обсягу інформації в компактному, систематизованому й зручному для сприйняття вигляді.

У статті розкрито поняття візуалізаційних категорій та інфографіки. Розглянуто класифікацію інфографіки. Визначено етапи створення інфографіки.

У статті представлено інструменти для створення інфографіки, серед яких перевага надається безкоштовним онлайн-сервісам. Описано створення інфографіки з допомогою конструктора Canva. Зроблено відповідні висновки.

Ключові слова: візуалізація даних, інтерактивність, візуалізаційні категорії, інфографіка, класифікація, онлайн-ресурс.

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