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Visualizers as an Effective Tool For Teaching Algorithms

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Annotation

The article discusses issues related to the use of visualization methods in teaching. The place and role of visualization of educational information in solving a number of pedagogical tasks, such as ensuring the intensification of learning, enhancing educational and cognitive activities, the formation and development of thinking, visual perception, figurative representation of knowledge and educational actions, knowledge transfer and pattern recognition, are stated. As an example, the structure and capabilities of the emulator of sorting algorithms developed in the Delphi 7 programming environment are considered.

Keywords: *educational process, "Theory of Algorithms", teaching methodology for the subject "Theory of Algorithms", visualization of educational material.*

Today, information technology is one of the most dynamic branches of knowledge, which requires you to constantly be aware of its changes and allows you to use the latest technologies in order to maximize the positive effect in the intellectual development of a person. One of the priority areas of the informatization process of modern society is the informatization of education, which is a system of methods, processes and software and hardware.

The term "visualization" comes from the Latin visualis - visually perceived, evident. Visualization is the process of presenting data in the form of an image in order to make it as easy as possible to understand it; giving a visible form to any conceivable object, subject, process, etc. In pedagogy, in particular in the methodology of teaching the exact sciences, the meaning of the concept of "visual" is always based on the demonstration of certain objects, processes, phenomena, the presentation of a finished image given from the outside , and not born and taken out of the inner plan of human activity. Therefore, the level of activation of the mental and cognitive activity of students depends on the properties of didactic visual means. In this regard, the role of visual models for the presentation of educational information is growing, allowing to overcome the difficulties associated with learning based on abstract logical thinking. Depending on the type and content of educational information, methods of its compaction or step-by-step deployment using a variety of visual tools are used. Currently, the use of cognitive visualization of didactic objects seems to be promising in education [1]. This definition actually covers all possible types of visualization of pedagogical objects, functioning on the principles of knowledge concentration, generalization of knowledge, expansion of orienting and presentational functions of visual didactic tools, algorithmization of educational and cognitive actions, implemented in visual tools.

By visualization we understand the general name of the methods of presenting information or a phenomenon in a form convenient for visual observation and analysis. At the same time, the role of visual models for presenting educational information increases, allowing to overcome the difficulties associated with learning based on abstract-logical thinking. Computer visualization is understood as a technique for translating abstract ideas about objects into geometric images, which makes it possible for the researcher to observe the results of computer modeling of phenomena and processes. The following types of computer visualization are traditionally distinguished: scientific visualization; software visualization; information visualization[2]. Scientific visualization refers to the use of computer graphics and human-machine interaction to represent data about objects, processes and phenomena that are modeled in scientific computing. Software visualization is understood as a set of techniques for using graphics and human-machine interaction tools used to better understand concepts and effectively operate software, as well as to specify and represent software objects in the process of creating programs. The term information visualization refers to the visual description and presentation of abstract information obtained as a result of the process of collecting and processing data of various types and purposes. Typically, these data do not have a natural and obvious graphical representation. Information visualization combines methods of scientific visualization and human-machine interaction. Information visualization methods are widely used in all areas using information technology. This also applies to the field of education.

Algorithmization is an important step in solving any problem using a computer. The effective activity of a specialist in the field of information technology depends not only on the knowledge of a specific programming language for solving applied problems, but also, to a greater extent, depends on the quality of knowledge in the field of building well-structured algorithms for processing information represented by various data structures [3, 4], as well as the experience accumulated in solving applied problems. Based on these considerations, it can be argued that for the successful assimilation of the mechanism of the algorithms, a necessary condition is a visual description of the algorithm for each stage of its execution. Visualization in the educational process is the process of presenting information, data, knowledge in the form of an image, with the goal of maximum convenience for their perception, understanding and analysis. For example, the visual representation of the algorithm will allow the learner to see and better understand what structural elements are used in the design of the algorithm, how the logic of their interaction is described, what real objects correspond to certain elements in the problem being solved. An algorithm visualizer can be used as a visual learning tool that allows implementing such an approach. Let's note the distinctive characteristics of visualizers: interactivity and visibility in the management of the visualization process by the user; ease of use of the visualizer interface; displaying the progress of the algorithm; availability of explanations; support for two imaging modes: step-by-step and automatic. In the educational process, visualizers of algorithms can be used subject to the following requirements: displaying input and output data in a visual form, which demonstrates the implementation of the algorithm; displaying comments on the implementation of the algorithm that would explain all the actions performed; the ability to follow the actions of the algorithm execution from beginning to end, step by step. The Delphi 7 visual programming environment can be used as software for developing an algorithm visualizer. The Delphi 7 environment has rich opportunities for designing the application interface and implementing visual reproduction of algorithms, in particular, the Timer and Image components can serve to animate the process of sorting

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array elements. Also, animation can be implemented through the Canvas object and its graphic methods. For textual explanations of the operation of algorithms and process control, components such as Button, RadioButton, Label, Memo are used. Components such as Edit, StringGrid, ComboBox are used to implement input. In addition, there is a group of Shape and PaintBox graphical components that can be used to display graphical objects on the form. As an example, let's describe the emulator of sorting algorithms developed in this environment (Fig. 1).

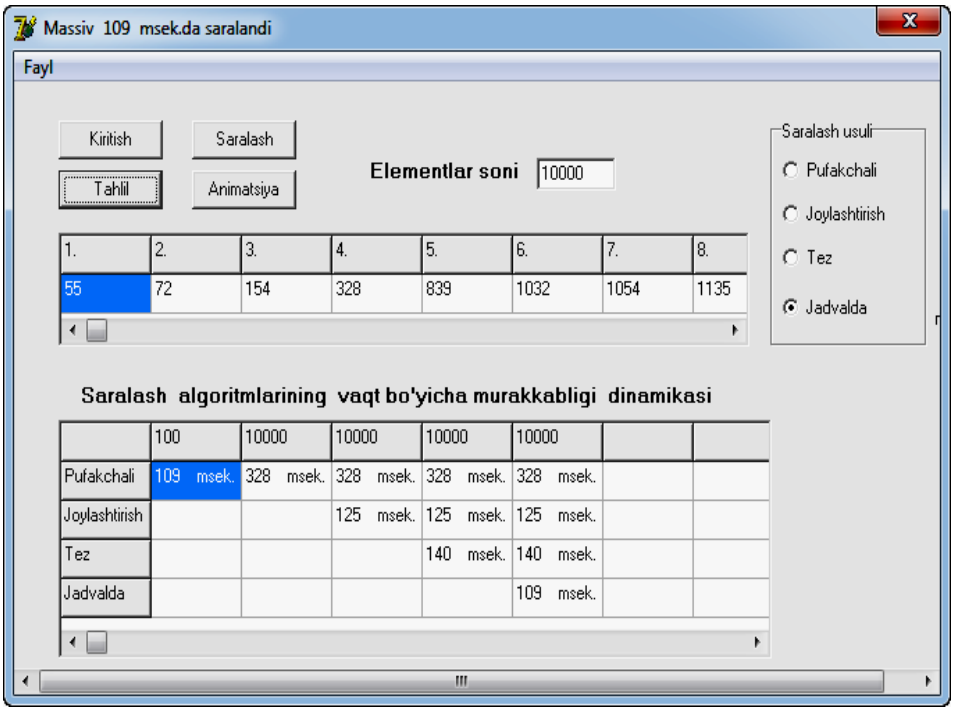

Fig.1. The operation of the emulator in the mode of creating a comparative table of time complexity of algorithms.

The application is designed to sort the elements of the visualization array and compare the time complexity of the algorithms. The functionality of the visualizer includes: generation of an integer array of a given size; sorting an integer array using Bubble sort, QuickSort, Insert sort and Table sort; determination of time complexity of algorithms, creation of a comparative table of time complexity of algorithms, reading values of array elements to be sorted from an external file, and writing the sorted array to an external file. The application also visualizes the operation of the Bubble sort, QuickSort, Insert sort, Merge sort and Heap sort.

Visualization of educational material opens up the possibility not only to bring together all the theoretical calculations, which will allow you to quickly reproduce the material, but also to apply schemes to assess the degree of assimilation of the topic under study. In practice, the method of analyzing a particular scheme or table is also widely used, in which skills are developed for collecting and processing information. The method makes it possible to involve trainees in active work on the application of theoretical information in practical work. A special place is given to joint discussion, during which there is an opportunity to receive prompt feedback, to better understand yourself and other

people. Summarizing what has been said, we note that, depending on the place and purpose of visual didactic materials in the process of concept formation (the study of a theory, phenomenon), various psychological and pedagogical requirements must be presented to the choice of a specific structural model and visual display of the learning content. When visualizing educational material, it should be taken into account that visual images shorten the chains of verbal reasoning and can synthesize a schematic image of a larger "capacity", thereby consolidating information. Another important aspect of using visual educational materials is to determine the optimal ratio of visual images and verbal, symbolic information. In practice, conceptual and visual thinking are in constant interaction. They reveal different aspects of the concept, process or phenomenon being studied. Verbal-logical thinking gives us a more accurate and generalized reflection of reality, but this reflection is abstract. In turn, visual thinking helps to organize images, makes them complete, generalized, complete. Thus, the visualization of educational information allows solving a number of pedagogical problems, such as:

- providing intensification of education;
- activation of educational and cognitive activity;
- formation and development of critical and visual thinking; visual perception;
- figurative representation of knowledge and learning activities;
- knowledge transfer and pattern recognition;
- Improving visual literacy and visual culture.

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