



Online Learning of Computer Science by Schoolchildren Using Interactive Educational Posters

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Abstract— This article deals with questions of organization online schoolchildren training using interactive posters as multidimensional didactic tools for a computer science teacher. The concept of "interactive posters" discusses and shows their important role for activating and managing the activities of schoolchildren in full-time and remote forms of interaction. We are considering the design and development of interactive posters on the web platform with the specifics of training in informatics and overcoming the problems of modern schoolchildren related to clip thinking.

Keywords— online learning computer science, educational web platforms, interactivity, interactive educational posters, multidimensional didactic tools

I. INTRODUCTION

The learning process in the digital-educational environment is based on pedagogical interaction, which is carried out using network technologies, since the vast majority of participants in the modern educational process get the opportunity to use computers with access to the Internet. The Internet affects the whole sphere of education, changing the nature and intensity of network communications, influencing social interactions and ways of transferring knowledge. We will consider the Internet as a special social and cultural space in which the structure and dynamics are determined by network communities that unite people on the basis of common ideas and forms of activity [17]. The widespread distribution of network communities allows to purposefully solve the problems of modern education using a variety of online platforms, Internet services that give opportunity to exchange information, participate in the discussion of various problems, organize joint activities with web documents, publish your own information on the network, etc.

There is an active search for innovative forms, methods and technologies for implementing interactive interaction between participants in the educational process using computers and the Internet in the field of education [7]. More attention is being paid at different levels of education to the concept of "flexible learning," which is understood as the use of online learning in the traditional educational process, which is a model combining online learning with social interactions and collaboration among schoolchildren in the classroom [2, 18, 19].

There are many discussions about the feasibility and possibilities of online schoolchildren training to date [9].

Especially many questions with organizing online training are raised by tools for organizing interactive interaction between teachers and schoolchildren in the process of online training, which are often created [5]:

- without theoretical ideas and empirical data of best teaching practices;
- without reliance on methodical aspects of material supply and interface organization;
- without using the principles of pedagogical design;
- without connection to diagnostic tools for tracking measurements of knowledge and skills, for further analysis of formed competencies in schoolchildren.

When designing online learning strategies based on online forms of interaction, where the principle of interactivity becomes key [9, 17], it is important for the teacher to understand [6, 7, 11]:

- where and how to apply the main types of interactivity - the interactivity of feedback (allows you to control the process of mastering educational information by schoolchildren, to respond to his actions); temporary (allows the schoolchildren to independently choose the time of mastering educational information, its duration and speed of mastering, etc.); sequential (allows the schoolchildren to choose the order of using fragments of educational information, etc.); substantial (allows the schoolchildren to dose the volume of mastering educational information himself, manipulate its appearance, etc.); creative (allows the schoolchildren to take creative actions with educational information - design, add, transform educational information, etc.);
- to organize the interaction of all schoolchildren both with the teacher and with each other through interactive educational resources and manage the cognitive activities of schoolchildren in the virtual and real space.

All this requires a computer science teacher, who has a sufficiently high level of information technology, to search for new tools that allow him to organize interaction with students in the context of Internet communications with large flows of information and taking into account the emerging problems of modern schoolchildren associated with clip thinking -

reducing the duration of concentration attention, schoolchildren's preference for visual or visual-verbal images. This makes the perception of information fragmented, and it is making difficult to understand the cause-and-effect relationships in the studied phenomena, etc.

Computer science teachers with a fairly high level of information technology are in the search for new tools that allow them to organize interactive interaction with students in the conditions of Internet communications. Of particular interest in this aspect are interactive posters, which are

- to increase the efficiency of external and internal plans of educational cognitive activity;
- to provide individual information trajectory training.

II. THE MULTIDIMENSIONAL DIDACTIC LEARNING TOOLS: ESSENCE, POTENTIAL AND PROBLEMS IN THE USE OF MODERN EDUCATIONAL PRACTICE

A. Multidimensional didactic learning tools

A computer science teacher can use multidimensional

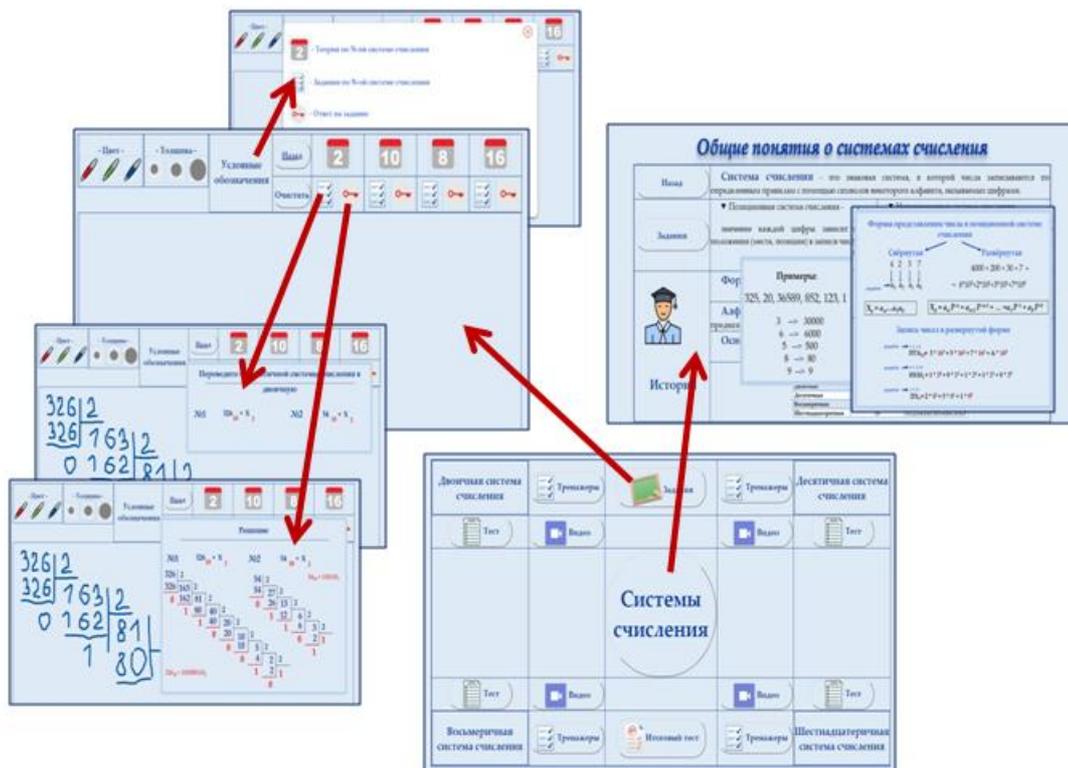


Fig. 1. An example of an interactive poster on the topic "Number systems" in the dynamics of working with it

multidimensional didactic tools with logical and visual organization of educational information and are posted on the Internet.

In this study, the multidimensionality of pedagogical objects (educational material and educational process, external and internal plans of cognitive activity, thinking) is considered as the basis of the multidimensionality tools of modern online learning technologies. Interactive educational posters can be used as an indicative basis of actions, didactic means of joint activities teachers and schoolchildren, navigators in mastering educational information (Shteinberg V.E.) [12].

Such posters allow you to:

- to increase the density of information presentation;
- to improve visualization and logical organization;
- to expand the presentation of educational information;
- to implement logic-semantic modeling of educational information;
- to organize, regulate educational activities with educational information;

didactic tools to organize interactive interaction with schoolchildren. Educational information is logically and visually organized in multidimensional didactic tools. They can be posted on the Internet, for example, on web platforms and used in various forms of interactive interaction with schoolchildren.

By multidimensional didactic tools (V.E. Shteinberg and others), we mean universal figurative and conceptual models of knowledge presentation and analysis in a natural language in the external and, accordingly, internal plan of educational and cognitive activities of schoolchildren. The task of using such tools includes the possibilities of presenting educational material in an incomplete form, in the form of a "knowledgeable designer" with modeling and figurative-conceptual properties, in a convenient form for visual, logical perception and for transformation and operation of knowledge elements [13]. Examples are: infographics (block logic diagrams, structural logic diagrams, structural functional diagrams, etc.), reference signals (V.F. Shatalov), enlarged didactic units (P.M. Erdniev), cognitive maps, interactive posters and etc.

V.E. Shteinberg based the substantiation of the advantages of using multidimensional didactic tools formulated by A.A. Verbitsky the purpose of visualization in didactics, as one of

the non-verbal methods of graphical presentation of information, which allows you to fold the mental content into a visual image, which, after being perceived, can be expanded and made a support for adequate mental and practical action [16].

The main task of the schoolchildren's activity is to identify, explicate, analyze and represent the object of cognition, where the main role is played by the isolation and binding of knowledge elements, their folding into model images, deployment of these model images and their operation [12].

B. Interactive educational posters

By interactive posters we mean modern multifunctional learning tools that allow for multi-level work with educational information with its maximum visualization at all stages of work (primary transfer, processing, control, etc.) [4].

By interactivity we mean the direct or mediated by an interactive poster interaction of the participants in the educational process, in which the principles of feedback are implemented, which provide an educational dialogue, freedom of choice of an educational trajectory, and management of educational activities [4, 6].

Figure 1 shows an example of an interactive poster in the dynamics of working with it online.

In the example above (see Fig. 1), an interactive poster consists of three main blocks:

- theoretical (basic synopsis, interactive video, etc.),
- practical block (online editor for collaboration, interactive tasks, hint system, simulators, etc.),
- control unit (tests).

content component of the activity (directly the educational material) and the control component of the activity (tentative foundations of activity) [3; 8; 10; 14, 15].

When developing interactive posters, it is important to take into account their didactic functions, which provide a visual representation of the content the educational subject and educational activities with the logic of their organization. The functionality of posters should increase in the direction: from illustrating the required activity - through the support in the activity - to directly regulating the activity.

It allows you to implement the following algorithm for building a model for studying a topic: to determine its characteristics - the coordinates of the measurement of the topic being studied; to arrange them according to the material study sequence; to select nodal content elements in each characteristic and arrange them according to the selected base; to identify and designate the most important connections between the nodal elements; to collapse the designations of coordinates, nodes and links to the minimum size - keywords. Such a reference-nodal coordinate system is presented in the form of ray-like graphics (Fig. 2). Ray-shaped ("solar") structures with radial and circular elements were chosen as the measure of multidimensionality [13]

III. METHODOLOGICAL FEATURES OF THE DEVELOPMENT AND CREATION INTERACTIVE EDUCATIONAL POSTERS FOR SCHOOLCHILDREN ON THE TEACHER'S WEB PLATFORM

During the research, it was revealed that an interactive educational poster for online learning should be:

- concise (in content and design);
- have the tools for rapid feedback to learners;
- contain a lot of clarity (with maximum visualization);

- contain several levels of presentation educational information (for example, collapse and expand information blocks in time, study with schoolchildren sequentially the concepts of the first level, second level, etc.).

In this case, the following characteristics play a significant role [4, 8; 12]:

- laconic design (limiting the use of the maximum number of printed characters);
- building a clear structure (the structure should be clear and easy to remember);

- blockiness (accommodation information in separate blocks, the allocation of semantic center, equilibration other objects relative main center);

- organization semantic accent (use a frame, separate some blocks from others, arrange original symbols, etc.);

- unification (implementation within the entire interactive poster of a single graphic and color

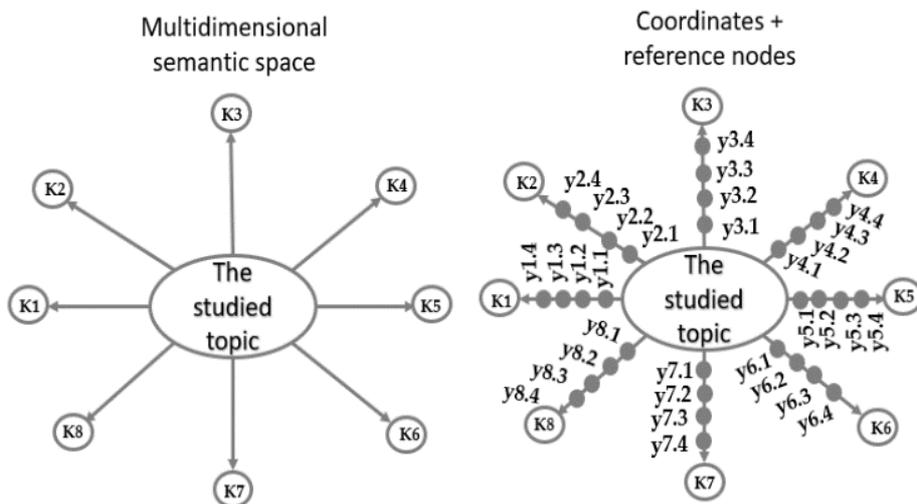


Fig. 2. Coordinate-matrix frame for learning educational information in an interactive educational poster

An interactive poster with maximum visualization allows, in this case, this abstract material on the topic "Number systems" to fold the mental content into a visual image, which, after being perceived by schoolchildren, can be expanded and made a support for their mental and practical actions.

At the same time, visualization allows you to solve an important problem of increasing the effectiveness didactic tools: dilution in the educational and information flow of the

solution for symbols, signs, drawings, etc., denoting the same objects, phenomena or events);

- autonomy (each of the designated blocks must be independent, clearly delimited from the others in meaning);
- associativity, color visibility and imagery;
- availability playback;
- convolution and deployment of information element symbols, etc.
- intelligibility (create taking into account the age and psychological characteristics of schoolchildren).

It is important for a computer science teacher to

- to develop an interactive poster using web-based tools.

Interactive posters placed on the web platforms of informatics teachers on the Internet allow them to be used in videoconferencing mode when providing interaction between the teacher and schoolchildren at a distance (for example, using the Zoom videoconferencing system) and for the implementation of the learning process using them as an educational resource electronic environment, with the specifics of teaching computer science [10]. Informatics is continuously and rapidly developing as a science, which leads to a constant increase in its volume and updating of content, which includes a lot of abstract educational material, which is difficult for schoolchildren to perceive, which leads to certain difficulties, since the curriculum for studying the school course of informatics takes an insufficient number of hours.

To solve the

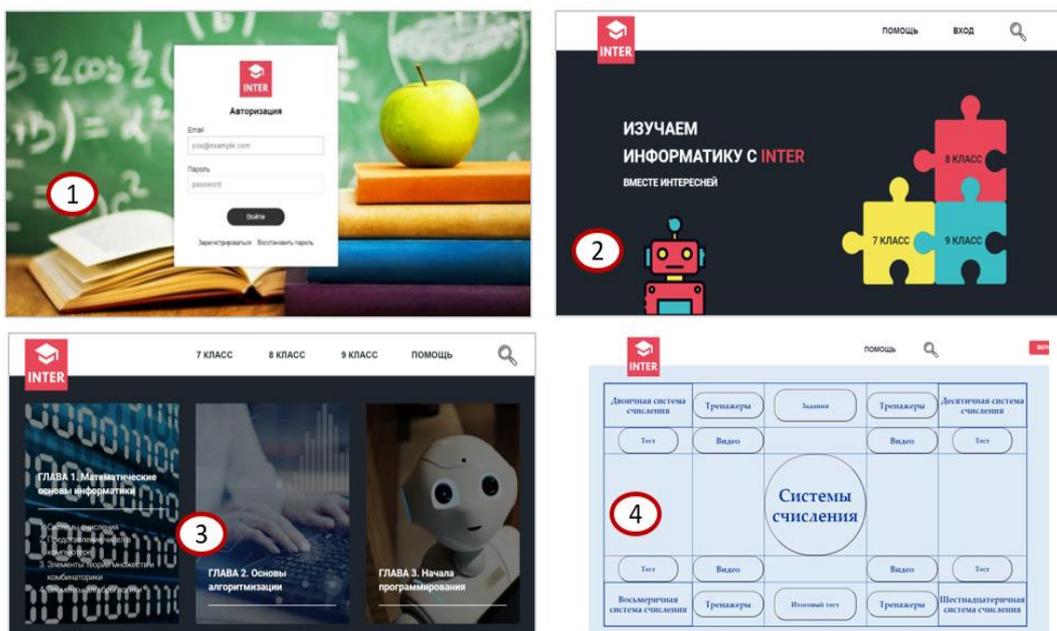


Fig. 3. Web platform "We study computer science with Inter," developed by students (1 - authorizing on the platform, 2 - main page of the course, 3 - transition to the choice of educational topics, 4 - an example of an interactive poster on the selected topic)

consider the following methodological aspects during the design and development stages of interactive posters:

- to analyze the content of standards and training programs in informatics and formulate goals, objectives, planned results for schoolchildren;
- to select and analyze the most complex parts of the educational material;
- to elect the content that will be visualized;
- to balance verbal and visual perception of educational material;
- to create a didactic image of the lesson, which should be formed by the schoolchildren during the work with the interactive poster;
- to design the interactive poster itself;
- to develop a system of practical tasks and monitoring materials for it;

emerging problems, the computer science teacher needs to be able to develop author's educational resources, due to their rapid obsolescence, to develop and search for new tools provided by the Internet and the digital educational environment.

When pre-designing a web-based learning platform with interactive posters, it is important for computer science teacher to first build an online learning model and highlight:

- subjects of the educational process (information about the participant of the educational process, necessary data for registration on the platform, basic knowledge of the subject, level of mastery of educational material, etc.);
- subject area (content of educational material, electronic educational resources, visual images, animated educational materials, video resources, materials for fixing, skills development, for monitoring and independent work of schoolchildren);

- learning process management models (learning material navigation, algorithm for navigating the course content, allowing to build individual educational trajectories and level differentiation at basic and in-depth levels) [1].

The analysis of pedagogical experience shows that computer science teachers actively use different web platforms (for example, Tilda Publishing, CMS WordPress, etc.), since they have at their disposal a fairly large number of various means for creating them [6]: visual and non-visual HTML editors, site designers, content management systems, Internet services, most of which are completely free. When you creating interactive educational resources placed on web platforms, the available tools for their development allow you to:

- to design and develop an extensive feedback system with schoolchildren;
- to use tools added to the web platform to effectively diagnose the development levels of schoolchildren with tracking their intermediate results and making timely adjustments;
- to fill the web platform with educational information and interactive educational resources that the teacher can create independently or integrate from various educational sites and resource libraries.

Web platforms developed by computer science teachers allow you to support online education of schoolchildren and use both ready-made educational resources and develop your own ones that meet the requirements of the teacher and emerging tasks, including to post interactive posters on web platforms (developed independently or integrated with other services) [6].

There are opportunities to create interactive posters or integrate into their individual parts of interactive educational resources that have appeared on the network of libraries (interactive tasks, books, posters, videos, etc.) as multidimensional didactic tools. You can use code to add them

to your web platforms or download resources to use in-person training with ability to refine their HTML code to change the finished resource to meet your teacher's goals. An example of such libraries is the resources of the popular H5P service among teachers (<https://h5p.org>), which allows you to use templates to create interactive posters, also Russian service (<https://udoba.org>), which allows you to create and download interactive resources on your computer and use the resource library H5P for free.

IV. THE DEVELOPMENT OF INTERACTIVE EDUCATIONAL POSTERS BY STUDENTS IN PEDAGOGICAL HIGH SCHOOL

At Volgograd State Socio-Pedagogical University, the Faculty of Mathematics, Computer Science and Physics is actively working to master the capabilities of network multidimensional didactic tools by future teachers.

Students get acquainted with the capabilities of interactive posters, which they embed in web platforms for online education schoolchildren. When developing authoring multidimensional interactive resources, presentation packages are used; HTML5 language, cascading stylesheets CSS3 and JavaScript; Internet services, etc.

Figure 3 shows an example of a web platform developed by students (using Tilda Publishing tools and the HTML5 language, in conjunction with CSS3 and JavaScript) with interactive posters.

Interactive posters have a clear structure with blocks of the first plan (giving an initial idea of the meaning and general content) and blocks subordinate to it with more detailed information. There are also control elements on all units, with which you can switch to visual theoretical information, practical tasks, simulators, tests, etc.

Below is an example of an interactive poster on the topic "Information and Information Processes" in the dynamics of online work with it (see Fig. 4).

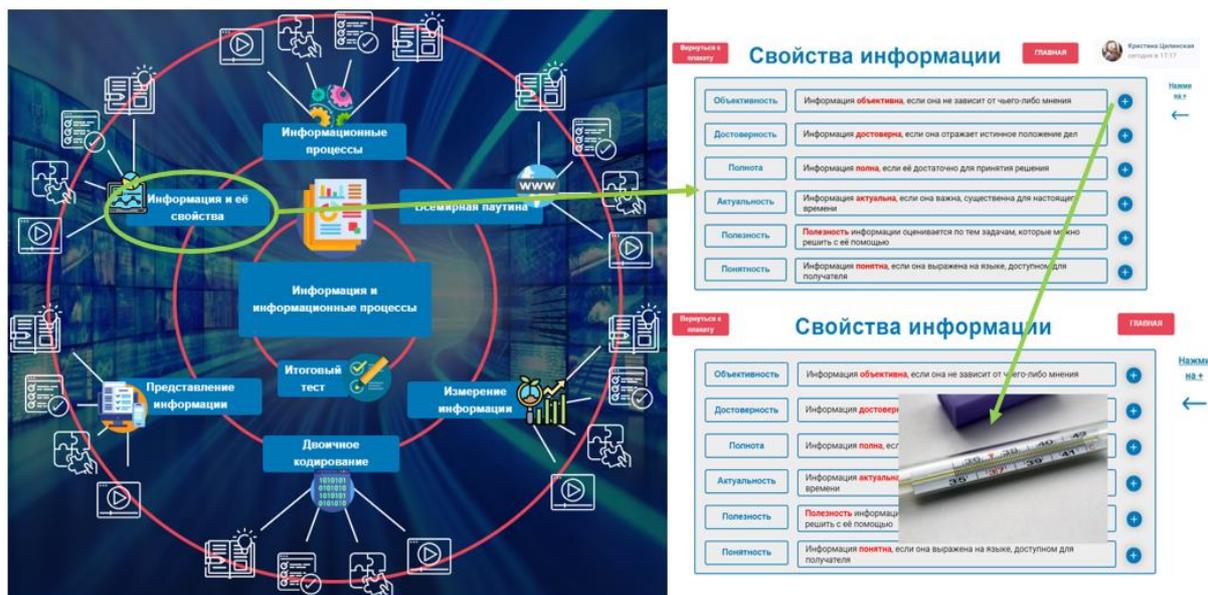


Fig. 4. An example of an interactive poster on the topic "Information and information processes" on the web platform "We study computer science with Inter" (1 - all elements are interactive, 2 - transition to embedded information; 3 - switching between different types of information)

In interactive posters integrate electronic multimedia learning materials, simulators, test and verification tasks into one pedagogical tool aimed at studying new material, as well as at consolidating, developing skills and controlling the quality of assimilation of the received information with specifics of online training.

V. CONCLUSION

In conclusion, we note that interactive educational posters don't represent a rigid algorithmic structure, but are a "constructor" that provides many opportunities for creativity for teachers and schoolchildren, which is confirmed by the pedagogical practice of their use.

Scientific novelty. The article substantiates the possibility of using interactive educational posters as multidimensional didactic tools that make it possible to activate the cognitive activity of schoolchildren in the process of online learning. Methodical recommendations have been developed for the design and creation of such tools on web platforms. As a result of evaluating the experimental creation and use of interactive educational posters in the course of pedagogical practice, students – future computer science teachers participating in the experiment, revealed their high interest and satisfaction with this experience. It is shown that the developed interactive content for new multidimensional didactic tools is effective for increasing the motivation for teaching schoolchildren and for enhancing the cognitive activity in online teaching of computer science.

Interactive posters placed on online platforms make it possible to make online computer science education for schoolchildren more effective by visualizing and structuring information; the ability to expand and collapse, to detail educational content; ensuring the active work of students with educational information regardless of the place and time of classes, which can significantly improve the quality of teaching computer science at school.

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