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DEVELOPMENT AND USE OF DIGITAL INTERACTIVE OBJECTS IN ELECTRONIC TEACHING MATERIALS

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Abstract

The article reveals the significance of creating flexible scenarios for individual lessons in modern education. Analysis of scientific publications and the existing experience of business education has shown the need to increase the role of organizing the interaction and communication between subjects of the learning process. Traditionally, these are webinars, binary lectures, virtual tutorials, creative activities, work in small groups, etc. The article defines digital interactive objects (DIO) as

the means to apply various interactive teaching methods using e-learning technologies. Considering the DIO as a didactic teaching tool, we distinguish several interactivity levels of teaching tools that allow us to choose the required form of educational content and to achieve learning goals. In the current study, DIO of business education has been developed. They are represented by sets of interactive objects for the implementation of various interactive methods and didactic teaching techniques according to the certain pedagogical scenario of the distance learning course. The relevance of the new pedagogical and technological scenarios for DIO results in the development of algorithms and methodological recommendations to be used by organizing training sessions in economic and business disciplines.

Keywords

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1. INTRODUCTION

The severe competition takes the educational services market to a new level. Thus, the volume of the global education market in 2021 amounted to 5 trillion dollars, of which 3% accounted for the online education market. In the CIS countries, the education market in 2021 amounted to over $27 million, of which the online education market accounts for 2.6% (Analysis, 2022).

In 2022, the online education market expects the following prospects:

- Transition to a Hybrid Form of Education (Online Combined With Full-Time Education);
- Improving the Quality of Services, Which Will Increase Consumer Confidence in Online Platforms;
- Emphasis on artificial intelligence, soft skills and voice technologies.
  In such conditions, a number of problems arise:
- The rapid change in production technology significantly exceeds the adaptation of universities to innovations; academic and practical business education. A high-quality theoretical base and thorough practical training prepare students to solve real-life cases. Moreover, western and domestic methods, ideal situations and existing restrictions in which business exists are used.
- The training of specialists takes longer than the development of modern industries;
- The relevance of the knowledge gained decreases and is lost.

Therefore, the main task of education is to create flexible individual training scenarios that adapt to the rate of knowledge assimilation by each student. Universities and business schools are to create engaging, adequate content for students.

The Institute of Business of the Belarusian State University combines basic principles of successful education are:

- Systematization of knowledge. Students use relevant theoretical material that finds practical application in key areas of business;

- Experience in solving real problems. Business cases develop rational thinking;

- Manager's competencies. Specialists develop leadership qualities, business and interpersonal communication skills;

- Convenient training schedule. Equal distribution of significant workload allows distributing study time.

An electronic educational resource provides interactivity – an automated response to the actions of students in accordance with technical and content constraints and conditions. Objects providing such interactivity by means of multimedia will be referred to as the "digital interactive objects" (DIO). The main advantage of the DIO is the student's direct participation in obtaining information or results. To develop DIO, it is necessary to provide technologies that allow these resources to be embedded in learning management systems or used autonomously.

Institute of Business of BSU introduced a system of high-quality electronic educational resources and created a library of digital interactive objects in economic and business disciplines with prepared guidelines. The system improves the quality of students' independent work and supports the educational process in full-time and distance learning.

2. RESEARCH RATIONALE

Considering interactive teaching methods, we highlight a whole range of interactive approaches that are aimed at organizing interaction and communication between the subjects of the learning process. These can be webinars, a binary lecture, a virtual tutorial, creative tasks, work in small groups, etc. Considering DIO as a didactic learning tool, we determine the levels of interactivity of learning tools, this allows us to choose the form of educational content that works most effectively for a given learning goal.

Within the scope of the research work, it is important to consider interactivity in two approaches. When reviewing technologies for the development of digital interactive objects, it is logical to focus on the context of interactivity from the perspective of information technology. When analyzing modern approaches to training and use - in a pedagogical vein. In the pedagogical

aspect, two directions can also be distinguished. One direction is related to the use of interactive teaching methods in higher professional education. In another direction, digital interactive objects are considered as didactic teaching aids.

2.1. Research Aims and Objectives

Research aims are to develop pedagogical and technological scenarios and to create digital interactive objects in e-learning. The following objectives were planned:

1) To scrutinize modern approaches and technologies in the development of digital interactive objects;

2) To develop pedagogical and technological scenarios for digital interactive objects in economic and business discipline;

3) To develop digital interactive objects in economic and business disciplines;

4) To prepare guidelines for the use of the developed digital interactive objects in the educational process.

2.2. Research Novelty and Relevance

The novelty of the approach lies in the development and testing of guidelines for the creation and use of digital interactive objects to support the educational process. The relevance lies in the principles of:

1) Constant progress. The student goes through the course, receives feedback and analyzes the results;

2) Relevance. It is necessary to provide access to electronic catalogues with relevant constantly updated information;

3) Involvement. Providing maximum comfort for the learner is crucial;

4) Increased coverage. Consists of increasing the number of trainees at no extra cost.

New technological scenarios include the development of algorithms and methodological recommendations for the use of DIO in economic and business disciplines. The algorithm meets modern market trends, uses new instrumental and project management methods to develop relevant pedagogical and technological scenarios.

Our proposed approach to selecting a digital learning system for the implementation of various interactive teaching methods using e-learning technologies has a number of advantages:

1) It implements an integrated approach to the preparation of an interactive lesson. This is manifested in the fact that when selecting the necessary interactive learning tools (in particular, DIO), both the methodology for conducting the selected interactive method/form of learning and the characteristics of the type of educational content necessary for this are taken into account.

2) The principle of necessity and sufficiency is implemented. It manifests itself in the fact that, using this approach to determining the list and characteristics of interactive teaching aids (DIO), we select exactly as many necessary DIO, which are sufficient to achieve the learning goals and objectives of the lesson.

3) This approach ensures consistency in the selection and use of digital information. When determining the list of interactive learning tools we need, we are guided by the achievement of these educational goals and objectives, which give us the necessary characteristics for our DIO.

4) The proposed approach helps to effectively decompose interactive teaching methods used in face-to-face classes into a remote learning format using e-learning technologies.

It is also expected to test the effectiveness of this approach in the preparation and use of digital interactive objects in education.

2.3. Literature review

Many researchers - A.V. Khutorskoy (Khutorskoy, 2002), J. Ravenn (Raven, 2002), S.S. Kashlev (Kashlev, 2013), P.S. Lomasko (Lomasko, 2017), S.A. Kalinovskaya (Kalinkovskaya, 2017), S.A. Druzhilov (Druzhilov, 2001), A.O. Blinov (Blinov, 2014), E.V. Shirshov (Shirshov, 2017) and others (Ivliyeva G.G. , 2020) single out the competency-based approach in education as one of the solutions in the training of personnel.

The positions of scientists have both similarities and differences.

From the standpoint of the preparation and use of DIO in teaching, it is useful to consider their taxonomic characteristics. This direction is less illuminated. P. S. Lomasko touched upon this issue in sufficient detail (Lomasko, 2017).

Stages of professional competence according to the degree of their awareness by the subject S.A. Druzhilov (Druzhilov, 2001) and De Armas Rodríguez N. (De Armas Rodríguez N., 2020) compared with the levels of individual professionalism.

With the development of information technology, interactive learning (Abramova N.S., 2021) has become relevant, the concept of which is also defined:

– "this is a priority strategy and tactics of university education, based on the interaction of learning subjects (online and offline) with the coordinating influence of pedagogical support (accompaniment) and contributing to the development of competencies and self-realization of students in educational and professional activities" (Deeva N.A., 2020);

It is "a pedagogical approach that incorporates social media and urban computing into course design and delivery. Interactive learning has evolved as result of the rapid growth in use of digital technologies and virtual communication, especially by students" (Almazova N., 2020).

Interactive learning is based on "interactive technology" (Russkova Yu.N., 2020), which, as a rule, refers to the use of certain gadgets - interactive whiteboard (Orshanskyi L., 2020), tablets, multimedia equipment, etc. (Egorova G.I., 2019); and forms - webinars, work with online information sources, distance learning format, etc. (Romanovskaya V. B., 2021; Rahman M.A, 2020).

Interactive objects as components of interactive technologies must comply with B. Bloom's taxonomy (Anderson, 2001), which obliges to use them in the sequence determined by the competence-based approach (Soboleva M.L., 2019).

3. PEDAGOGICAL SCENARIO FOR EDUCATIONAL DIO IN BUSINESS DISCIPLINES

Digital interactive objects must be correctly integrated into the general system of mastering the academic discipline. Pedagogical design means a systematic approach to the educational process construction: the content, methodology and organization of the educational process are subordinated to the goal of learning. The issues of pedagogical design cover the ways of presenting educational material and the sequence of its presentation, the combination of theory and practice, building an educational trajectory, the use of various types of teaching load, methods of attracting the attention of students, shaping their motivation and desire to continue learning, options for interaction between participants in the educational process and a number of related issues

From the standpoint of pedagogical design, a distance course (DC) includes:

- Funds working for the content of the training;
- Tools for attracting attention;
- Techniques for the formation of motivation for continuing education.

The development of a DC begins with the preparation of pedagogical and technological scenarios (pic. 1).
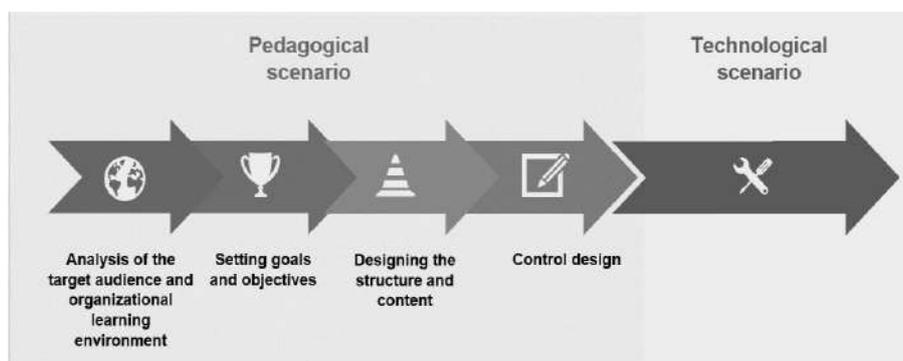
*Picture 1.* The process of pedagogical and technological scenarios developing

(Source: Self)

The goals of learning, the choice of strategy and means of delivery and the way of assessing and improving the result are determined by the pedagogical scenario. Thus, we have the following algorithm for designing the distance course structure:

Stage I. Analysis of the target audience and organizational learning conditions. The key is to determine the social status and motivation of students, their training needs, organizational conditions and constraints. For example, full-time and part-time students differ in organizational learning conditions and the degree of motivation. The characteristics of the target audience makes it possible to determine the style, tone of content, the level of technical implementation of both the distance course and digital interactive objects.

Stage II. The educational goal and objectives of the distance course. Setting the goal means indicating the desired change in the learner behavior. Students' result specification after completing the course is crucial. The basic objectives are levels of knowledge, understanding and application. To creative - analysis, synthesis, evaluation.

Stage III. A list of components included in the DC and its modules. Learning material and learning activities are structured with content which makes learning comfortable and successful. Next, we define the structure of the training module template according to the previously defined structure elements. An example is shown in pic. 2.
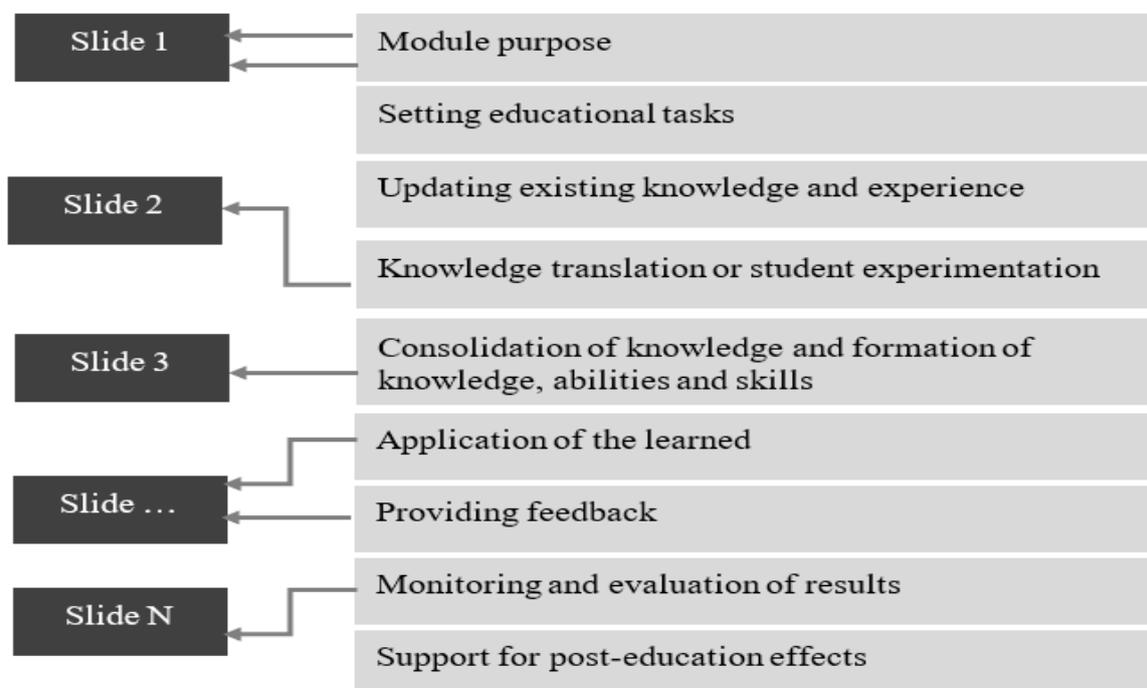
Picture 2. *Training module template structure, example*

(Source: Self)

Time to move on to detailing and defining the types of knowledge. The principle of redundancy of content lies in working with the same object of study in two or more types of knowledge.

Next, a strategy for the distance course and the nature of the demonstration of educational content are determined. An interactive strategy means that the course is designed not so much for the transfer of knowledge, skills and abilities as for the student's response to them. It is advisable to build a distance course map in which digital interactive objects are planned. As a result, the following algorithm for designing the content of the DC is formed:

1) Determine the list of course sections based on the goals and objectives of the course;
2) Formulate the goal and objectives for each section;
3) Determine the list of modules for each of the sections of the DC;
4) Formulate the goal and objectives for each module;
5) Determine the types of knowledge of the DC, guided by the principle of "redundancy";
6) Determine the strategy for the implementation of the DC.

Stage IV. The control of the distance course. We propose the following control algorithm in DC:

1) Place control points;
2) For each control point, select an assessment method that corresponds to the set taxonomic goals and objectives;
3) Determine the method of verification for each control point, based on the purpose of the training task;
4) Develop control measures;
5) Carry out experimental verification.

Last but not least is to complete pedagogical scenarios by creating scenarios for the implementation of each module and writing all the selected educational content into the chosen strategy.

When writing pedagogical scenarios, it is important to use methodological techniques based on the key mechanisms of memory and attention and the fundamental principles of pedagogy:

- Gradual complication of the material: a large amount of new information will not only lead to rapid fatigue of the student but may reduce his motivation to learn.
- Maintaining a balance between the abilities of the student and the task he is solving. Too complex tasks can cause frustration. Too simple - despondency. Use a slightly more difficult task to train thinking, and a simple one to train already mastered skills.

- The priority types of functional and semantic text types used are reasoning, not description and narration.

- Uniform distribution of theoretical, practical and control material.

- Adding the possibility of self-assessment at the beginning of the course/unit.

- Use of gamification techniques.

- Using storytelling to explain complex concepts, phenomena or processes.

4. TECHNOLOGICAL SCENARIO AND EDUCATIONAL TOOLS

The technological scenario contains the means of technical implementation of the pedagogical scenario of the DC including tools for organizing and conducting training, tools for developing training materials.

Training tools are tools that are used to host and deliver training content; organization of the educational process; communications, etc. For example, a forum is a popular tool to support educational activities and can be used to;

- Study the material and organize work on the joint formation of content;

- Answer questions and conduct consultations;

- Hold round tables;

- Demonstrate the results of students' activities.

The selection of tools for the development of educational materials is carried out according to the following algorithm:

1) Identify software products from the available list;

2) List the available tools of the selected software;

3) List the available means of available technologies.

Designing a distance course design includes the following steps:

1) Determine the types of screens of the Information Centre;

2) Make prototypes of screens of all kinds;

3) Think over the navigation system;

4) Develop a stylistic design;

5) Develop text design;

6) Design graphic elements;

7) Determine the composition of the screens.

As a result, we distinguish the following stages of the development of a DSC:

I. Pedagogical scenario:

a) Analysis of the target audience.

b) Purpose and objectives of the DIO.

c) Selection of the characteristics of the educational Centre according to the required level of interactivity determined by the pedagogical tasks of the educational centre.

d) Writing a script for the DIO.

II. Technological scenario:

a) Selection of funds for organizing and conducting training.

b) Selection of tools for the development of educational materials.

c) Design;

d) Selection of data presentation forms.

After analyzing modern approaches to the development of pedagogical and technological scenarios for a distance course, it can be seen that when designing the entire course, the place, goal, tasks, etc. for digital interactive objects are formed as part of the overall work on the course and do not cause difficulties.

5. PRACTICAL OUTCOME

On the basis of technological scenario principles, the Institute of Business of BSU has started the pilot study project which is dedicated to the development of DIO in the discipline "Information Technology". DIO is being developed on the topic "Principles of Web Applications Operation".

A technological scenario of the development of DIO consists of the following stages:

__Stage I. Means of education are defined__.

Training courses are organized with the use of LMS Moodle. A web application is developed with HTML5, CSS3, JavaScript. The built-in tools are used for testing purposes.

*__Stage II. Technical tools are implemented.__*

Pop-up windows displayed on the Start page and the "How Does the Web Server Work" page were developed with the Image Hotspots from H5P. Text blocks with illustrations were provided with pop-up windows to help the User to fill correct data in the fields "URL addressing", "Client-server architecture», "HTTP request", "HTTP response: contents, codes". The animation with the explanation "How to transfer data in the network from the site to the user's device" based on the PowToon.com platform was developed.

__Stage III. Design is completed.__

Screen views and prototypes are defined as the main screen, pop-up window, animation screen. Navigation is simple and user-friendly. The concept of minimalism for the DIO is implemented. The Roboto Cn font ensures readability. Several controls and the logo of the

educational institution are original graphic elements. The rest of the controls and animations will be selected in the libraries of the used SaaS resources. The layout of the Start page is shown in the pic. 3.
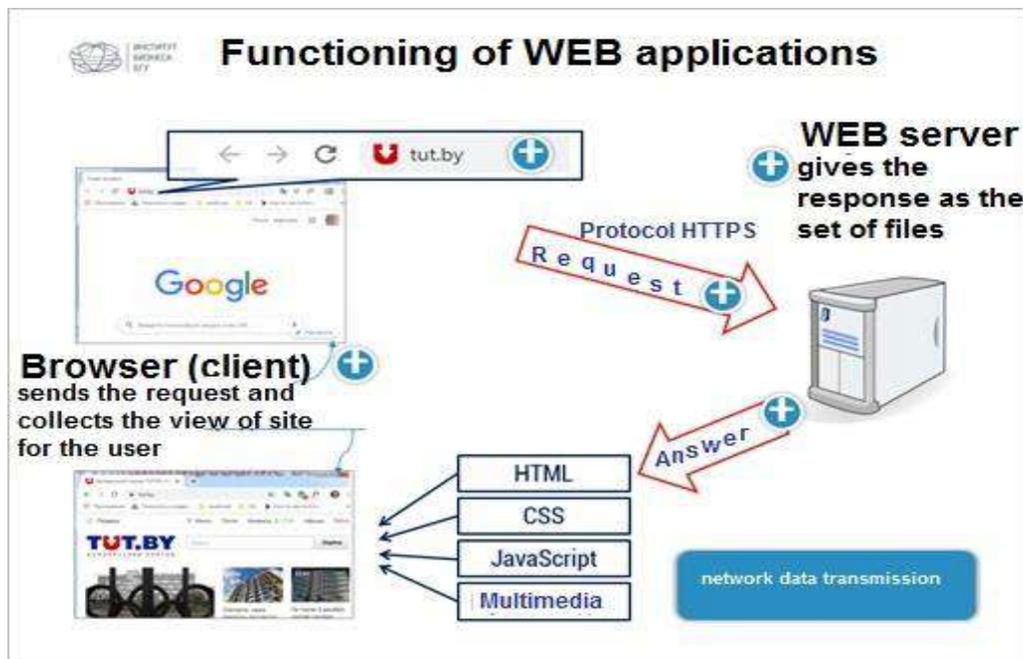
Picture 3. Start page wireframe

(Source: Self)

Stage IV. Data representation forms are selected.

The DIO will use the following data presentation forms: text, hypertext, illustration, video, animation, tests.

Stage V. Methodological recommendations are developed.

The following structure is presented: name of the DIO; list of recommended disciplines/topics to be used; the purpose of the DIO; tasks to be completed; the prevailing cognitive processes in the particular DIO; recommended target audience; tools and techniques to be used by organizing and conducting training.

6. CONCLUSIONS

E-education is the fast-growing segment of the global education market. Modern electronic educational resources require the possibility of interaction with the user, i.e. its interactivity. Digital interactive objects make it possible to provide interactivity with multimedia. The main advantage of using digital interactive objects is the student's direct participation in obtaining information or results, which ultimately directly affects the quality of his training. In the research work the following results were obtained:

- A Concept For The Preparation And Use Of Digital Interactive Objects In E-Learning Materials Has Been Developed;

- The Characteristics Of Digital Interactive Objects For The Implementation Of Various Interactive Teaching Methods Using E-Learning Technologies Are Determined;

- Requirements That Meet Modern Market Trends In The Use Of Digital Interactive Objects In Teaching Have Been Developed;

- Algorithms for The Development of Pedagogical and Technological Scenarios for The Use of Digital Interactive Objects Are Determined;

- An Algorithm for The Development of Digital Interactive Objects Has Been Proposed, According to Which Pedagogical Scenarios of DIO Have Been Developed, Including the Analysis of The Target Audience and The Selection of Characteristics According to The Required Level of Interactivity and The Pedagogical Tasks Set;

- Technological scenarios for digital interactive objects have been developed: means for organizing and conducting training have been identified; tools for the development of educational materials; design project; selected techniques for converting text into educational content as part of an interactive strategy;

- Designed pedagogical and technological scenarios and developed digital interactive objects in economic and business disciplines.

During the final stage, the proposed approach was tested to determine the list and characteristics of the necessary teaching aids in the form of digital interactive objects in accordance with pedagogical goals and objectives. For each digital interactive object, methodological recommendations have been developed for their use in e-learning, formed according to the following structure: DIO name; list of disciplines/topics for which it is recommended to use; the purpose of the DIO (from the perspective of the learner); tasks of the DIO (from the position of the student); prevailing cognitive processes in a given DIO; features of the target audience of this DIO; recommended ways of organizing training; recommended means of organizing training..

The practical result of this work is the library of digital interactive objects, with guidelines for their use in e-learning in various subject areas, including for training business professionals.

6.1. Research Limitations

Research limitations are general methodological limitations and the lack of previous comprehensive research in the field of forming the process of developing pedagogical and technological scenarios for digital interactive objects. In the course of the research, we for the first time defined the concept of "digital interactive object" and the scenarios for its creation in the domestic literature.

7. ACKNOWLEDGMENT

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