

The Use of Information Technology in the Invariant System of Presentation of Learning Material in the Learning Process

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ABSTRACT

The article reveals a systematic approach to the pedagogical technology of visualization of educational information in higher education. Consistency is inherent in any technology; therefore, pedagogical technology is no exception and exhibits the properties of a system. As mentioned above, pedagogical technology consists of interrelated components that describe the educational process. The concept of educational technology is presented, which consists of three main interrelated components: scientific, formal-descriptive and procedural-effective. This paragraph reveals the scientific component of the pedagogical technology of visualization of educational information, which will justify the pedagogical technology of visualization of educational information in higher education, as well as determine its composition and structure.

Keywords: Science Preparation, Higher Education Institution Training, Principle of Clarity, Discipline, Pedagogy.

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INTRODUCTION

In this work, the process of visualization of educational information in modern higher education is considered as an object of research. The study of this object includes the clarification of the concept of educational information, as well as an analysis of its foundations, which allows to reveal the educational process in higher education in a new way. At the philosophical level, the concept of "information" was considered by ancient philosophers, and until the beginning of the industrial revolution, the definition of the essence of information remained primarily the prerogative of philosophy. However, as the world community enters the post-industrial stage of its development, characterized as an information society, defining the role of information, its essence becomes a necessary task of education. At the general scientific level, information includes:

information about objects and phenomena of the surrounding reality, a description of their properties, states, etc.

exchange of information between people, data between a person and a computer, etc.

transmission of signals of animate and inanimate nature; genetic information [6]. A student, considered from the standpoint of the science of pedagogy, as a subject of the educational process and is a carrier of a significant amount of various information: knowledge in the form of various facts and theories, existing experience of activity, etc. [4]. In general terms, human thinking can be represented as a process of receiving, processing and storing information. In philosophy, there are three main forms of information presentation:

physical information - primary, maybe as living, so inanimate.

figurative information - secondary, exists only in living nature (in dynamic systems).

sign information (linguistic, visual, audio information, etc.)

- complex, exists in the form of a material-ideal object -

language, in which, for example, a material object - a text, when processed by the subject of education, turns into an ideal object - the meaning of this text. The main way of transferring in the educational process the meaning of general scientific knowledge [5], obtained empirically, or analytically, is "sign information". Sign information in the structure of the information system is treated as meta-information and is associated with the coding and interpretation of facts. In this case, an information system is understood as an ordered structure or sequence of information, which has three types of relations: syntactic, semantic and pragmatic. Meta information refers to second order information, or information about information. Coding means the assignment to a certain sign of some definite meaning, and by interpretation, the meaning of a syntactically complete block of information presented in a particular language. Sign information in this study will be revealed using the example of figurative information reflected in educational information resources and considered from the position of the systemic nature of its presentation in the educational process of higher education. Modern teaching aids are multifaceted, in this work, the general term "information educational resource" [13] means digital educational resources, innovative educational and methodological complexes and other digital publications and educational resources that have a significant visual component and lose their effectiveness when duplicated on paper. The system-forming aspect of visualization is associated with the concept of visibility, traditional in pedagogy, revised in line with the information approach. The essence of the information approach is to describe the pedagogical process in terms of information theory [2] (source, receiver, information channel, feedback, etc.). From the standpoint of system analysis, visual educational information can be viewed from functional, morphological and information points of view. Each of the designated points of view is associated with a specific

direction of visualization. The functional direction determines the place and role of educational information in the educational process. Morphological describes the structure of educational information according to its functional purpose. Informational reflects the process of transforming educational information into a visual form, taking into account the syntactic, semantic and pragmatic aspects of information.

MAIN TEXT

The pedagogical technology of visualization of educational information in higher education, as mentioned above, answers the question: how to use the achievements of modern science and educational practice, taking into account the specifics of future activities, to carry out the visualization process in order to achieve the required learning outcome. In accordance with the horizontal structure of G.K. Selevko, the pedagogical technology of visualization of educational information in higher education consists of the following components: scientific, formalized description of visualization and testing in the educational process. The scientific component of the pedagogical technology of visualization of educational information in higher education includes general ideas about the process of visualization, the interdisciplinary content of visualization and the specific features of the purposeful process of visualization. The level of general understanding of the visualization process includes: the basis of visualization, based on the interpretations that have developed in modern literature and are most significant for this study.

1) Systematic approach.

2) Principles: visibility, fundamentalization and professionalization.

3) Leading requirements: guarantee the provision of a variety of composition and provision of structuring.

The interdisciplinary content of visualization includes conceptual ideas based on the systemic nature of visualization of educational information and the level structure of visualization of educational information. The specific features of the purposeful visualization process include: the features of the selection of productive forms and methods adequate to the visualization conditions, as well as the use of visual elements of educational information with real-abstract or space-time characteristics. Since the pedagogical technology of visualization of educational information has a tiered structure and is considered at the level of the entire learning process.

Considering the technology of visualization of educational information from the standpoint of the object of management, one can characterize its orientation from the standpoint of pedagogical interaction towards teachers engaged in educational activities, developers of educational information resources and specialists in educational and methodological activities, as well as heads of educational institutions, etc. Further, in accordance with the structure indicated above, we will reveal the specific features of the purposeful process of visualizing educational information in higher education, which are manifested in the selection of productive forms and methods of teaching, as well as the corresponding techniques for displaying visual educational information. First of all, we will reveal the concretization of the specific features of the visualization of educational information on the example of the use of certain forms of organization of education [15], corresponding to the educational process in the conditions of visualization of

educational information in higher education. Let us explain the use of the concept "specific features of the forms of organization of education" in the conditions of visualization of educational information in higher education and show their manifestation in the educational process. The form of organization of education in pedagogy is interpreted as "a mechanism for ordering the educational process in relation to the positions of its subjects, their functions, as well as the completion of cycles, structural units of learning in time." Techniques for displaying visual educational information in higher education are feasible within the framework of a set of general and specific forms of organization of education, adequate to the conditions of visualization, taking into account the structure of communication (V.K.Dyachenko) in the educational process and characteristic of working with visual educational information. Visualization of educational information of higher education is carried out in the process of obtaining theoretical knowledge at lectures and the formation of experience in activities at seminars and includes visual elements of educational information corresponding to the following stages: updating knowledge, motivating educational activities, presenting new material, performing both typical and problem tasks, as well as control and evaluation activities. The dynamics of visualization elements corresponding to the named stages illustrates the fulfillment of the previously formulated requirement to ensure a variety of educational information. At the same time, with the transition from one stage to another, educational information for its better development is presented as an understandable, visual and high-quality illustrative material that multifacetedly reflects the theory and practice of the studied area. Moreover, for better memorization of this information, a harmony of its repetition in various contexts and ways of activity, taking into account the degree of achievement of educational goals, which are associated with the dynamics of the formed experience of the student audience, must be found. Accordingly, the implementation of a variety of presentation of educational information includes the alternation of verbal-symbolic and figurative-emotional information, the use of both previously mastered and proposed for mastering methods of transforming visual educational information, grouped so as to maximize the productive educational process, implemented in the context of the use of pedagogical technology visualization of educational information in higher education. In more detail, the techniques for displaying visual educational information can be considered on the example of adapting educational information to the characteristics of students, which implies the process of processing and individual coding of educational information, described from an information point of view. Individualized training (including training according to an individual plan) in the literature is divided into three models of training organization [14]:

1) the teacher interacts with only one student.

2) the student interacts only with the teaching medium.

3) students interact with each other without the direct participation of the teacher.

From the standpoint of visualization of educational information, the specificity is manifested in the adaptation of educational information to the individual characteristics and preferences of the subject of education due to its coding, operational organization of feedback, choice of educational trajectory and the pace of

mastering educational information. At the same time, visualization techniques in large audiences are selected on the basis of universality and strict adherence to the logic of presentation, and in individual lessons (and lessons in small groups) it is possible to use algorithms that take into account the individual experience of previously mastered visual activity. Practical examples of this training are Trump's Plan (USA) - a training organization that combines lectures using modern technology in large classrooms with one-to-one lessons. Dalton plan - individual work according to a special plan, in the form of cards. The teacher works with the audience in the introductory lesson, and in summing up, which is assessed by the performance of individual independent work. Next, we will trace the choice of methods for displaying visual educational information that create the required structural basis for visualizing educational information, taking into account the conditions of students' activity, taking into account the intensity of the presentation of educational information in time, the duration of training sessions over a certain period and training cycle. We will trace the allocation of the structural basis of the visualization of educational information using the example of concentrated teaching. Concentrated learning [1-4] is a specially organized learning process in which due to changes in the mechanisms of assimilation, structure, forms of presentation of educational information, its greater assimilation takes place (without increasing the training time). This training is based on the ideas of improving the quality of training (systematic presentation, mobility, initiative, etc.) and the creation of an optimal structure of the educational process. There are three basic models of the organization of concentrated training [13], which can be considered from a morphological point of view. The first involves studying the main subject for a certain time (the effect of "immersion" in the subject).

The second is the consolidation of one unit - a school day, consisting of two or three blocks (block: lecture - independent work - practical work - test) and one or two subjects.

The third is the parallel study of two or three disciplines that form the module. The specificity of visualization lies in the structuring of educational information, using methods of concentration and enlargement of educational information, taking into account its continuity, the organization of intersubject connections, the alternation of visual-figurative and logical-symbolic educational information. The most complete correspondence to educational needs can be achieved by means of interactive learning, in the framework of which an active dialogue provides the mobile management of educational activities, detailed on a functional basis. We will trace the selection of the functional basis using the example of interactive learning [31], which is based on the active interaction of the subjects of the educational process and takes place not in a passive, but in an active mode, during the exchange of opinions. This type of training is focused on developing critical thinking skills, provides for an active search for information, correlating it with one's own experience, and comparing it with other research in this area. The specificity of visualization is manifested in the active process of assimilation of educational information, depending on the designated functions of educational information (information, adaptive, compensatory, managerial, integrative, interactive, motivational, etc.), the process of search, selection, analysis of information is carried out, in which

the visual educational information (videos, models, drawings, diagrams, etc.) reflecting the process of thinking and used at all stages of learning. Examples of interactive learning are discussion, conference, symposium and others. An example of modern interactive learning is case technology (active problem-situational analysis based on learning by solving specific problems - situations) [17], in which the result of learning is not only knowledge, but also practical experience. Another example of interactive learning is media education (the formation of culture, creative, communication skills, critical thinking, teaching various forms of self-expression using media technology) [22]. Let's move on to concretizing the specific features of visualization corresponding to certain methods and techniques for displaying visual educational information. To do this, we will analyze the groups of teaching methods, with the aim of highlighting the corresponding techniques for visualizing educational information, focused on identifying universal ones corresponding to modern scientific fundamental knowledge, and specific ones corresponding to applied knowledge. This analysis will reveal the goals, content features of visualization and the experimental implementation of the pedagogical technology of visualization of educational information, including in the context of the applied methods and techniques of teaching, as well as the corresponding nature of educational information, specific to higher education. Analysis of the system of teaching methods focused on identifying universal and specific techniques for visualizing educational information in the educational process of higher education, will be carried out on the example of studying the interaction of educational information visualization systems and teaching methods (which has a decisive influence on the structuring and nature of the links of educational information). Let us explain what is meant in this presentation by teaching methods and techniques, and also describe the systems of teaching methods that are significant from the standpoint of the technology of visualization of educational information. The teaching method is the main component of the teaching process, in which the goals and content of teaching determine what to teach, the teaching method recommends how to do it [22]. The teaching method is "a way of orderly activity of the teacher and students, aimed at solving educational problems" [25]. "Reception of training" - an action or a set of actions aimed at achieving a particular goal. That is, the teaching method is a strategic category of teaching, and the technique is its tactical manifestation [32]. In pedagogy, certain classifications of the system of teaching methods have developed [34], the application of which is aimed at solving a given range of problems [33]. Accordingly, the grounds for the classification of methods in the higher education system can be subdivided into: grounds oriented towards modern scientific and fundamental knowledge and having general educational and general cultural significance, as well as grounds oriented towards applied knowledge and experience of activity. Let us designate the foundations, focused on scientific and fundamental knowledge and having general educational and general cultural significance. Here, first of all, it is necessary to highlight: a) the problem of increasing the volume of educational content, which implies the introduction of such a basis for the classification of teaching methods as reliance on generalized knowledge, regulated by means of enlarging didactic units; b) the problem of increasing the complexity of educational

material, which manifests itself in taking into account the structural features characterized by cause-and-effect, logical-semantic relationships between its structural components and involves the introduction of such a basis for the classification of teaching methods as the schematic presentation of information and the use of sign models; c) the problem of organizing the process of multidimensional thinking and the hierarchical structure of information, which involves the introduction of such a basis for the classification of teaching methods as reliance on semantic structures built on the basis of logical-symbolic multidimensional models. We will reveal the foundations focused on scientific fundamental knowledge and having general educational and general cultural significance. Here, first of all, let us turn to the basis of the classification of teaching methods, based on generalized knowledge, regulated by means of enlarging didactic units using an example (enlarging didactic units, P.M. Erdniev). Assessing the significance of the method from the standpoint of highlighting universal and specific techniques for visualizing educational information, we note the expediency of using the isolation of the functional basis of educational information obtained as a result of its compression and enlargement, as well as structuring educational information using various models (direct and reverse actions, comparison of opposite and comparison related and similar concepts, stages of work and methods of solution, etc.). Turning to the origins of innovative practice in the development of complex, interconnected educational material based on circuit models and sign systems V.F. Shatalov introduced the concept of "basic synopsis" into pedagogical use [15-18]. This training is based on the assumption that the transition from thought to utterance is built with the allocation of a general scheme, then the choice of lexical units, while understanding speech includes: expansion and folding (coding and re-coding) of educational information. Assessing the significance of the method from the standpoint of highlighting universal and specific techniques for visualizing educational information, we note the expediency of presenting educational information in the form of a structure characterized by the folding of information into a visual image (sign, diagram, drawing, model, etc., due to which there is a "deception" of RAM), using inductive and deductive methods of reproducing information, reminder signs (examples, experiments) classified by the level of significance (color, font, etc.). It is important that this method complements the previously described technology of enlarging didactic units, enriching the structuring described above with figurative coding of educational information. Considering logical-symbolic multidimensional models based on semantic fractals (V.E.Steinberg) from the standpoint of visualizing educational information, it seems expedient to use multidimensional models for organizing the thinking process and presenting a complex structure of information. This allows you to compare phenomena, events, to establish cause-effect and logical-semantic connections of information, supplementing the techniques described above with the hierarchical structuring of educational information based on multidimensional logical-symbolic models (radial-concentric, coordinate-matrix frameworks with designated knowledge components).

Let us designate the basis for the classification of methods in the system of higher education, focused on applied knowledge and experience. Here, first of all, it is

necessary to highlight: a) the problem of professional development, which implies the introduction of such a basis for the classification of methods as the level of problematicity in a professionally oriented situation, we will reveal it using the example of problem and problem-modular training; b) the problem of the transition from a cognitive type of activity to a professional one, which involves the introduction of such a basis for the classification of methods as modeling the subject and social content of future activity, we will reveal using the example of contextual learning; c) the problem of increasing cognitive activity and independence in the chosen field, which involves the introduction of such a basis for the classification of methods as the level of professional productivity, we will reveal using the example of project-based learning. We will reveal the problem of professional development using the example of problem and problem-modular training. The following concepts are encountered in the literature: problematic approach (TI Shamova), the principle of problematicity (VT Kudryavtsev, AM Matyushkin); problematic methods (V. Okon); problem learning (M.I. Makhmutov, M.N. Skatkin). Essential for this presentation is the integration of problem-based and modular learning (a module is a separated part of educational information that has the properties of integrity, logical completeness and accompanied by control of assimilation), which allows using the advantages of both technologies (P.I.Pidkasty, M.A.Choshanov). The main mechanism of problem and problem-modular training according to M.I. Makhmutov is the creation of problem situations in which the teacher leads to a certain contradiction, suggests finding a way to resolve it, expounds different points of view, suggests considering the problem from different positions, encourages to compare facts and formulate conclusions [35]. Evaluating the significance of the method from the standpoint of highlighting universal and specific techniques for visualizing educational information, we note the advisability of selecting a problem task, which is the functional basis of educational information and can be implemented in a visual schematic form that allows us to abstract from unnecessary details and present in a generalized form a whole class of similar problems ... We will reveal the problem of the transition from the cognitive type of activity to the professional one using the example of sign-contextual (contextual) learning (A.A. Verbitsky), in which the transition from the cognitive type of activity to the professional one is ensured. Assessing the importance of the method from the standpoint of highlighting universal and specific methods of visualizing educational information, we note the expediency of presenting educational information in the form of a certain structure that simulates the subject and social content of the future field of activity by moving from educational activity of an academic type, through quasi-professional activity to educational and professional activity. We will reveal the problem of increasing cognitive activity and independence in the chosen field of activity using the example of project learning [36]. The founders of the project method are American educators W. Kilpatrick and E. Collings. Among educational projects stand out: research (in structure close to scientific research), creative (creation of certain products: newspaper, film, presentation, website, etc.), informational (collection, analysis and generalization of facts), socially significant (focused on performing certain tasks, drawing attention to the problem, etc.). Assessing the significance of this group of methods from the

standpoint of highlighting universal and specific techniques for visualizing educational information, we note that the methods of this group most fully meet the requirement of a multifaceted formation of experience with visual scientific, fundamental and applied educational information. In the methods of this group, the visualization of educational information is present at each of the stages of training, from designing goals, collecting and analyzing information to proposing a hypothesis, formulating and formalizing the results of the study, as well as their public presentation [37].

Assessing the significance of the above-mentioned groups of teaching methods, three basic techniques (algorithms) should be designated:

- 1) highlighting the functional basis of information on the basis of which the presentation of educational material is built.
- 2) structuring educational information by means of logical, productive, frame and semantic models.
- 3) figurative coding of educational information using symbolic information, visual-figurative and logical-symbolic models.

The innovative possibilities of visualization of educational information in modern conditions are characterized by the active use of information educational resources and educational-methodological complexes and are associated with the cyclical organization of the management of the educational process in higher education. Such opportunities are achieved due to the construction of information in the form of a certain structure with the allocation of direct and feedback links, due to which the educational process is controlled. In this regard, we will designate the specifics of the visualization of educational information using the example of teaching using ideas: algorithmic, programmed teaching [18-22, 27], as the basis of the cyclical organization of the management of the educational process, as well as teaching in the information-educational environment. The ability to automate the learning information management function is at the heart of algorithmic and programmed learning. Let us consider the main ideas of algorithmic learning using the example of the theory of the stage-by-stage formation of mental actions (I.Ya. Galperin, N.I. Talyzina, etc.). The teaching is based on the assumption that the formation of mental actions takes place in stages: motivation, presentation of the action scheme, the practical implementation of actions according to the model (speaking out loud the algorithm of action), pronouncing "to oneself", refusal of speech accompaniment, the formation of mental action in a minimized form - interiorization. Assessing the significance of the method from the standpoint of highlighting universal and specific techniques for visualizing educational information, we note the expediency of structuring educational information into a kind of logical scheme with a step-by-step tracking of the degree of formation of experience with visual educational information. The main ideas of programmed teaching (A.I. Berg, V.P. Bepalko, N.I. Talyzina, etc.) are associated with the organization of feedback, which follows from the theory of control systems and requires a cyclical organization of the educational process control system. In the literature stand out: linear programs (B. Skinner) - the student must give the correct answer, or choose it from several possible; branched programs (N. Crowder and G. Pask) - react to mistakes made by the trainee by regulating the degree of development of educational

information; mixed (combined) - is a combination of different types of programs. Assessing the importance of the method from the standpoint of highlighting universal and specific techniques for visualizing educational information, we note the expediency of structuring and coding educational information depending on its functions in the educational process, the possibility of adjusting the degree of development and variability of educational information, as well as the speed of progress through educational information. The innovative possibilities of visualization of educational information are associated with the active formation of scientific, fundamental and applied experience of working with visual information in the information and educational environment [1-9, etc.]. Assessing the importance of the implementation of the educational process in the information-educational environment from the standpoint of highlighting universal and specific methods of visualizing educational information, we note the expediency of using: prompt organization of feedback; the ability to adjust the quantity and quality, professional orientation of educational information; the speed of progress and the degree of immersion in the subject; updates and replenishment of educational content. The formalized description of the visualization of educational information in higher education is intended to reveal the ratio of different ordinal components according to the level structure in the invariant directions of visualization: functional, morphological and informational. The formalized description of visualization is supposed to be carried out: at the level of the learning process by general descriptions; at the level of the subject - by specifying content parameters; at the level of a training session - by specifying procedural parameters. At each level, the formalized description of the visualization will be revealed by the corresponding invariant directions.

CONCLUSION

Thus, the article reveals the composition and structure of the pedagogical technology of visualization of educational information, considered as a set of components of scientific, formalized description and testing in the educational process. In the article, based on the analysis of productive forms and methods of teaching adequate to visualization conditions, general and specific methods of displaying visual educational information in higher education are highlighted. Based on the analysis of the forms of organization of training, the following visualization techniques were identified: a) adaptation of educational information to the individual characteristics and preferences of the subject of education (coding, organization of feedback, the ability to choose an educational trajectory and pace of development, etc.); b) changing the mechanisms for assimilating educational information (concentration of educational information, systematic presentation, variability and dynamism, etc.); c) activation of the cognition process (development of critical thinking skills, correlation with one's own experience, comparison with other studies in the field, etc.). On the basis of the analysis of groups of teaching methods, general, focused on scientific and fundamental knowledge, and specific visualization techniques, focused on professionally significant activity experience, are identified. Visualization techniques focused on scientific fundamental knowledge are characterized by: a) the problem of increasing the volume of educational content, regulated by means of enlarging didactic units; b) the problem of increasing the complexity of educational

material, involving the maintenance of a schematic presentation of information; c) the problem of organizing the process of multidimensional thinking, implemented on the basis of logical-symbolic multidimensional models. Visualization techniques focused on applied experience are characterized by: a) the problem of professional development, revealed by the example of problem-modular training; b) the problem of the transition from a cognitive type of activity to a professional one, revealed by the example of contextual learning; c) the problem of increasing cognitive activity and independence in the professional sphere, revealed by the example of project-based training. The innovative possibilities of visualizing educational information are associated with the cyclical organization of the educational process management (based on algorithmic, programmed teaching), as well as teaching in the information and educational environment. The cyclical organization of the management of the educational process allows you to gradually track the process of forming experience. Training in an information and educational environment allows you to use all of the above techniques, supplementing them with multifaceted, variable, constantly updated educational information, as well as training using the capabilities of professional communities, Web 2.0 and Web 3.0 technology, distance learning and others. The composition and structure of a formalized description of visualization has been determined, which will be disclosed in the following presentation.

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