DESIGN OF INTERACTIVE VISUAL TOOLS IN THE COMPUTER MULTIMEDIA EDUCATION PROGRAM (BY THE EXAMPLE OF MANAGEMENT DISCIPLINES)

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Introduction

In the recent past, domestic pedagogy of higher schools did not appreciate the important role played by visual media-information in the education and intellectual development of the present-day person. This eventually resulted in the formation of a contradiction, even among the pedagogues, between the recognized function of visual thinking and media tools in the education, as well as to the inadequate understanding of the fact that perception and analysis of visual media-messages must be properly learned.

Media elements should be necessarily included in the education of students of all majors also because their socialization is largely effected through the mass media: cognition of the world, foreign countries and one's own environment of activity, which allows to enter the society of one's native country and the global community in the natural way.

The skills of well-qualified computer operation are becoming a constituent of professional knowledge in any branch of science and nowadays can be already referred to the all-cultural level. The diversity of brand-new media tools also results in the phenomenon that, while providing the necessary comprehensive training in the field of innovative technologies, introduction of media tools into the educational process contributes to the transition from the study of audiovisual language as elements of the cinema art towards the elements of the general communication theory: this type of education enables the students to master the integral pattern of the tools for development, principles of operation and influence of the contemporary media [1].

At present, basic purposes of introducing media tools into the educational process may be regarded as follows:

- raising the level of familiarization with the material;
- development of communicative abilities in the students;
- formation of critical thinking in the students;
- teaching to perceive information from the screen as well as to recode visual images into a verbal system of signs;
- assessment of the information quality, development of selectivity skills to be used when "consuming" the mass-media information;
- improving the general level of the students' culture.

It is worth mentioning that expansion of the didactic function of mass media in the education takes place alongside with the modification of the educational context, its cognitive tasks and comments. At the same time, there is a need for creating special tools of education that would more profoundly use the possibilities and advantages of media as specific targets conditioned by the social order of modern man-made civilization.

Basing ourselves on the chosen application domain, i.e. learning of subjects within the "management" cycle by the students, it is essential to concretize the goals of elaborating the computer multimedia educational programs:

1) visualization of the offered material, which will enable to adapt the style of knowledge transfer to the psychological features of a student;

2) familiarization with the technical tools of new mass media, interpreted as the skill to utilize the studied tools of innovative technologies and the ability to master brand-new technical facilities[2];

3) imparting the skills of evaluating the quality of information, developing the habits of selectivity when "consuming" the mass media information and its usage in the decision-making process;

4) formation of the students' thinking and abilities to assign a part of functions related to preparation and adoption of decisions in the management to computerized systems;

5) teaching the methods of organizing the processes of communication and information transfer on the basis of contemporary media.

Since computer animation, while broadening the possibilities of its traditional counterpart, allows to realize human fantasies as well as to imitate things existing in nature, appearance of modeling programs (simulations) has led to the origination of virtual controllable worlds. Within them, the computer simulates a certain part of either real or imaginary world, offering the chance to influence its development and to observe what happens as a result, which provides the students with extensive opportunities for accumulating individual experience.

When developing multimedia tools for the up-to-date system of education, one should be guided by the oriental concepts of cognition, which traditionally laid a special emphasis on the extra-logic experience [6]. Thus, for example, the driving motive of world outlook in the Zen-philosophy consists in extralinguistic experience, perception of the world without logical reasoning or verbal communication, which compels one to directly live through reality instead of expressing it with words.

In contrast to this approach, educational systems of European and American universities are based on the assumption that thinking proceeds separately from the perceptual experience. Within them, visual component of the educational environment is at best founded on purely demonstrative material which presupposes not analytical work with the represented image, but only its memorization aimed at creating a more or less vivid association with the verbal or numerical material in the student's mind.

According to the widely published data [1], more than 40 % of educational institutions in advanced countries are presently employing data banks, electronic filings, telecommunicational exchange and many other facilities in their activity, whereas 80 % of the population receive information exclusively per television. Since computer is not only introduced into the educational context, but is also capable of altering it, such innovative technical facilities as computer graphics and animation reveal brand-new possibilities for communication, enabling to convey practical and emotional experience from teacher to student instead of trying to explain it by means of verbal and abstract language.

Visual thinking is becoming an essential component of the learning environment and educational techniques. However, specialists point out [1,7] that application of visual material is per se unable to generate visual thinking chiefly due to two reasons. First of all, visual thinking does not amount to the usage of concepts with existing concrete analogues. Visual thinking in its present-day comprehension [1] is interpreted as reflection by means of visual operations. In other words, a work of fine art should be considered not as an illustration to the thoughts of its author, but as the final manifestation of the thinking itself.

The above-cited specific educational and cognitive opportunities of the computer animation permit to implement the conception of information visualization, elaborated by the authors, in the process of teaching the students.

Basic contents.

Essence of the proposed conception of information visualization in the process of teaching the students.

Thesis 1. Learning environment undergoes the procedure of structuring. For this purpose, three principal layers are to be distinguished:

1) idea of the application domain structure in the form

of substances and objects with interrelations established between them;
2) notion of the properties of all substances and objects within the application domain;
3) visualization of substances and objects in the application domain.

When constructing a visual series positioned in layer 3, use can be made of both static pictures and all possible elements of animation. For instance, when compiling an electronic textbook, one may apply mindmaps along with instruments of visualization available in their library. In this process, the student may correct his/her own version of layer 3 by visualizing the substances of the application domain. Having successfully solved a problematic situation, the student single-handedly forms a visual space on the basis of interactive design (i.e. constructs mindmaps of the problems).

Thesis 2. The dynamic succession of the studied material can be arranged in the following order: text – hypertext – cognitive maps – network multilayer structures (structure visualization + text) – mindmaps – text – hypermedia (references to visual objects in the text).

Mindmaps are a special method of producing and sorting ideas, developed by the psychologist Tony Buzan [3], who relied on the joint activity of both hemispheres in the cerebral cortex. It embodies a graphic representation of processes in the multidimensional thinking, discovering the potential present in the student's brain. Mindmaps used when constructing the learning environment should have the following distinctive features:

- the object of study is focused in the central image;
- main topics and ideas associated with the object of study ramify from the central image by way of branches;
- branches assuming the form of smooth lines are interpreted and denoted by key images and words, ideas of second, third etc. order being also depicted as minor branches diverging from the central ones;
- the branches compose an interlinked nodal structure (system).

The efficiency of mindmaps increases with the usage of colour, drawings, symbols, abbreviations and the implementation of three-dimensional depth, which significantly improves the understanding and memorizing of information contained by the map. Examples of various sorts of mindmaps constructed upon the subject "Strategic Planning" of the discipline "Manage-ment" are set forth in Figures 1 – 3.

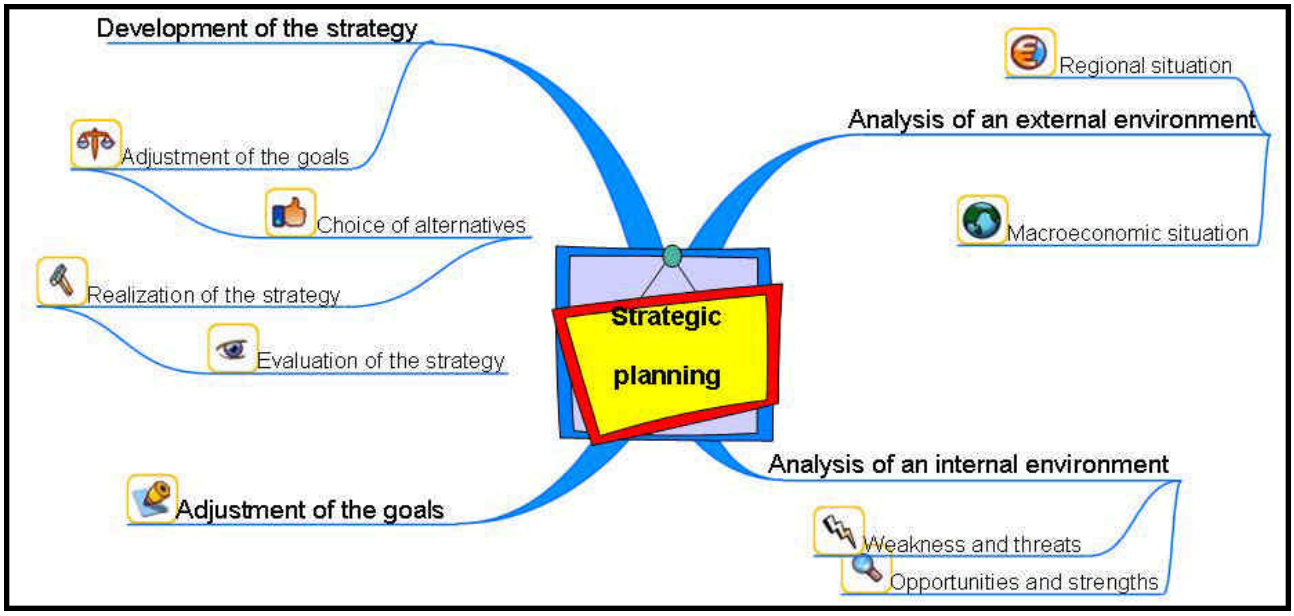

Fig.1. Example of mind map "Strategic Planning" which build on ConceptDraw MINDMAP

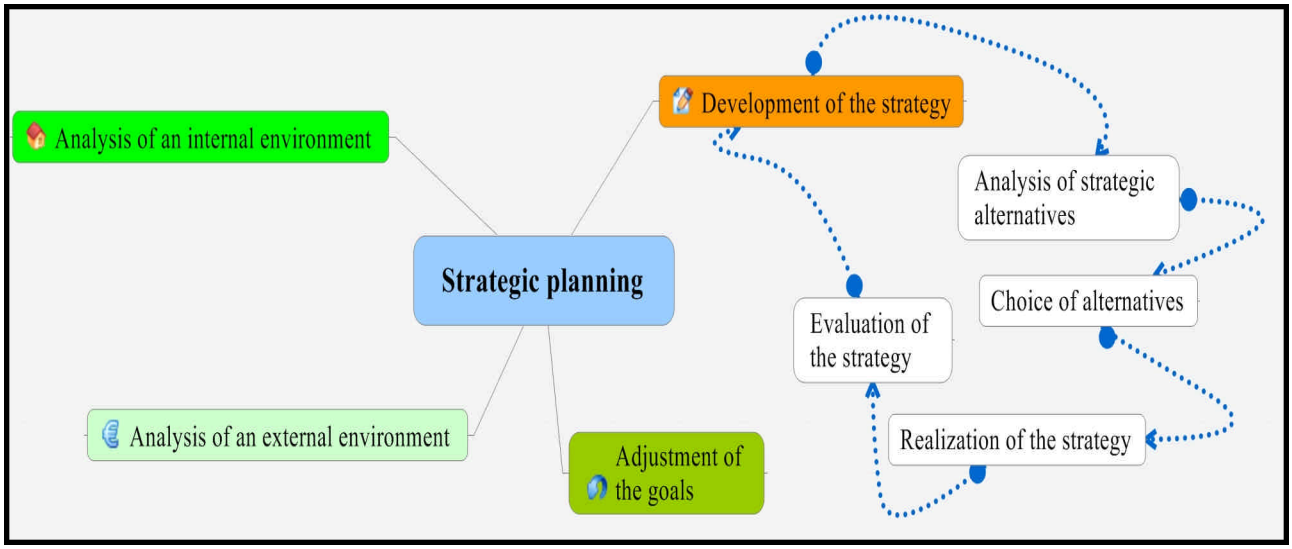

Fig.2. Example of mind map “Strategic Planning” which build on Mindjet MindManager

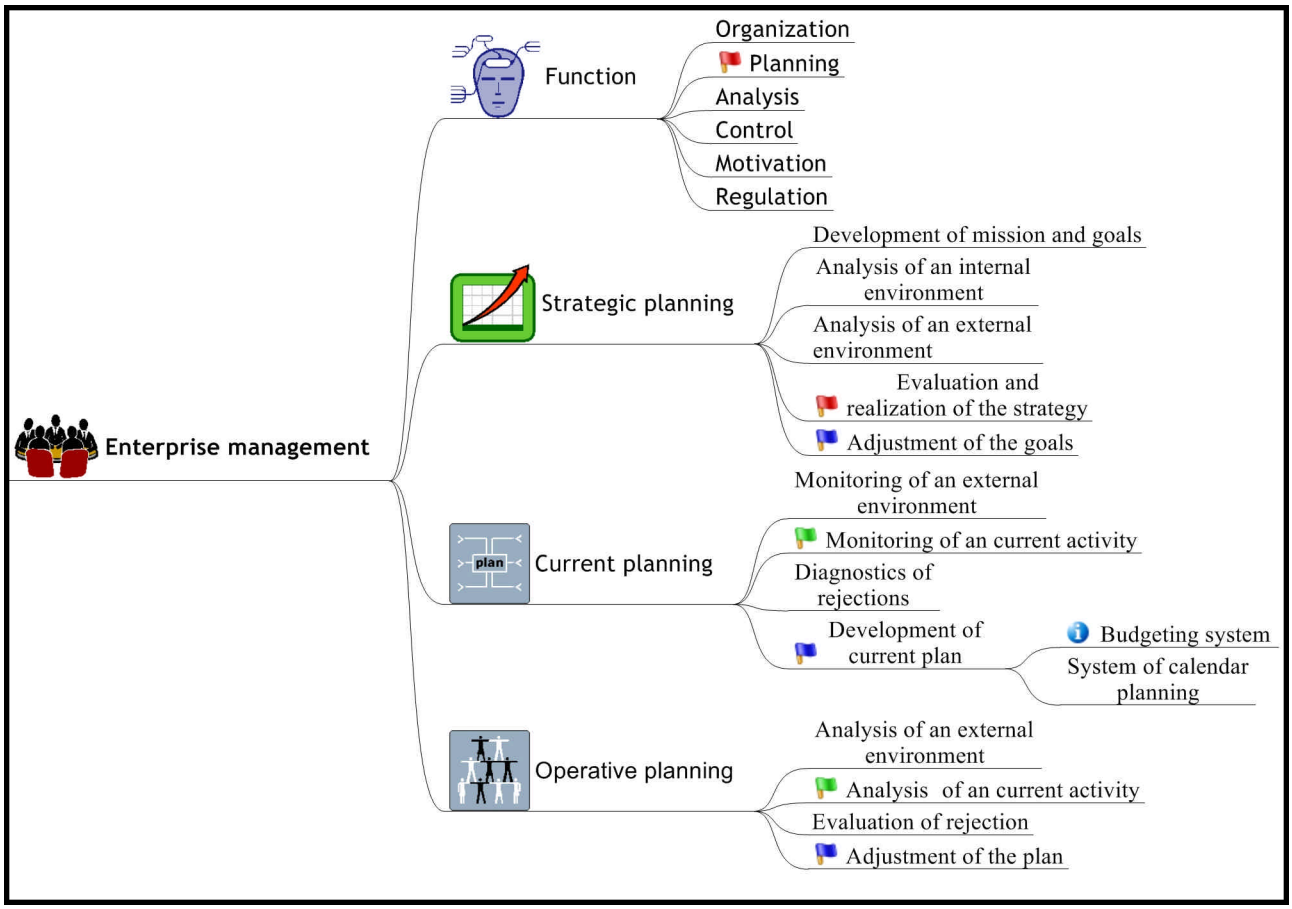

Fig.3. Example of mind map “Enterprise management” which build on ConceptDraw MINDMAP

The mindmaps enhance, above all, the student's ability to effectively store information, that is, to retain and comprehend it.

Although specialists [7] number a multitude of fields where mindmaps can be employed, the most important ones among them for the construction of learning environment are as follows:

- memorization of crucial information which, firstly, requires less time and, secondly, helps achieve better results when reproducing the same information;
- compilation of capacious and effective notes reflecting the relations and interactions within the studied material;
- naturally induced, compulsion-free focusing of attention on the posed task, considerably increasing the efficiency of the educational process;
- retention of information and its mastery in connection with other knowledge of the application domain;
- composition of a presentation more intelligible for the listeners by virtue of using the natural laws of thinking, as well as presence of the opportunity to change the direction of a message owing to the volumetric structure of a map;
- organization of all details in one display, allowing to view interconnections between them and, if necessary, to promptly enter amendments into the course of education;
- analysis of one's own thoughts and notions along with the activation of creative abilities and generation of creative ideas.

Thesis 3. Visualization of language structures on the grounds of interactive design techniques.

Thesis 4. To visualize the sphere of education, one has to apply specialized versions of interface.

When designing such an learning environment interface (LEI), it is imperative to take into account the following factors:

- peculiarities of thinking, perception and information processing in the human mind;
- the student's desire to successfully operate with the learning environment without any prior preparation;
- ergonomics of the interface – creation of a comfortable and effective interaction between the student and the learning environment;
- specific features in the development of an learning environment interface are determined by the type of user, sort of task and situation underlying the learning environment.

Design of the LEI is founded on conformity with a certain standard comprising three basic aspects:
1. Language of actions (definition of what the student can do while working in the learning environment. This aspect embraces such operations as usage of keyboard, functional keys, touchpads and the like).
2. Language of display (definition of what the student sees as a result of working in the learning environment. This includes printers, screens, X-Y plotters, sound outputs etc.)
3. Knowledge base (definition of what the student must know in order to successfully work in the learning environment. Such a base may be located in the user's head, on paper in the form of manuals, prompts or learning aids etc.)

Three central mechanisms may be marked out in the organization of interaction between the student and the learning environment:
1. Formal dialogue (oriented at the understanding of computer considering its structure as that of a virtual machine);
2. Natural language (reflecting a concrete person and based on the linguistic fundamentals of knowledge representation);
3. Graphic dialogue (reproducing a specified application domain, particularly with the involvement of pictograms – graphic images of operands, mindmaps etc.)

The learning environment interface must comply with a number of key principles:
1. For display and management tools: all the

displayed information must be easily understandable; the student must be constantly able to control the situation; access must be provided to facilities enabling the student to create and recognize visual images as well as to travel through the learning environment.

2. For the component of dialogue between the student and the learning environment: inputting of data and visual images must be made as uncomplicated for the student as possible, in order to minimize the probability of input errors; alternative methods must be available for the procedures of input and error handling.

3. Compatibility of the displayed information and dialogue must be maintained throughout the entire learning environment.

4. Means must be secured for the storage of performed operations (aimed at reentering the system), as well as for the "friendly" mode of reentry.

5. It is necessary to furnish specialized and built-in protocol-keeping facilities along with their in-line displays, including the prompting tools and the library of standard protocols.

6. Importation of external data into the learning environment can be only effected by means of built-in communication facilities.

In the authors' opinion, four alternative variants of the user interface may be applied in the practice of designing multimedia interactive learning environments, namely:

- menu-based interface;
- adaptive interface;
- interface using a natural language;
- graphical tools for the construction of a dialogue between the student and the learning environment.

Most interesting for the purposes of learning environment visualization is the last variety of interface – graphical tools used for the construction of dialogues, which presume:

- built-in modeling of processes for controlling the condition of learning environment;
- graphical elucidative tools on the basis of analogies (can also be based on a set of scenarios);
- graphical tools of traveling (navigation) through the learning environment (created on the basis of pictograms);
- graphical tools for visualizing the substance of main objects in the application domain.

Built-in modeling of processes is a technique devised for enabling the user to observe all functions, tasks and subtasks in the system "from above" (see Figure 4).

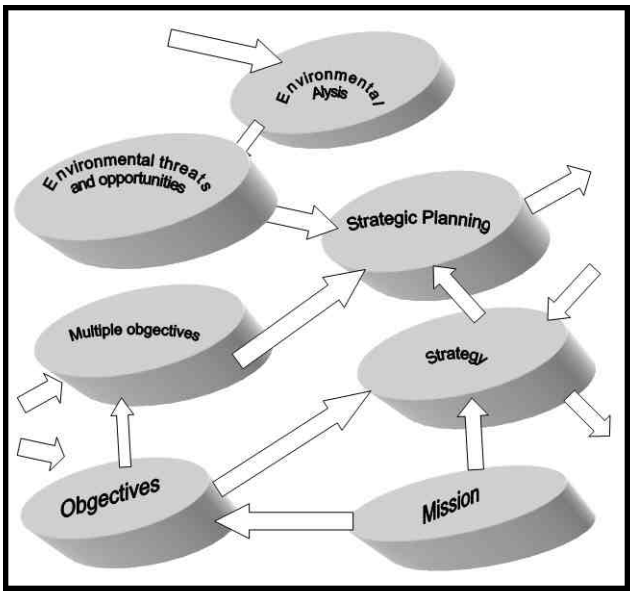

Fig.4. An Example of Graphical Interface Based on the Mindmap of the Problem Area "Strategic Planning".

Graphical tools for visualizing the substance of main objects in the application domain are set up in the form of tool and image libraries utilized when constructing the mindmaps.

Thesis 5. The learning environment should be constructed in such a manner as to activate both the left-hemisphere and the right-hemisphere thinking.

The terms "left-hemisphere" and "right-hemisphere" were brought into use by the Nobel Prize winner Professor Roger Sperry, who discovered that in the vast majority of cases, the left hemisphere of the cerebral cortex serves as the source of logical and

analytical thinking, whilst the right hemisphere is responsible for the creation of images and pictures in mind [4,5]. He noted that “the educational system, just as science in general, is prone to disregard the non-verbal forms of intellect. The main point actually lies in the fact that modern society has a biased and suspicious attitude towards the right hemisphere” [4,5].

In the course of education, an important role is played by the individual traits of a personality, such as the level of anxiety, self-confidence and agility of thought, familiarity with the outer world and the inner self .

From the viewpoint of learning environment visualization, the most significant property is the student’s idea as to the source of control, i.e. the student’s knowledge of his/her own self which determines the source of his/her achievements and failures, progress and defeats.

According to this feature, the students are divided into ones with internal and ones with external strategy. Students who have internal strategy believe that their achievements primarily depend on their inner qualities, i.e. competence, purposefulness and level of intellectual faculties. In such students’ conviction, their success and ill luck are predetermined by their own rational actions.

The students with external strategy consider their achievements and failures as dependent on outside forces. In this case, the student will suppose that consequences of his decisions are conditioned not so much by his competence as by the influence of outward factors.

This appears particularly important for the construction of an learning environment, since divergences in the behavior of students with different strategies are manifested in the following aspects:
1. Students with internal strategy show greater activity in the search for information than ones pursuing external strategy; they are better at using data available in an uncertain situation. Besides, they act more constructively in situations when their original intents come tumbling down, and undertake well-defined steps in order to surmount an obstacle.

2. Students with external strategy pay more attention to information acquired from the previous learning experience; they are more stubborn and less adaptive. External strategy makes the students poorly resistant to the pressure of public opinion and the impact of manipulative information (teacher’s recommendations, advertisement, opinions of fellow students), as well as inclines them to conformism.
When visualizing the learning environment, it is necessary to take into account differences in the processes of information treatment by the brains of persons with dominating functions of right or left hemisphere (see Table 1).

No	**Left cerebral hemisphere**	**Right cerebral hemisphere**
1	Words	Imagination
2	Analytic process	Intuition
3	Ordering	Parallelism
4	Activity	Impressionability
5	Realism	Fantasy
6	Pre-arrangement	Insightfulness

Table 1. Peculiarities of Information Processing in the Human Brain.

It becomes obvious that the left cerebral hemisphere performs all the rational, ordered and dynamic functions, whereas the right one answers for intuitive and parallel actions of qualitative nature.

Depending on which hemisphere prevails in the mental activity of the student, he/she respectively prefers either analytical or heuristic style. Area supporting the quality of educational process is referred to as “qualitative”, in accordance with which a qualitative approach has to be developed towards the creation of learning environments, targeted at a more complete realization of the function of right hemisphere in the human brain.

Interactive visual systems of learning environment support designed for left-hemisphere students:

- predominantly deal with numerical data bases;
- offer numerical comparison of alternatives and effects of decisions;
- carry out statistical data treatment;
- support the processes of extrapolation, logical deduction and comparison by means of simple numerical operations and numerical comparison;
- selection of information, filtration, pattern recognition and modeling is based on such categories as number, vector, matrix and function;

Systems of learning environment support intended for right-hemisphere students:

- operate with visual images (both static and dynamic), supplied with comments consisting of words, phrases and decisions;
- conduct a qualitative analysis of similarity (resemblance) of individual objects in the learning environment;
- examine the issues of volume and
- mutual relation of subordinate groups and categories while creating visual images;
- perform the analysis of content (for scenarios, arrangements, alternatives);
- maintain the processes of extrapolation, deduction and logical comparison by means of combinatorial generation and restructuring;
- selection of information, filtration, pattern recognition and modeling in the right-hemisphere DSS relies on such categories as knowledge, reason, analogy and scenario;

The most serious problem faced when designing learning environments lies in the construction of adequate mechanisms for the formation of purposes and motivation for learning in the students' minds.

Literary sources [2] report of the following types of purpose-formation:

- generation of a common purpose, implying a certain non-concretized image of the future outcome;
- occurrence of a specific intent;
- integral process of purpose-formation, including the origination of both common and specific purposes as successive phases.

Thesis 6. Further deepening of the visual learning environment is effected into two other layers: layer 4 – level of processes with corresponding structures, and layer 5 – mindmap of the process layer.

Thesis 7. Construction of the learning environment is founded on alternative structures, as compared to the traditional linear one. These are more complicated branched structures, defined by such metaphors as tree, interlacement, appearance, commonality. Structures of this type conform to present-day notions as to the structure of knowledge and mode of human thinking, obtained with the aid of cognitive psychology, neurology and sciences devoted to artificial intelligence. Realization of the present thesis can rely upon the methods of artificial knowledge transfer (multimedia, interaction, informational submersion systems).

Thesis 8. The proposed learning environment must be supplemented with methods of synectics. With their application, visual design of the learning environment includes presentation of customary images through uncustomary visual metaphors. On the other hand, new and unknown objects as well as problem situations are represented through well-known, familiar images.

Thesis 9. Systems of learning process support can be characterized as a base of dynamic image models available for the student's use when mastering the material. It is proposed to build the libraries of dynamic image models on the basis of MindMap libraries in application domains.

Conclusion

Media-education via the tools of computer visualization – especially if integrated into the traditional disciplines of university curriculum – shall permit the students to actively master the pictorial material, for such mastery can only be possible when essential properties of the objects of thinking are graphically explained by means of an image.

The steadily growing amounts of information which the student ought to memorize in the process of education require more efficient tools to be applied in

the organization of the educational system. One of the most productive tools in the learning environment organization is the utilization of the students' visual thinking in combination with visual interactive design based on the personal computer.

The above-examined conception proposes to create multimedia electronic learning aids which will secure support for the student's visual thinking on the grounds of such components of interactive visual design as: graphical interface with built-in modeling of processes; multilevel structure of the spatial representation of learning environment; visualization of the components of application domain structure with the involvement of MindMap tools and libraries; scenarios of vivid interaction between the student and the computer are to be constructed using the methods of synectics and non-linear structures, as well as taking into account the peculiarities of "left-hemisphere" and "right-hemisphere" ways of thinking among the students.

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