Information and technological support for knowledge management in the educational process

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Abstract — **The problem of creating favorable conditions for knowledge transfer in educational process is considered in the article. The information and technological support of two methods is offered: the initialization of the personal interest of the recipient of knowledge, as well as the formation of an individual experience that adapts to reality to solve actual problems. The basic conditions of creativity in the process of knowledge transfer are determined: personal experience, comfort and availability heuristic, which plays a connecting role between the elements of learning. The availability heuristic works as a qualitative estimate of the frequency or probability of selection. Based on the fundamental nature of the creative approach to the knowledge transfer, a creative-contextual form is proposed. Its purpose is to provide positioning and fixation of the necessary information elements in training, which inspires creative insight of problem solving.**

Keywords — *knowledge transfer, knowledge holder, acceptor, availability heuristic, creative process.*

I. INTRODUCTION

For improvement of the quality of educational processes, it is important to have a complete understanding of the interaction of impersonal information and individually oriented factors of its distribution and consumption. It is necessary to define the basic concepts to obtain positive answers to questions related to the practical adaptation of knowledge transfer schemes. Under knowledge management, we understand the process of transferring individually meaningful information from the knowledge holder to their recipient (acceptor). This process occurs under the condition of practical assimilation of this information by the acceptor. The proposed definition does not contradict the conceptual foundations of the research conducted in the field of knowledge management [1].

The importance of practical approbation of information is based on need of its further application. The procedural dynamics of knowledge management implies the need for the use of information automation tools to support the development and decision-making. The problem of understanding the educational material is closely correlated with the emergence of creative insight. Reference [2] shows that increasing requirements leads to a better understanding of ideas and methods of solutions. Short-term memory is of particular importance for the emergence of insight [3]. Reference [4] suggests the creation of different contradictions in the structure of the presentation of the material in order to

increase understanding. In addition, the works devoted to the discussion of disagreements between different theories of creative knowledge are of particular interest [5].

Initially, we will proceed from the position that any schemes in themselves do not work, especially the schemes of processes controlled by the creative human factor. Schemes also do not work in the form of ready-made templates, transferred from real situations. Any scheme does not work independently, but always its productivity corresponds to activity of the specific individual. Therefore, in respect of adaptation of schemes and templates it is necessary to provide a support on identity. At the same time there is a set of the problems connected with a creative component of the individual's thinking. If an element of some system is the person, it is important to always find the possibility of exploiting his individuality, knowledge, creative skills and experience.

II. METHODS

A. Model of individual knowledge management

Individuality includes at least two components: perception and interpretation, as a result of which information can acquire different forms and contents in the individual's consciousness. It should also be noted one more point. The process of knowledge transfer to another person may also be important. In this instance, much depends on the quality of the transfer process, as well as on the capabilities and abilities of the knowledge holder. In the extreme case, the information can be transferred completely that looks improbable. It is too idealistic. Otherwise, the information will not be transmitted at all, including also its completely false value. This case seems much more natural and realistic.

In addition, when we talk about knowledge management, we need to focus on monitoring the results of such management. The wider the area of control over the process of knowledge transfer, the higher the reliability of the actual achievement of the goals. It means that in aspiration to adaptation of schemes in respect of achievement of reliable transfer from the holder to the acceptor of knowledge, it is important to answer the question: how it is possible to make sure that knowledge is really imparted and transferred in satisfactory quality? The subculture of interpersonal interaction which would promote both direct broadcast of knowledge, and their correction or transformation is for this purpose important. It is important to establish the intellectual

creative environment of interaction for all participants in the process of knowledge transfer. Since the 1960s, an adaptive approach to collective learning has been practiced in the USSR through systems created on the basis of hybrid intelligence [6]. Today, the developed base of information technology tools and solutions needs balance in the direction of supporting the creative activity of the individual.

For an example we will consider one of the most used elements of the organizational scheme of knowledge transfer, such as mentoring. In this scheme there is a mentor and an acceptor of knowledge transmitted by the mentor. We pose the question of how the mentor himself and the external observer will be able to verify the satisfactory of knowledge transfer? It is possible to guarantee that the question posed in this way will allow preventive control over the quality of knowledge transfer to the recipient. This question is addressed to both the mentor (the knowledge holder) and any external observers. The quintessence of the value of this issue is the requirement of responsibility for the result, on the part of each of the participants in the interaction. The manifestation of the result of knowledge transfer is the presentation of the results of completed tasks.

In addressing the issue of knowledge transfer (control over the result of their transfer), it should be noted that the basis for knowledge acquisition contains two elements:

- The interest of an acceptor in the gained knowledge.

- Experience of their practical application.

Knowledge is always "tied" to the context of its use. They are required to conform to the environment relevant to the actual practice of their use. It is necessary to organize the obligatory approbation of the transferred knowledge in special conditions. In other words, knowledge transferred without immediate approbation is practically doomed to be forgotten soon.

The achievement of interest in the knowledge acceptor is associated with the appearance of the difference of states between the lack of information on the subject and the sense of the importance of its acquisition. The arising interest involves the possibility of positive perception of the transferred knowledge. The obtained knowledge should be immediately consolidated in the conscious experience of the acceptor. To do this, you need to set yourself a few tasks, and then solve them. Such independently formulated tasks will allow to connect the theory of the transferred knowledge with own experience of the acceptor on the basis of the arising interest. The similar task, its statement and decision will be carried out by an acceptor exclusively individually that will allow to estimate each element in the chain of knowledge management process. It is important to exclude typical tasks that are formulated outside the interest and comfort of the individual. They will not benefit, and knowledge will not be transferred.

Let's dare the term "knowledge" to correlate only to properties of consciousness of the person: remember, create and correct (though, in the intellectual plan it is possible to add to this list: choose). Thus, only personally oriented quality of information will remain in knowledge management. It is possible to construct information model of the personality-oriented knowledge management –Holder/Transfer/Acceptor (Fig. 1).
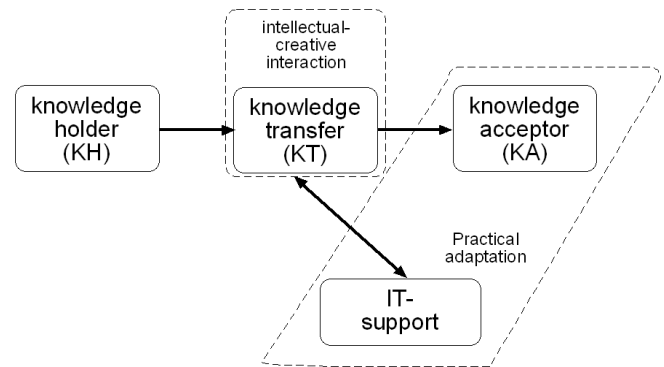

Fig. 1. Information model of personality-oriented knowledge management

In this model knowledge transfer is based on the intellectual and creative interaction of an individual nature, and any information technological support is found outside such interaction and should to be considered separately. In addition, this model points to external control over knowledge transfer on the part of managers of the educational process. Conceptually, the «Holder/Transfer/Acceptor» model can be associatively compared with the methodology of extreme programming [7], in which the effectiveness of achieving the result is associated with a short feedback cycle, continuous information integration and mutual knowledge.

B. Information technology support for knowledge management

The great mathematician H. Poincare noticed: «One geometry cannot be more true than another; it can only be more convenient."[8]. He specified the simplicity connected with "direct intuition" as the reason of this convenience. This statement contains the fact that, over time, was lost. The criterion of convenience in practice must exceed the criterion of truth! This criterion has a predominant attitude to the experience as well. The experience represents a support for creativity and helps to choose the most acceptable solution.

A person is accustomed to making decisions based on experience, convenience, and informational accessibility, so the so-called *availability heuristic* is a determining component in the search for solutions and in the acquisition of knowledge. The availability heuristic is used for estimating frequency or probability by the ease with which instances or associations could be brought to mind [9].

The method of a blackboard framework offered in 1962 by A. Newell and described in the book by G. Booch is suitable for information and technological implementation of the described scenario [10]. As Figure (2) indicates, the blackboard framework consists of three elements: a blackboard, multiple knowledge sources, and a controller that mediates among these knowledge sources. The blackboard consists of objects from the solution space. The objects on the blackboard are hierarchically organized into levels of analysis. The objects and their properties define the vocabulary of the solution space. The controller performs the following role, each knowledge source is associated with the controller and sends him his thoughts, in addition, the controller can activate the knowledge sources.
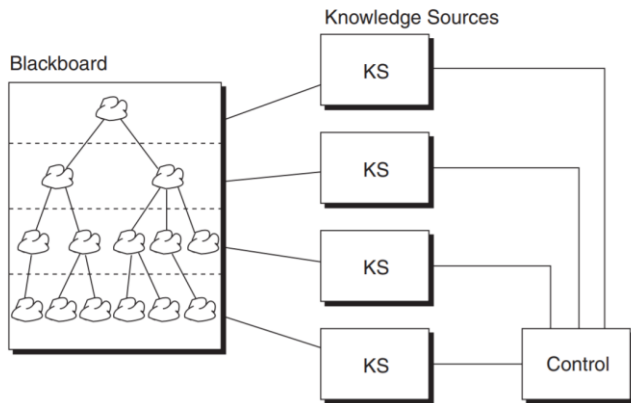
Fig. 2.   A blackboard framework [10]

It is important to note that the presentation of data on a blackboard framework is specified and involuntary. This means using valid information prepared for logical thinking and decision-making. On the other hand, it is important for knowledge transfer to be able to temporarily retain perceived information or to incubate creative solutions. Besides, the role of the controller needs to be expanded, having allowed it to make any actions with knowledge sources: add, delete, move, update, group, save and reproduce. In such definition the controller turns into the active element operating out of rules and is limited only by the volume of a blackboard framework and a set of knowledge sources.

III. A CREATIVE-CONTEXTUAL FORM

In fact, the active control element, not constrained by the rules of behavior, can only be the creative process of man. Therefore, the controller and a knowledge sources should be transformed to the elementary creative processes (CP). It is also necessary to exclude the positioning of the elements on a blackboard strictly according to the levels of analysis. As the problem of application of a blackboard changes in the direction of the need for incubation, then the updated object should be called differently. This underlines the fundamental nature of creative approach in knowledge management and transfer (fig. 3). Terminological replacement of "board" by "form" corresponds to the plan of information and technological support of creative processes of knowledge management.

The main advantage of using a creative-contextual form in the educational process is to provoke insight. Solved problems are fixed on the form and stored in the database. After that, at any arbitrary time, each content of a creative-contextual form can be reused. Restoration for the analysis, correction and statement of the next problem on the basis of the acquired material is allowed. In other words, a creative-contextual form captures the accumulated knowledge and practical experience of their application. Reference [11] offers a new view on the induction of inference based on incomplete data, which confirms the effectiveness of the use of a creative-contextual form in the process of knowledge transfer.
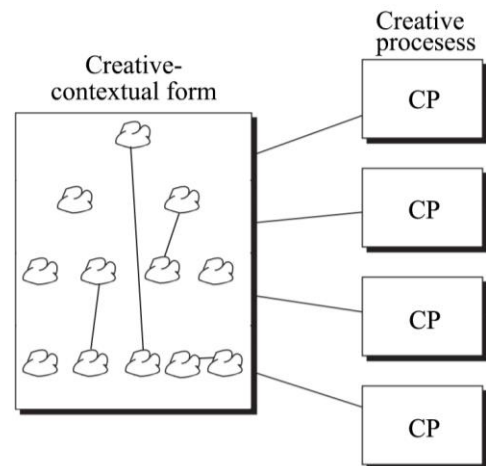

Fig. 3.   Information model of correspondence of a creative-contextual form and creative processes

There are two classes of information that determine the creative development of solutions: real and irrational information [12]. The first consists of the visible elements of the project, located on a creative-contextual form: a linguistic and structural-schematic representation of knowledge, notes, textual and figurative data of the accompanying methodological plans, various interfaces. To irrational information we refer to what is connected with creative processes: intuitive guesses and insights, which are formed as a result of incubation over the data already present in the field of view on a blackboard framework. In terms of creative processes, irrational information has a significant value advantage over real information.

It is important to realize that irrational information can be recorded for the purpose of repeated subsequent use. For the name of such information is convenient to choose the term: augmented knowledge. Augmented knowledge is such fixed information facts and fragments of the process of knowledge transfer in the «holder/transfer/acceptor» model, which may include any graphically expressed data: notes, photos, specifications, requirements, schemes, etc.

By analogy with augmented reality [13], augmented knowledge provides:

- contextual combination of project, analytical and result information;

- real-time performance;

- individually comfortable fixation and data recovery;

- implementation in the form of 2D or 3D graphics solutions.

The augmented knowledge accumulated together is positioned in a single plane or spatial context on a creative-contextual form. The determining factor of importance will be the concentration and fixation of all possible information elements at the time of creative insight. Accumulation and fixation of augmented knowledge in on a creative-contextual form will be conformed with the theory of double coding of A. Paivio [14], according to which cognition involves the activity of two separate subsystems: verbal and nonverbal (figurative).

For development, decision making and subsequent knowledge transfer, it is important to have in the field of perception on a creative-contextual form source data, analytical data (comparisons, clarifications, and errors), dynamics of changes of, as well as numerical and visual results of certain decisions and executed programs.

Without using a creative-contextual form, these individual data are not easy to recover, and therefore use in practice. Individual knowledge contains the structure of thoughts that corresponds to the specific solution found at the time of creative insight, and, thanks to incubation, is based on data from previous insights of knowledge.

IV. DISCUSSION

The proposed methodology was tested in the practice of teaching programming in high-level language. We have noted an increase in the interest of students through the introduction of the educational process of additional communication between the teacher and the student on the basis of individual creative-contextual forms. This suggests the idea of forming a plan for each student. Such an individual tactic will allow focusing on individual details of the subject, exploiting the characteristics of the individual and the emerging experience. In addition, the effect of reciprocity is being actively studied in the context of creating and consuming information content [15-17].

V. CONCLUSION

To achieve success in the educational process, it is necessary to provide the creation of an environment for the best assimilation of knowledge by students. Among the favorable conditions for knowledge transfer should be included, firstly, the formation of the personal interest of their acceptor Secondly, the intensification of individual experience of the solution of specific objectives is extremely important. These objectives should be adapted to real, but not abstract practice.

The first condition is achieved by direct studying of a subject, on the basis of trust to subjects of process of knowledge transfer. Its performance causes the use of a creative-contextual form promoting both to awakening of interest, and provoking of an insight of the decision. The second condition comprises the plentiful practice consisting of real, individually significant tasks. The set of both conditions will create a situation of the improved trust to a subject that

means a steady rise not only knowledge, but also practical experience in realization of the ideas.

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