

# Structural-logical schemes as a means of methodological support of students' thinking processes

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**Abstract.** The article discusses the possibilities of methodological support of students' thinking processes by means of cognitive visualization. The article substantiates that one of the optimal means is the structural-logical schemes, since they are multifunctional, effective, and easy to learn. Special attention is paid to thinking, which is presented from the following two positions: as a process and as an activity. The author clarifies the concept of methodological support, describes the experience of using structural-logical schemes in the educational process.

**Keywords:** structural-logical schemes, methodological support, students' thinking processes, educational process

## 1. Introduction

At the present stage of development of human society, the pressure of information flow on the memory and thinking of a person increases, which manifests itself in the form of cognitive difficulties and psychological overloads of students. The human mechanisms for reflecting knowledge do not cope with new tasks and, thus, the prerequisites for the need to form students' skills to operate with models, formulas, schemes, etc. are created.

In this regard, a number of researchers consider it necessary to supplement the nomenclature of educational goals with the tasks of developing thinking. There is a need to find means of enhancing the thinking and independence of students, building their ability to work with a large amount of information and structure learning knowledge. In our opinion, one of the ways to solve this problem is the methodological support of students' thinking processes using visual learning tools, such as reference notes, memory cards, logical and semantic models, etc. The most well-known and common means of cognitive visualization is considered to be structural-logical circuits. Such schemes make it possible to solve the following learning tasks more precisely and more clearly than with the help of descriptive techniques: to highlight the leading idea of the topic, to clarify the basic concepts and categories, to strengthen the connection of the structural units of the topic and course, and to provide effective feedback.

## 2. Materials and Methods

The methodological basis relies on systemic, activity-based, student-centered and innovative approaches. The solution of research problems was provided by the following complex of complementary theoretical methods: analyzing domestic and foreign psychological and pedagogical

literature on the presentation of visual educational information in training; general scientific methods, such as classification, modeling of teaching and pedagogical activity, comparison and generalization of research results, development of provisions for the practical implementation of structural and logical schemes in the educational process.

### **3. Results**

One of the tasks of contemporary education is the development of thinking. The term “thinking” can be viewed from the following two points: as a mental process and as a mental activity.

Cognitive psychology defines thinking precisely as a process for the formation of a new mental representation, including the transformation of information [1]. As a result of thinking, information is converted from an exterior, external object into an interior object, into knowledge. At the same time, along with declarative information represented by concepts that answer the question “what?”, contemporary science identifies procedural information that answers the question “how?”. Procedural information is the methods, techniques, activities or operations that are transformed into skills in the course of interiorization. The ongoing processes of integrating new information and further generalization of knowledge and automation of skills occur without mind control. According to A. V. Brushlinsky, that is what distinguishes thinking as a process, from thinking as an activity [2].

R. G. Valeev, exploring the dual nature of the term thinking (thinking as a mental process and thinking as a mental activity), points out the fundamental differences between pedagogical influences on the thinking process and pedagogical influences on mental activity. In his opinion, thinking should be maximally stimulated, intensified, complicated as a conscious activity, but the thinking process should be eased as much as possible, including providing optimal access to the thesaurus already formed in the mind of the student. The thesaurus here is understood as a system of knowledge about reality formed by an individual information carrier, which is a complex of semantic units – descriptes united by a network of hierarchical and associative links [3].

In modern conditions of growing information overload, education is obliged to save thinking in order to solve those tasks that other cognitive processes cannot solve. To optimize the thinking process, the following main areas are highlighted in contemporary psychological research (in our opinion, they need the development of special methodological support):

1. The processes of memorization and reproduction are the most accelerated during the structuring and organization of semantic units by various methods, including means of cognitive graphics. Such techniques help develop complex knowledge structures based on their externalization. During the development of educational material, the attention of students should be focused on the elements united by the greatest number of logical connections. According to experimental data, these elements cause the greatest number of errors and questions in the self-study of educational texts. The time actually spent by an experienced educator on explaining various connections increases.
2. There are special techniques for “turning on both hemispheres of the student”, in connection with which the symbolic images, “icons”, avatars that can affect the affective and motivational sphere of the personality should be used. At the same time, the main purpose of cognitive graphics is the optimization of thinking. There is an opinion that if a student is sufficiently fluent in various methods of coding and transcoding, then there is no sense in transmitting information to him with a code of lower order. This makes it possible to move from extensive forms of transmission of educational information, constantly increasing its volume, to intensive, changing forms of presentation and processing of information. “A minimum of words, but a maximum of meaning” optimizes the thinking process more than anything else.
3. The student, in the process of working with new information, may experience psychological discomfort that is uncontrollable by consciousness, which occurs as a reaction to cognitive dissonance when trying to integrate conflicting elements of knowledge. It is at the level of general connections that giving the studied material a personal context is facilitated, which is an additional stimulation of thinking as a process [3].

Based on this concept of thinking, we believe that, unlike mental activity, which needs more rigid management by the teacher, the term “methodological support” is more suitable for stimulating thought processes. Analysis of the scientific literature on the problem of support in the pedagogical field allows us to conclude that the methodological support is an organic link in a broader concept, such as pedagogical support.

Recently, the problem of support in pedagogy is becoming increasingly widespread and the scientific justification. Most often they talk about pedagogical or psychological-pedagogical support, which is considered as a specific pedagogical activity of creating optimal conditions for students to develop their potential, their spiritual beginnings, to form self-reliance, their ability to self-education, and self-realization.

The content of the concept of “pedagogical support” does not yet have a holistic scientific understanding, but has signs relating to different areas of scientific knowledge. In general, the unifying basis of this concept is the focus on creating an enabling environment, a safe environment necessary for the development and self-development of the individual, contributing to the achievement of joint activity and accelerating the processes of disclosure and realization of the personal potential of interaction participants [4]. M. I. Gubanova considers pedagogical support, first of all, as actions of the subject of upbringing, training and development (teacher), accompanying and supplementing the actions of another subject (student) to assist and help in difficult situations. Describing the mechanisms for the implementation of pedagogical support, M. I. Gubanova identifies two of its sides, such as the scientific and theoretical substantiation of the mechanism and its organizational and methodological support. Scientific and theoretical rationale includes a set of goals, principles, approaches, rules, forms, and conditions. Organizational and methodological support of pedagogical support contains a set of technologies, methods, and tools aimed at the implementation of the process of socialization of students [4].

Currently, the meaning of the concept of “support” is being actively clarified in pedagogical science. Depending on the content, the support in the pedagogical process can be informational, methodical, technological, visual, musical, technical, etc. Often, this division is conditional, since the development of the subject and the dynamics of his mental manifestations often depend on a whole complex of conditions and influences. The development and self-development of a professional occurs in conditions of choice in problem or crisis situations. In many respects, the regress or progress of this development depends on the teacher organizing the educational environment, evaluating the norms and requirements set from outside [5].

We understand the methodological support as a set of methods, techniques and tools, specially designed by the teacher. With their help, the following is accomplished: creating an enabling environment and a safe environment for students to learn and develop, their inner strength is revealed and realized, support and assistance is provided in difficult learning situations, an ability to act independently in learning in conditions of free choice is formed.

In the conditions of recognizing the student as the main acting figure of the entire educational process, the methodological support of students thinking processes determines their goal-oriented self-development and the development of individuality in unity with the outside world. According to I. S. Yakimanskaya, in the educational process, not just the internalization of students of given pedagogical influences occurs, but also a “meeting” of the assigned and subject experience, the enrichment of the latter, its increment and transformation.

We are interested in the possibilities of methodological support of students’ thinking processes by means of cognitive visualization. The technology of visualization of educational material requires from students, first of all, the possession of general educational skills to highlight the basic concepts of the topic, around which other information should be built. Second, the development of visual thinking and creative imagination is highly important [6]. Undoubtedly, a creatively working teacher will find a lot of techniques that allow students to be included in active joint activities to highlight concepts of the topic and translate educational information into the visualization language. The variety of such tools (mind maps, reference notes, schematic notes, frames, etc.) predetermines the problem of choosing

one of them. The optimal means of methodological support is structural-logical schemes (SLS), since this tool is multifunctional (provides generalization and systematization of knowledge, visualization of the material, search for keywords, etc.), being efficiently and easily in mastering, at the same time.

The SLS includes the following two components: the semantic component in the form of basic concepts (keywords) on the topic of the lesson and the logical component that organizes these concepts into a semantically related system and supports the execution of analysis and synthesis operations. The choice of this form is connected with the fact that the single-channel nature of our thinking prevents the combination of information of different purposes (descriptive and controlling) in the same verbal form. In turn, the operations of processing and assimilation of knowledge must be assimilated involuntarily, i.e. with the participation of the predominantly right hemisphere. The logical component of adequate visibility must be carried out in graphic form and possess the properties of imagery and natural conformity [7].

The SLS is a figurative and conceptual didactic construction, presented in the form of a graph, in which the semantic component is a semantically connected system of concepts placed at the vertices, and the logical component is represented by the edges of the graph, intended to establish semantic relations between these concepts.

In general, the SLS contributes to the following:

- Stimulate thought processes, and intuitive thinking, above all;
- To facilitate the selection and output of information from the subconscious due to its presentation in a structured and coherent way;
- The visual presentation of concepts in a logically convenient form that provides memory support;
- The improvement of pedagogical reflection through auto-dialogue (dialogue with oneself) [7].

The use of SLS in the educational process was tested by us on the academic discipline “Innovative educational technologies.” This discipline is dynamic, as new promising technologies appear and the technologization of the learning process is carried out fairly quickly. One of the main tasks of this discipline is to teach students to structure educational material in accordance with the principles of technological education and to create various visual models of educational information. In addition, the discipline is practice-oriented and the subjective preferences of students when they choose a particular technology for a deeper study should be considered when studying it. All this suggests that the discipline “Innovative educational technology” is one of those that need special methodological support and stimulate the process of thinking of students in its study. Many years of experience in the use of various visual models in the educational process show that students cannot always immediately accept the visual models of educational information that the teacher gives them. Moreover, some students deny the idea of visualizing educational material until they learn to translate the text into a visual image themselves. General educational skills of structuring and visualizing educational material include the following steps:

1. Selecting the educational material; the selection of the main (core), methodological and applied aspects of the topic;
2. The location of educational material, taking into account the logic of the formation of educational concepts;
3. Selecting reference and keywords, concepts, fragments;
4. Searching for internal logical relationships and interdisciplinary connections;
5. Structural and logical analysis and construction of a structural and logical scheme of educational information.

#### **4. Conclusion**

The structural-logical schemes refer to the didactic visual means of supporting educational actions containing semantic conceptual and logical components (reference circuits, signals). They can be considered an effective means of methodical support of thinking processes.

The SLS complements the existing teaching methods, activates and improves the use of the teacher's professional capabilities, changes the teacher and student's personal attitudes towards academic subjects and generally occupies a free niche of effective teaching tools at the methodological level.

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