

## Logical-Semantic Visual Navigators - Aids for Teachers

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### ABSTRACT

The relevance of the article in question is that the success of pupils' learning depends not only on the aptitude of pupils, but also on the teaching technique, including universal educational technique of various complexities. This problem is relevant on all levels of learning- from nursery schools up to higher education, including refresher courses and retraining of teachers. The purpose of this article is working out visual aids for a teacher, based on logical-semantic modeling and functioning as navigators in learners' actions, when fulfilling educational tasks. The leading method of this problem is the method of visual notion of logical- semantic models of educational actions, which enable us to view the initial problem as a purposeful and well-organized process of learning. According to the scheme of the learning process students fulfill few-stepped and multi-stepped actions and, as a result, the time of the teacher's oral explanation is shortened. The article gives logical foundation to the implementation of logical-semantic visual navigators for presenting universal educational actions. These actions are realized in coordinate matrix structures which help to fulfill few-stepped educational actions; at the same time the contents of navigators clearly reflect multi-stepped, i. e. scenario-based training actions. The functions of visual forms of navigators are clearly shown in the article. This enables students to be guided by them in the educational process, and the teacher can control the process of solving educational tasks according to the given training actions. It has been proved that the professional competence of teachers are improved thanks to the projecting of logical-semantic navigators which enable them to solve systematic tasks in forming universal training actions, performed by students.

### KEYWORDS

Teacher, navigators, logical-semantic modeling, universal educational actions

### ARTICLE HISTORY

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## Introduction

### *Urgency of the problem*

The success of educational process and its dependence not only on natural aptitude of pupils is in the focus of attention of school, family and society.

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Mastering the technique of learning is one of the aims of solving this problem, including universal teaching actions of different complexity. This is significant for all levels of education- from nursery schools to higher schools, including refresher courses and retraining of teachers. Special visual aids play an important role in solving this problem, including those which put into order both material for learning and learning activity, as well as the so called “mental maps” (Buzan, 2003; Taylor, 2014; Krasnic, 2011), frames (Gurina and Sokolova, 2005) and modular graphical visualization (Ostapenko, 2008).

Mental maps ease the structuring of the material for learning in the mental process and finding the ties between structural elements, memorizing the information, and its mutual discussion. That is perform the function of support and navigators in the contents of educational material. The common graphic sign of mental maps is visual and convenient for perception of radiant or ‘solar’ (radial) outline, and common logical feature-structuring of information, making its analysis easier and operating by it. Scientific laboratories of didactic design suggest coordinative-matrix graphic outline of mental maps on the principle of logical-semantic modeling of knowledge, presented in native tongue or the language of learning. The method in question, which serves as a foundation of a certain semantic network, includes division of the teaching material into meaningful groups, assigned to the corresponding coordinates, singling out basic elements of contents in each meaningful groups and attaching them to the corresponding nodes of the coordinates, and putting all the nodes in order on the coordinates according to this or that reason; curtailing the marked coordinates and nodes with the help of key words for making the information more compact and preserving its readability. Such visual constructions are called our ‘logical-semantic models’ and are used as visual didactic aids for teachers and students. (Steinberg, 2000; Steinberg, 2002; Steinberg, 2015; Manko, 2013).

An example of a logical-semantic model ‘A magic cribbing’ is shown in table I (only some relationship between the elements are shown as an example); Few-step educational actions are also mastered in the model. Some information about multi-stage training procedures can be found on the model. It is presented on the logical-semantic navigators for the subject ‘Biology’. Table 2 and Table 3.

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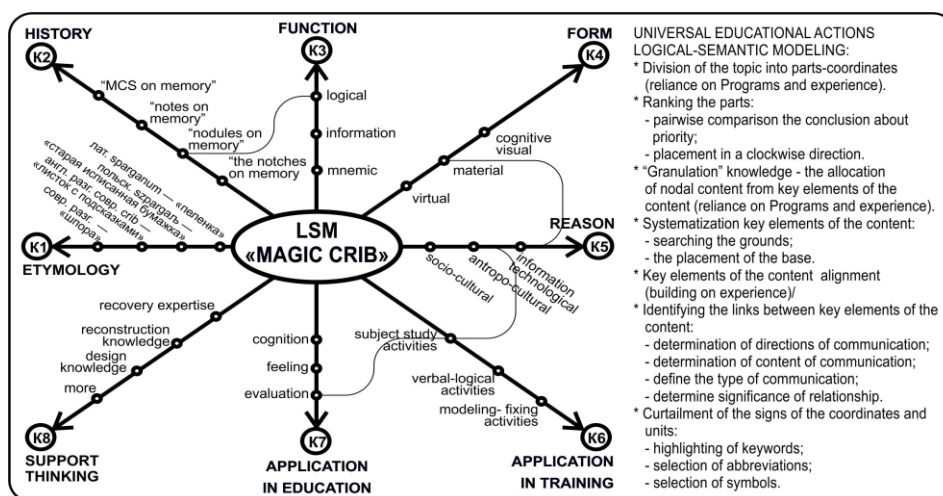


Figure 1. Logical-semantic model ‘MAGIC CRIB’

The structure of logical-semantic model, as is seen in Table 1, is realized as follows:

- The studied theme is divided into blocks of 'sense groups', which are assigned to the corresponding coordinates- 'power informational lines' as the most significant meaningful dimensions of the theme in question (measures of multi-dimensional semantic space), placed on blackboards sheet of paper, computer screen ,etc.

- the coordinates are ranked according to the plan of studying the subject and are arranged in a certain order on the plane, where the first coordinate is placed in the same conditional point of reference, e. g. corresponding to nine o'clock on the dial.

- basic elements of contents are singled out and ranked in each block. They are located along the coordinates according to this or that selected foundation or, in the absence of thereof, from the convenience of using.

- the basic semantic ties are singled out between the nodal elements of the contents, which are placed in corresponding coordination gaps or matrix, and the matrix is formed by non-adjacent pairs of the coordinates that are submitted in the form of separate fragments;

- the contents and semantic ties of the basic elements are marked by key words or abbreviations, or replaced by signs.

A group of teachers projected the navigators of universal teaching actions according to this method. They tested these projects during their experimental work. Table 2 shows an example of such work at the lesson of Biology. The first navigator helps the learner to fulfill the experiment in accordance with the plan, given by the navigator and the second navigator helps the learner to formalize the results of the experiment according to the given requirements. It is quite clear that students' independence increases thanks to the usage of such navigators and the teacher's burden is eased, which enables him to function as a teacher.



Figure 2. Logical-semantic navigator 'BIOLOGY- EXPERIMENT'

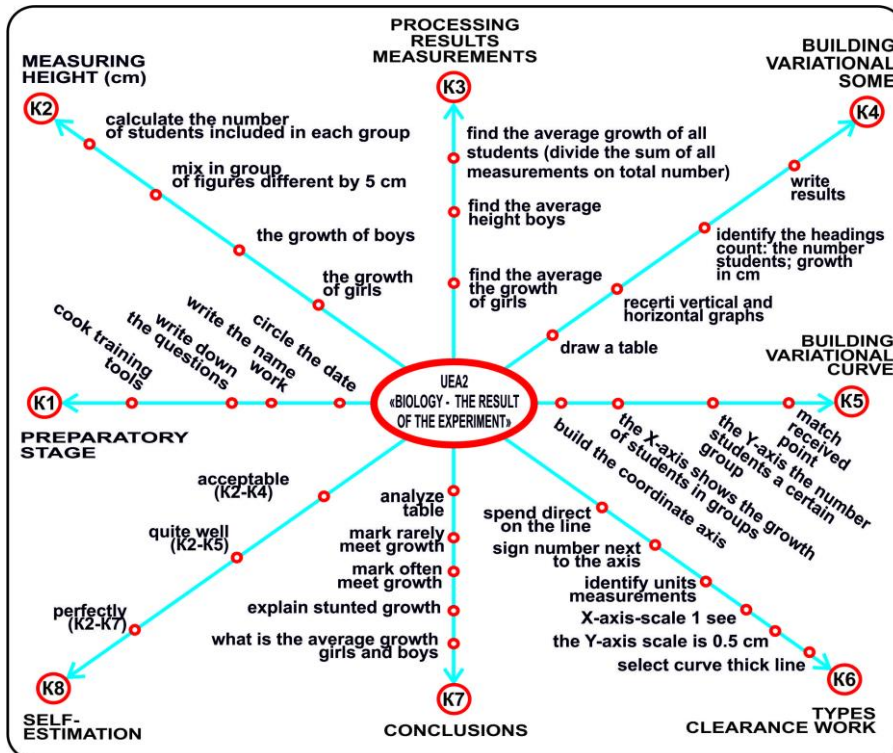


Figure 3. Logico-semantic Navigator 'BIOLOGE-THE RESULT OF THE EXPERIMENT'

## Materials and Methods

The purpose of the pilot study of the logical-semantic navigators is determined by the necessity of reducing cognitive difficulties for the learner, which arise due to the increasing flow of scientific and other information and the problems of its processing and assimilation. The teacher is also faced with the problem of rational structuring and using the material which he presents to his pupils. The Federal State educational standards of the second generation are aimed at solving these problems. Accordingly, the gymnasium in the town of Meleuz set the following major tasks of the experiment: defining technology which is able to form universal learning actions among students, to increase the quality of the educational process: training teachers for realization of new generation standards. In 2012 the gymnasium, together with the scientific laboratory of didactic design of the Bashkir State Pedagogical University (the Head of the laboratory is Doctor of Pedagogical Science, Professor V. E. Steinberg) worked out the program of the experiment. A group of teachers-experimenters was formed; the scientific and methods Council of the school undertook coordination of the experimental work. The following subject areas were determined: Russian and literature; Biology, Mathematics and computer science, English, social science and law. Beginning with 2015 - elementary grades were added (mathematics, Russian language, emphatic reading, the surrounding world). 160 students took part in the experiment. The following methods were used at the experiment: projecting the didactic components of training, experimental observation of the lesson and its further analysis, observation of the student's work and its analysis, ask and answer work.

### *Tasks of the Experimental Research*

1. To familiarize the teaching staff with then logical= semantic models of navigation, development of a scientific laboratory of didactic design.
2. To familiarize the teaching staff with the program of the experiment and the expected results.
3. A study of the Federal State educational standards for forming the universal educational activities; mastering the art of designing logical-semantic models.
4. Creation and development of didactic aids logical-semantic visual navigation for forming universal educational actions in the version of 'paper technology' for selected subjects.
5. Testing the logical-semantic navigation aids for forming universal educational activities and micro navigation in the training activity.
6. Curriculum development of teachers and works of the gymnasium authorities for further discussion and publishing in scientific pedagogical journals.

The hypothesis of the experimental study: formation of few-stepped and multistage scenario of universal educational activities and, accordingly, realization of the standards of the second generation will be successful if visual logical-semantic means- navigators, programming the fulfillment of one- and multistep universal educational actions will be used as aids for teachers.

### ***Organization and Implementation of the Experiment***

School teachers distant budget professional development courses on the theme: 'Modern educational technologies under conditions of realization of Federal State educational standards for new generation' from the scientific laboratory of didactic design of the University and of the Pedagogical Institute Department of education development of Bashkortostan. Legal documents and scientific methodological literature are studied by didactic multidimensional technology within 96 hours. School teachers studied the experiments of Lyceum No. 68. Ufa through joint workshops on the theme: 'Formation of students' universal educational actions by using special didactic means', 'Usage of logical-semantic models in activization of informative activity junior form pupils'. School authorities, teachers and heads of methods union studied the results of the design and technological approach to the creation of the logical-semantic navigators. The results of projecting were discussed at the sitting of the chairs, scientific methods unions and staff council of the gymnasium.

According to the theory (Galperin, 1958) educational actions aimed at solving certain tasks must become the subject of planned and multi-staged formation of mental actions and notions. It is necessary to create such a system which will 'force' pupils to act correctly within the required forms and tasks. A pair of 'complex' logical-semantic navigators, which programmed students to perform certain required actions became an important component of this experiment. The essence of this projecting is that first 'the ideal final result' is formulated and then the process of how to get it is defined. In this case training a student with the help of logical-semantic navigators becomes the essential activity at the lesson. Students must execute their works propelly and produce the results of their work. Exrerience of the teacher contributes to it and the teacher's repeated explanation is replaced by the usage of navigators. Paire of logical-semantic navigators and instructions for their usage have been developed and tested successfully at the lessons of biology, mathematics, computer science, social science, the Russian language and literature, the English language. This experiment proved that these navigators contribute much to the formation of universal educational actions, coordination of joint activity in class, translation of educational material and management of learners, and, hence, guidance of the educational process quality as a whole .The hypothesis about the expediency of using the visual logical-semantic navigators for forming students' universal action was confirmed by the survey among the pupils of the experimental classes.

The survey involved 160 students 2, 3, 6, 7, 8, 10 and 11 classes (tab. 1).

1. Do you like to work with logico-semantic navigators in the classroom?

Responded positively:

2 - 3 classes – 90%, grades 6-8 – 70%, 10-11 – 44%.

2. Do you use the logical-semantic navigators for lesson preparation?

Answered in the affirmative:

2 - 3 classes – 76%, grades 6-8 – 15%, 10-11 is 22%.

3. Can you independently to design the logical-semantic navigators through the textbook material?

Can: 2 - 3 classes – 36%, grades 6-8 – 15%, 10-11 – 2%.

I can, but only with the indicated vectors teachers:

2 - 3 classes – 24%, grades 6-8 – 23%, 10-11 is 42%.

**Table 1.** The student survey results 2, 3, 6, 7, 8, 10 and grade 11 (questions 1, 2, 3)

Do you like to work with logico-semantic models in the classroom?		
2-3 classes	6-8 classes	10-11 classes
90%	70%	44%
Whether you are using LSM for lesson preparation		
76%	20%	22%
Can you independently to design the logical-semantic model the material of the textbook?		
<i>can</i>		
36%	15%	20%
<i>I can, but only with the indicated vectors teachers</i>		
24%	23%	42%

4. What, in your opinion, helps you in the formation of universal educational actions logico-semantic navigators (tab. 2, tab. 3)?

2-3 classes:

- cognitive – 1,8;
- regulatory – 2,07;
- personal – 2,4;
- communication – 2.5.

6-8 classes:

- regulatory – 1,5;
- cognitive – 1,7;
- personality – 2,5;
- communication – 2.7.

10-11 classes:

- cognitive – 1,02;
- personality– 1,08;
- regulatory – 1,2;
- communicative – 1,4

**Table 2.** The student survey results 2, 3, 6, 7, 8, 10 and 11 classes (question 4)

	Universal educational actions
Personal	A) increases interest in the subject
Regulatory	B) helps to work according to plan; independently to evaluate the correctness of self- actions; to understand what is learned and what is yet to learn
Cognitive	C) helps to intelligently read the text; learns how to work with information (highlight main and secondary); helps to convert information into the model, establishing a causal link
Communicative	D) helps to listen to different points of view; helps to negotiate with each other; teaches to formulate questions

**Table 3.** The student survey results 2, 3, 6, 7, 8, 10 and 11 classes (question 4)

	Universal educational actions		
	2-3 classes	6-8 classes	10-11 classes
Personal	2,4	2,5	1,08
Regulatory	2	1,5	1,2
Cognitive	1,8	1,7	1
Communicative	2,5	2,5	1,4

5. I prefer to work with logico-semantic navigators because (tab. 4):

a) I like to build a logical chain, to work with symbols:

the left hemisphere – 16% right – 16%, Ambidextrous – 25%.

b) I prefer to perceive information in general, to restore the whole in parts:

left hemisphere – 53%, right – 55%, the Ambidextrous -54%.

**Table 4.** The student survey results 2, 3, 6, 7, 8, 10 and 11 classes (question 5)

I prefer to work with logico-semantic navigators because		
I like to build a logical chain, to work with symbols:		
the left hemisphere - 16%	theright hemisphere - 16%	the Ambidextrous - 25%
I prefer to perceive information in general, to restore the whole in parts		
the left hemisphere - 53%	theright hemisphere - 55%	the Ambidextrous -54%

6. What difficulties do you experience when working with logico-semantic navigators?

- distribution of data vectors;
- the selection of keywords for the nodes;
- little information, are used to teach notes.

## Results

The results of the experimental work can be subdivided into the following groups:

A) The following results are gained by the school teaching staff:

- The plan of the Federal state educational standard for formation of universal educational actions is mastered;
- Elements of experimental work on formation on formation of universal educational actions are planned and tested;
- Logical-semantic navigators used for development of universal educational actions are tested;
- Training manuals for training activities and administration are created

B) new didactic visual means – logical-semantic navigators, which enable learners to formulate universal educational actions were mastered. Learners can be guided by them when fulfilling educational tasks.

C) Logical-semantic navigators permit the teacher to improve his professional competence on the subject, improve his relationship with pupils thanks to reduction of oral explanations and instructions, to improve coordination and control of the pupils. Master-classes were held by teachers-experimenters for gymnasium teachers; within municipal workshops for



teachers of biology and history, for Deputy Directors on educational work of the city and the district.

The fact that visual aids of logical-semantic modeling of knowledge, presented on native tongue can fulfill the function of a navigator both for learners and teachers can be considered as its practical result. Besides, new didactic visual aids and recommendations to them which were created and tested, can be used by different teaching stuffs, because formation and development of universal educational actions are important trends in the educational activity. The didactic means are, in fact, guiding logical essence of teaching, which do not hinder creative activity of the teacher.

The information about the experiment can be found in publications in pedagogical press in three Federal journals and collections of five all-Russian scientific practical conferences, including: a journal 'Pedagogical technology' №5, 2014; a journal 'Bulletin of the BSPU after M. Akhmulla', No. 33, 2015; a journal 'Educational technologies' No 3, 2015.

### Discussions

The above mentioned special visual aids which put in order educational material and teaching activity is in the focus of attention of many scholars. They managed to prove that mental maps in the process of thinking ease structuring of the material, which they are learning and, besides, single out ties between structural elements, help to memorize the information, and discuss it. It should be pointed out that the purposeful usage of mental maps frames and similar visual aids for forming universal educational actions were not considered before and should be regarded as new. The same can be said about the usage of logical-semantic navigators.

At the same time it is advisable to continue working at this problem for improving the usage of new didactic means as was proved by practice:

- some pupils avoid fulfilling logical actions and continue memorizing the material mechanically that prevents mastering logical-semantic navigators;
- professional stereotype of some teachers had to be overcome for they present the new material monotonously and require monotonous actions at it;
- the school authorities should provide good conditions for the experiment and support the creative activity of teachers in mastering new didactic means, those teachers who created the full package of logical-semantic navigators must be encouraged.

In the course of the experiment the main problems and means to overcome them were cleared out. Both the teacher and the learner should learn the skill of changing the educational material and information into a logical model form to establish causal relationship.

### Conclusion

The results of the experimental work enable us to make the following conclusions:

The method of visual presentation of logical-semantic models in fulfilling educational actions, permits to realize mastering and fulfillment of few-stepped and multi-stepped educational actions and reduce the time used by the teacher for presenting the new material. The mastering the basic few-stepped educational actions takes place in the process of building logical semantic navigators.

In the process of doing educational tasks pupils can be guided by didactic functions of navigators, that is to use them as supporting schemes. Besides, navigators of visual forms help the teacher to control and support his pupils in fulfilling their tasks.

The method of logical-semantic modeling on which the navigators are based enables to improve the teacher's projecting skills as the navigators become the central 'nuclear' of the project, which defines its contents and quality.

The experimental work also showed that:

- logical-semantic navigators can be productively used only beginning with the junior school (unfortunately, students of senior school are used to the reproductive work with the educational material: summaries, retelling without logical understanding);

- logical-semantic navigators are universal means of cognition as their usage in any school subjects can help pupils in their preparation to their lessons and tests, as the material of the lesson is projected during mutual work at the lesson;

- logical-semantic navigators help to form universal educational actions, cognitive in the first place (they teach pupils to structure the information), and also regulative (forming skills of working according to a plan), personal (increase their interest to the subject), and communicative (teach by communicating with the teacher and other pupils);

- the work with logical-semantic navigators is convenient for pupils with different type of perception.

It is advisable to use logical-semantic visual navigators as a means of forming universal educational activities, and graphical usage of these funds in the form of multi-axis enables the pupils to use a universal design method and transition from 'paper technology' to an electronic one, including hypertext.

Substantive-logical 'framework' educational material is combined with the author's variety of organization and training of the teacher. It also promotes the development of productive stereotypes of professional educational activity.

### Recommendations

The material of the article can be useful for educators in various fields.

For teachers of secondary and higher educational institutions: in mastering the project method and its chief component- building logical-semantic navigators, in differentiating their approach to tuition, when the pupils are grouped according to their mastering the material and active using of logical-semantic navigators.

For educational authorities: when planning their experimental work and creating corresponding logical-semantic navigators and also samples of educational developments, when protecting copyright creating and testing training works on tuition, as the application of logical-semantic navigators for the same purpose is considerably easier.

For undergraduates and post-graduates, who make investigations in the field of education, logical-semantic navigations can be used as useful aids of their investigation, in the working out of didactic components of the investigation results for subsequent implementation in practice.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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