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THE INFORMATION ENVIRONMENT OF THE AUTOMATED TRAINING BASED ON THE COGNITIVE MODELS

In light of the significant globalization of the information environment and the intensification of growth of diverse flows of information as a antiderivative of the aggregate of knowledge in a wide spectrum of subject areas actualizes the development of covariant approaches, methods and technologies, increasing the efficiency of creation, distribution and use of the different information resources, products and services between the various categories of the subjects of information process.

The informatization of establishments of the system of science and education initiates the consideration of a wide spectrum of the diverse aspects: regional, economic, organizational, technical, introduction, pedagogical, methodical, physiological, psychological, linguistic, ergonomic and others. The institutional bodies, regulating the politics in the sphere of education, are significantly concerned in the problematics of the personalized (individually-oriented and adaptive) training (at distance), partly by the introduction of the means of training, allowing to take into account the individual features of personality of the subjects of training.

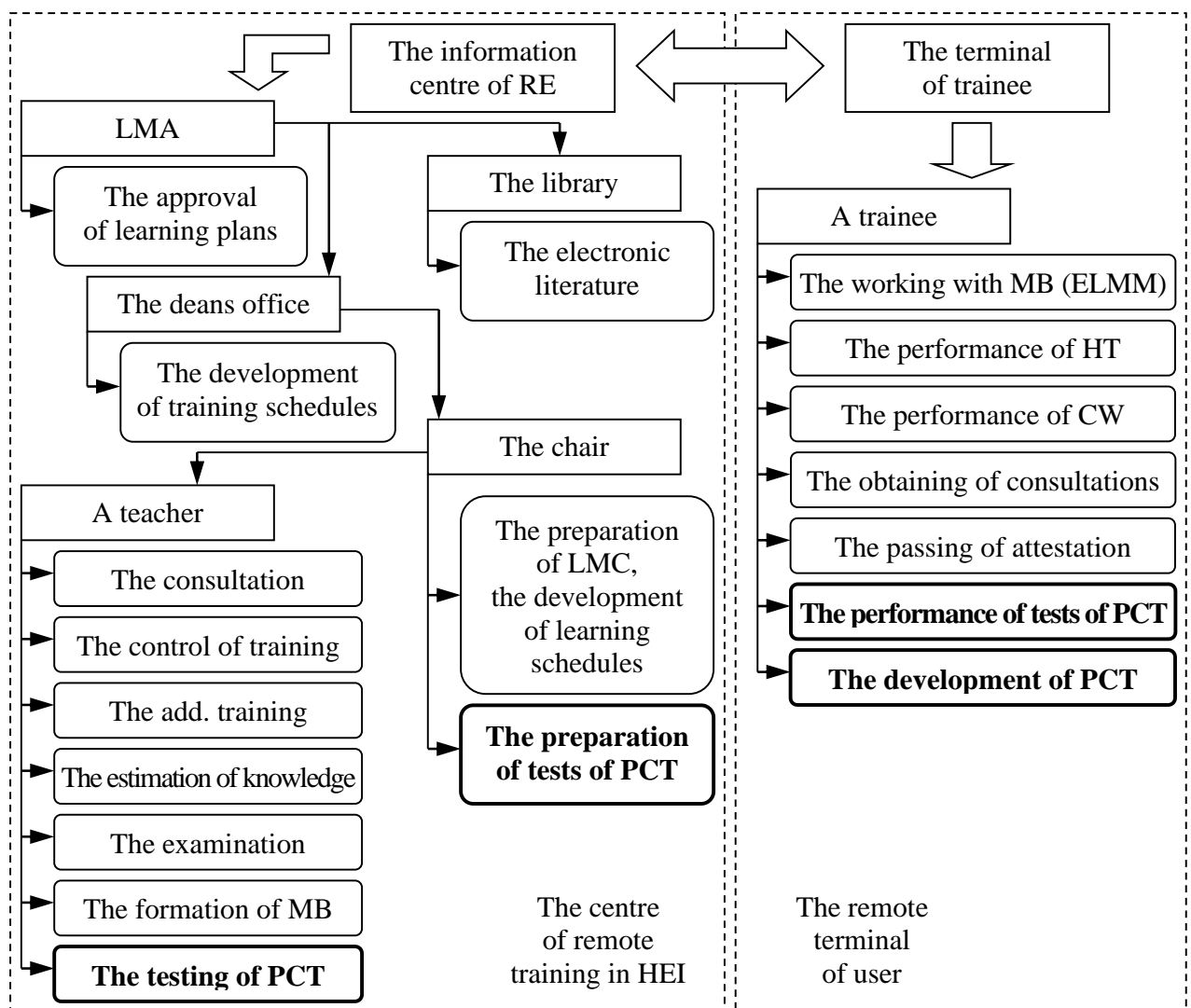
The traditional information-educational environments (IEE) of the automated (remote) training systems are practically not take into account the individual features (characteristics) of personality of the subject of training, which have influence on the level of quality of (re)training of the specialists.

The individual orientation of information interaction between the subjects and means of training in the automated IEE is directly achieved due to the use of a row of technologies: the technology of individual training – realizes the scheme “subject – means of training”, the technology of individualized training – allows to take into account the individual features of personality of the subjects of training in the educational process, the technology of adaptive training – the generation of diverse information-educational influences is carried out on the basis of an invariant model.

At the development and introduction of the technologies of personally-oriented training it is necessary to take into account the personal characteristics of the subjects of training (PCT): physiological, psychological, linguistic and others.

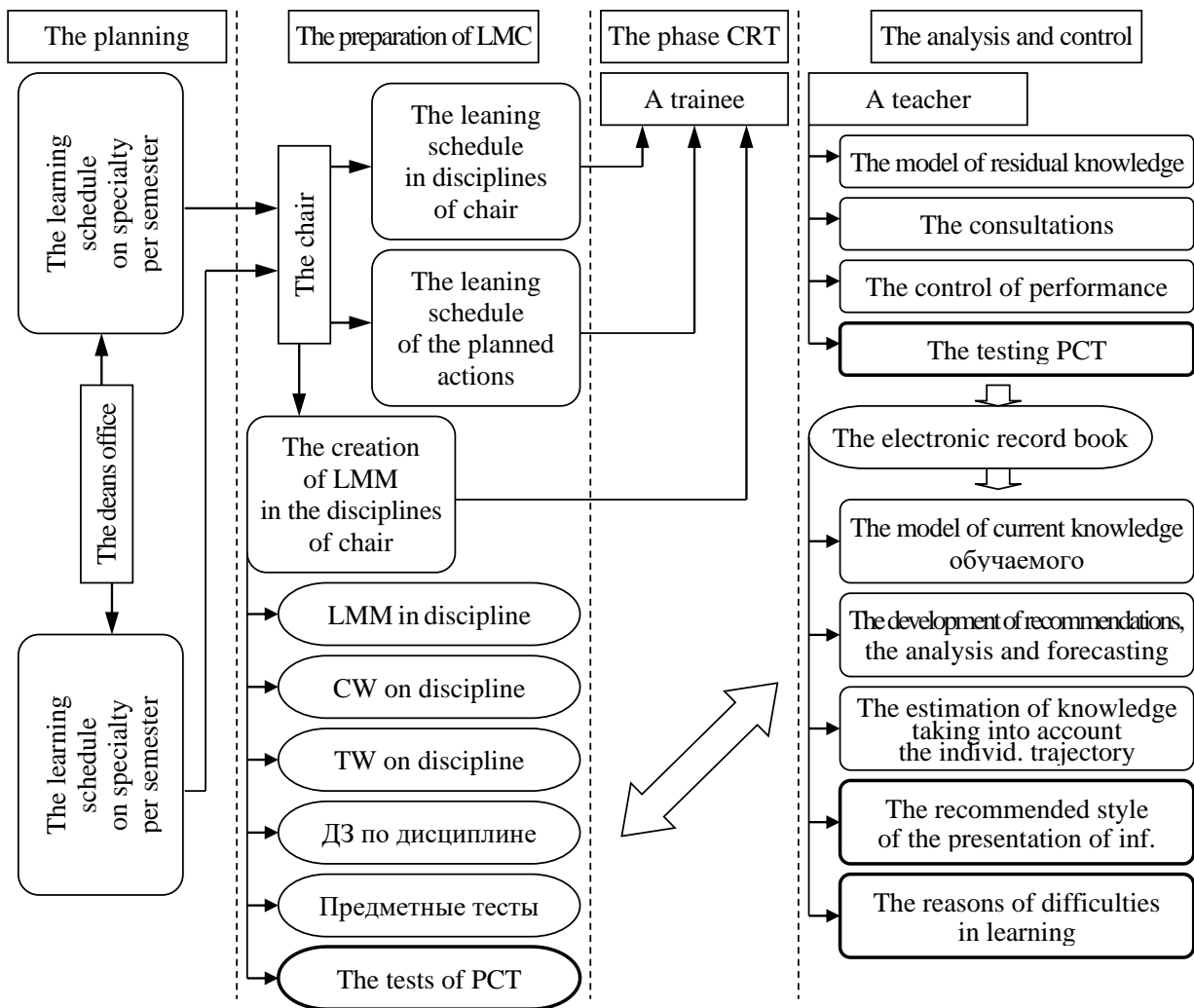
As the means of realization of the adaptive generation of the diverse information-educational influences according to PCT in the environment of automated (remote) training (ART) acts the parametrical cognitive model (CM), at the development of the structure of which it is necessary to take into account a set of requirements: the relevance (to form the parametrical model with a set of personal characteristics of the subject, taking into account by the means of IEE and the essential for the achieving of a certain purposes of training), the adequacy (the compliance of the obtained parametrical model to the original), the solvency (the support by the means of IEE of quasi-dynamic system analysis and the updating of the parameters of model due to the systematic accumulation of data about the condition of the subject of training).

IEE of the adaptive training based on the parametrical CM block has a row of the significant specific features (pic. 1): the organizational units of the information centre of the establishment it is needed to provide the preparation of tests and testing of PCT, and to trainee needs to perform the tests of PCT and the tasks, developing PCT.



Pic. 1. The features of the information environment at the organization of the adaptive training based on the parametrical cognitive models

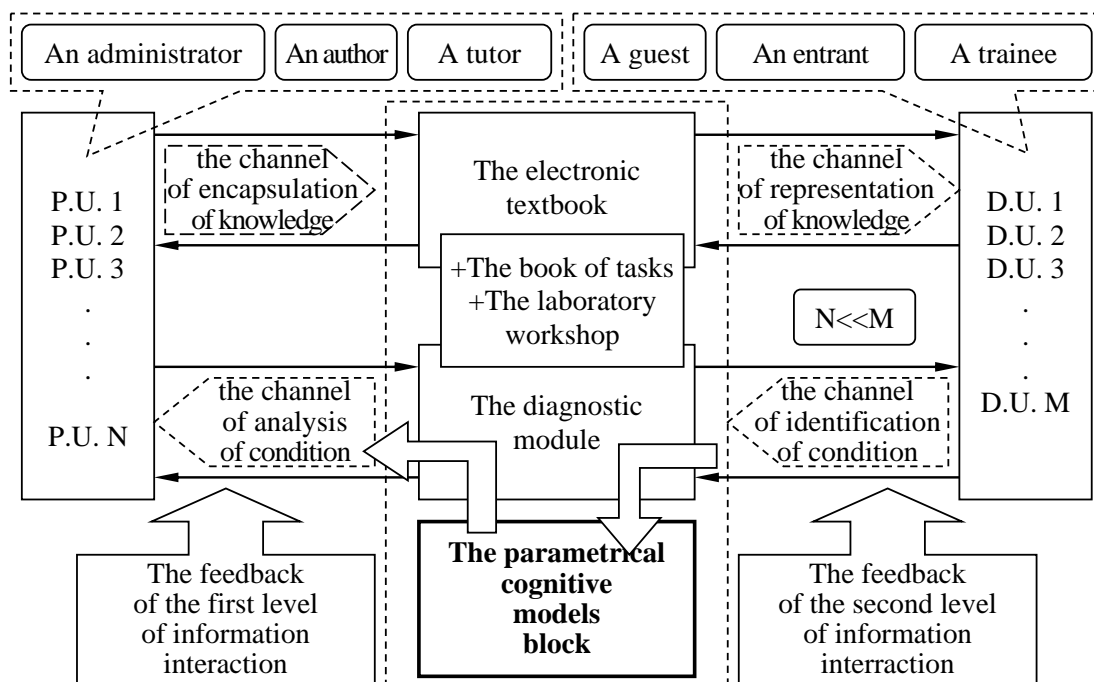
The innovative modifications of IEE are also reflected on the structure of training as the technological process of the formation of knowledge of the trainee (pic. 2), including a set of technological gaps (stages): the planning, the preparation of the learning-methodical complex (LMC), the stages of training (at distance), the analysis and control of condition.



Pic. 2. The technological features at the organization of the automated (remote) training based on the parametrical cognitive models

At the stage of the preparation of LMC it is necessary to prepare the tests of LWC, at the stage of the analysis and control of condition of the subjects of training to test PCT, and then to identify the recommended way and style of presentation of the information, the causes of difficulties of the trainee in the process of training (at distance) and to record the results in the electronic record book (ERB).

The structure of ADO system with the element of adaptation based on CM (pic. 3) is represented the closed contour (with feedback), including two levels of information interaction: the first level is represented by the channel of encapsulation of knowledge and the channel of analysis of condition, the second level contains the channel of representation of knowledge and the channel of identification of the condition of trainee.



Pic. 3. The structure of the automated (remote) training system

with the elements of adaptation based on the parametrical cognitive models block

In relation to the process of formation of knowledge the subjects of IEE of ART system are differentiated by the level of access and act in the various roles: the proficient units (P.E.): an administrator, an author, a tutor and others; the deficit units (D.E.): a guest, an entrant, a trainee and others. The virtual dialogue between the subjects of training is carried out by means of the means of IEE of ART system and therefore has a significant drawback – the limitation of communication interaction (in a wide sense), which needs to be researched and technologically eliminated.

The training (at distance) is considered as the technological process of controlled transfer of subject knowledge into the consciousness of trainee and includes a sequence stages of information processing (the visual representation, the perception, the understanding, the development of skills, the formation of skills and the aggregation of the received information into knowledge), therefore the level of residual knowledge of the trainee significantly depends on the quality of perception and understanding of the content of information fragments.

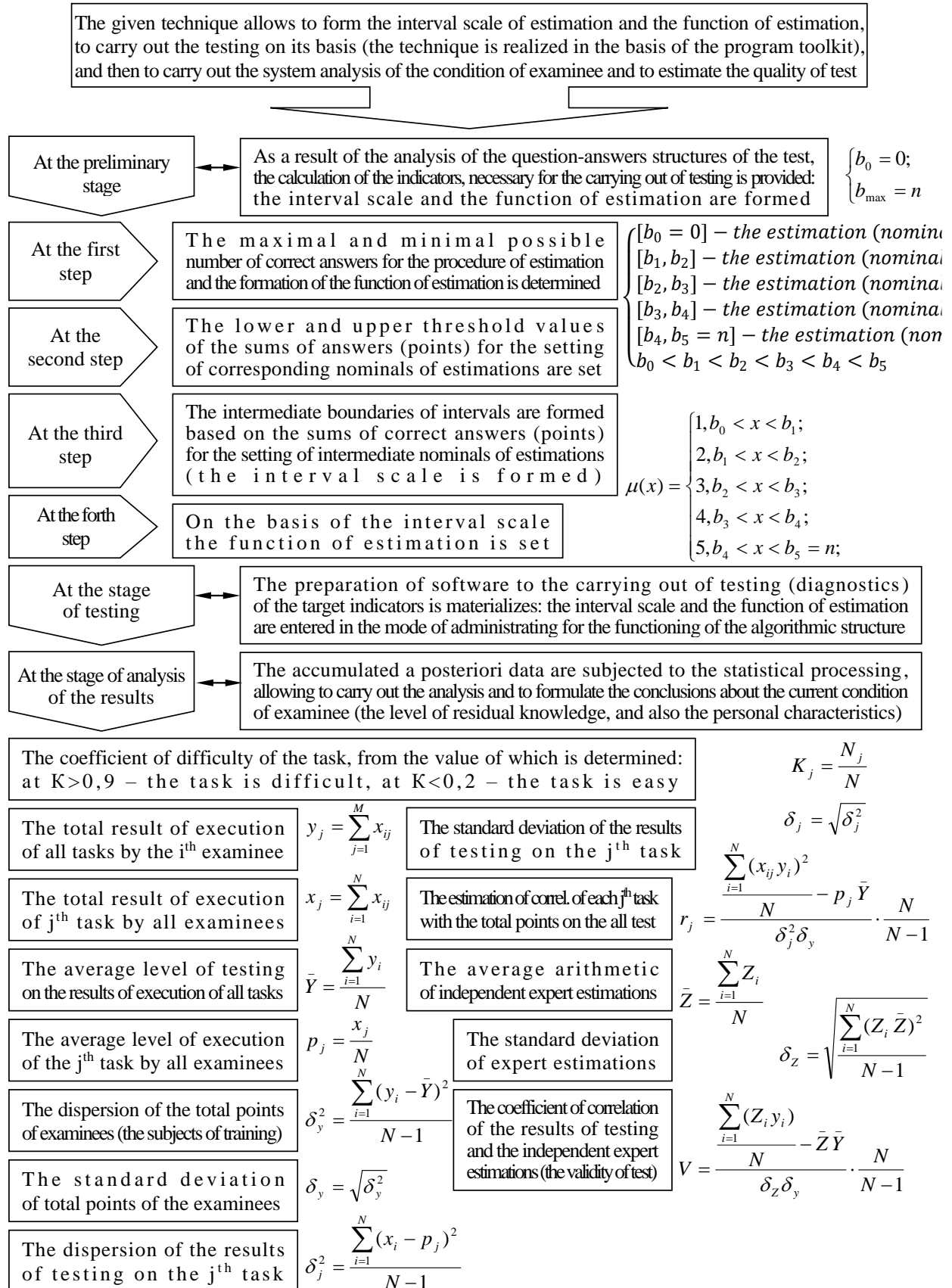
The control of displaying of a sequence of information fragments (the electronic book, section, chapter, paragraph and information page) by the various ways realizes directly the innovative adaptive representation of information fragments processor of the electronic textbook based on the structural (semantic) meta-model of the subject of studying and the innovative high-technological parametrical CM block.

The structural (semantic) meta-model of the subject of studying is necessary and sufficient for the filling by the subject content in the cycle of disciplines.

The diagnostic module of ART system is intended for the automation of the initial, intermediate and final control testing of the level of residual knowledge of the trainee in the subject of studying, and also realizes the automation of the initial and quasi-dynamic research of the parameters of PCT for the filling of CM of the subject of training by the nominal values.

For the automation of research of the level of residual knowledge of trainees the program toolkit (the basic diagnostical module) was developed, allowing to carry out the estimation on the basis of two diverse scales: “rough” – the calculation of the sum of valid answers to the questions of the method of research, “extended” or “exact” – the calculation of the sum of scored (penalty) points by each (in)valid variant of answer to the question of the method of research.

For the processing of a posteriori results of research is intended the technique of estimation of the level of knowledge of trainee and the analysis of quality of test (pic. 4).



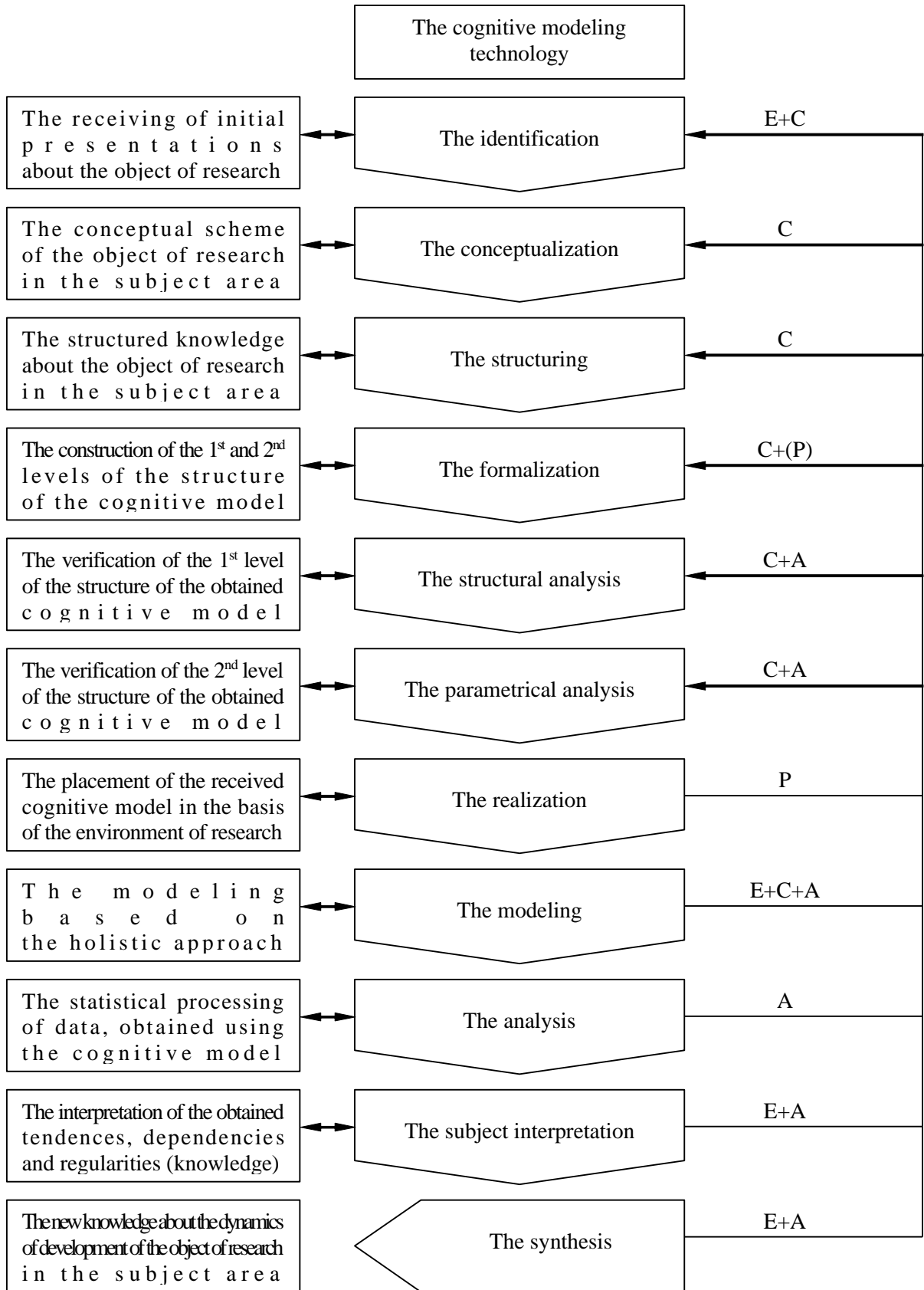
Pic. 4. The technique of estimation of the level of knowledge of the examinee and the analysis of quality of the test based on a posteriori results of testing

For the complex solution of the scientific problem of creation and the subsequent effective system analysis of IEE of the personally-oriented training (at distance) is intended the cognitive modeling technology (CMT), the technique of use of CMT and the algorithm of formation of the parametrical CM.

CMT (pic. 5) is the universal in relation to the object of research and is represented the iterative cycle, including a set of stages, allowing not only to obtain the primary presentations in the context of the selected spectrum of the scientific aspects of consideration, but and to carry out the structural and parametrical system analysis.

For the system analysis of the difficult objects of research CMT provides the involvement of a row of consultants (specialists), which are directly designated by the various letters (letters): an expert (E) – the qualified specialist in the subject area (for IEE is attracted a methodist, a teacher and others), a cognitologist (C) – the qualified specialist in the field of knowledge engineering, providing the correctness of the obtained structure of the parametrical CM, a system analyst (A) – the specialist in the field of the system analysis and modeling, revealing compliance of the obtained parametrical CM to the real object, a programmer (P) – the qualified specialist in the field of languages of programming, knowing the methods and approaches to the realization of the modern means of IEE by means of the highly-technological integrated environments of programming.

The technique of use of CMT (pic. 6) and the algorithm of formation of the structure of CM are developed for the formalization of a sequence of the use of CMT with the purpose of formation of the structure of the cognitive model for the tasks of the system analysis of IEE of ART system with the elements of adaptation based on the parametrical CM block.

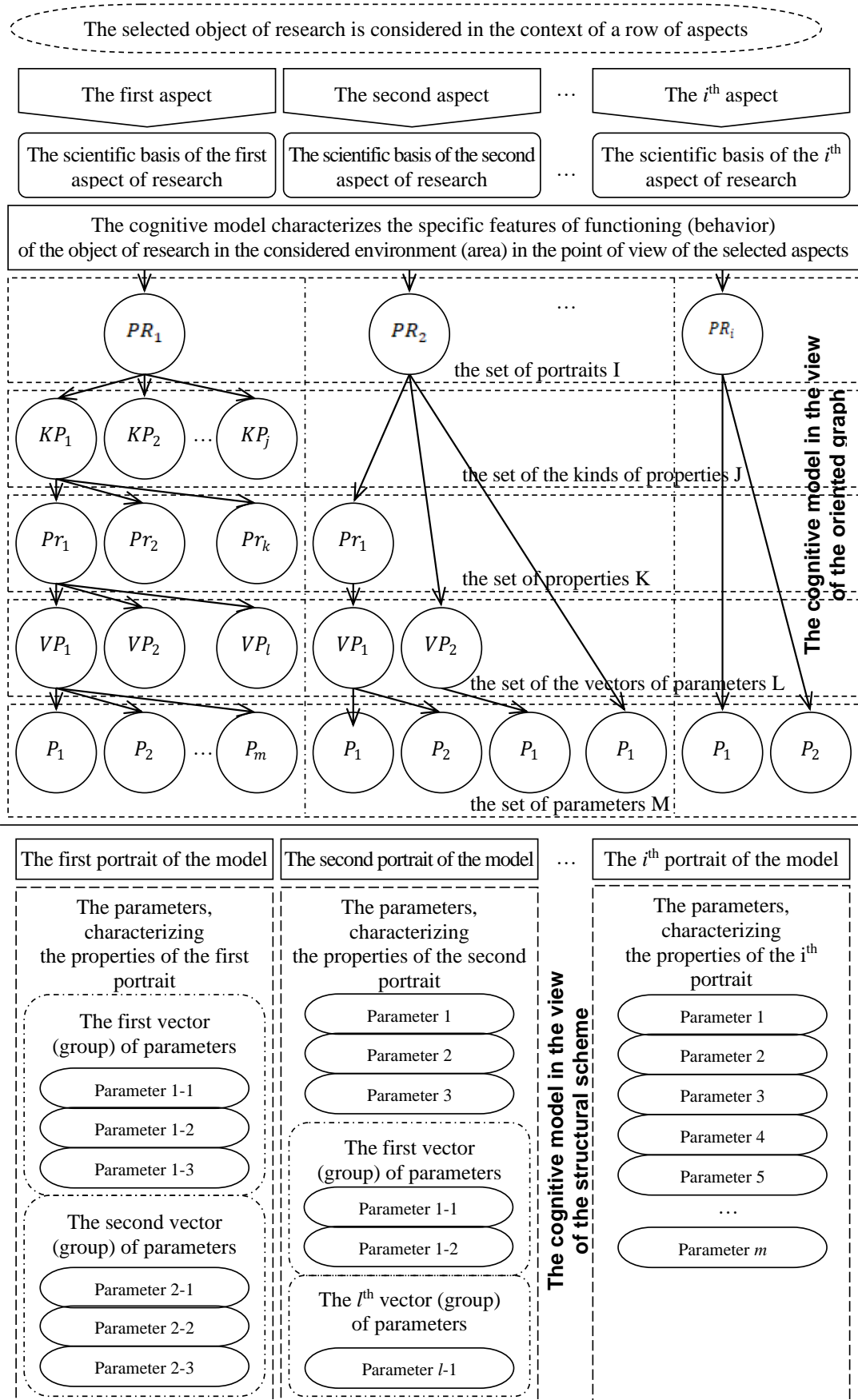


Pic. 5. The iterative cycle of the cognitive modeling technology



Pic. 6. The technique of use of the cognitive modeling technology

For the research of the structurally difficult objects it is recommended to use the representation of CM in the view of the oriented graph, the vertices of which form a row of mathematical sets (pic. 7, above), what is convenient for the subsequent system analysis.



Pic. 7. The basis for the formation of the structure of the cognitive model, presented in the view of the graph (top) and the structural scheme (bottom)

For the structurally simple objects of research it is recommended to use the schematic representation of CM (pic. 7, below).

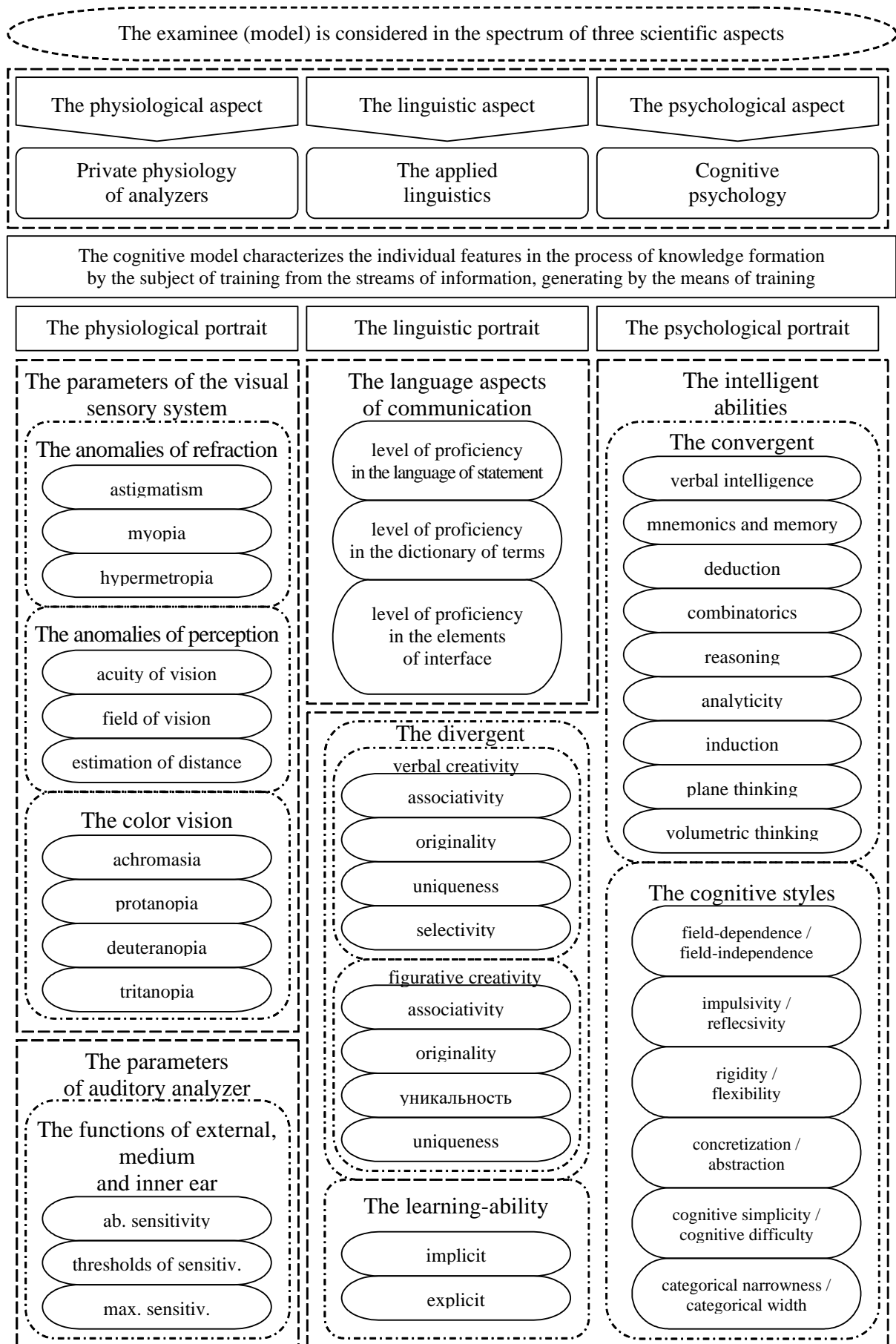
The parametrical CM acts as a repertoire of parameters, echeloned on a set of portraits and stratified on a row of mathematical sets (the representation of CM in pic. 7, above), reflecting the most important aspects of information interaction of the subjects of training and the means of training in IEE of ART system, providing the consistency of generation of the diverse information-educational influences with PCT, and also allowing to reveal the causes of different difficulties in the technological process of the formation of knowledge of the contingent of trainees.

At the same time the parametrical CM is differentiated on CM of the subject of training (the parameters, characterizing PCT) and CM of the means of training (the parameters, characterizing the potentially possible types and kinds of generated information-educational influences).

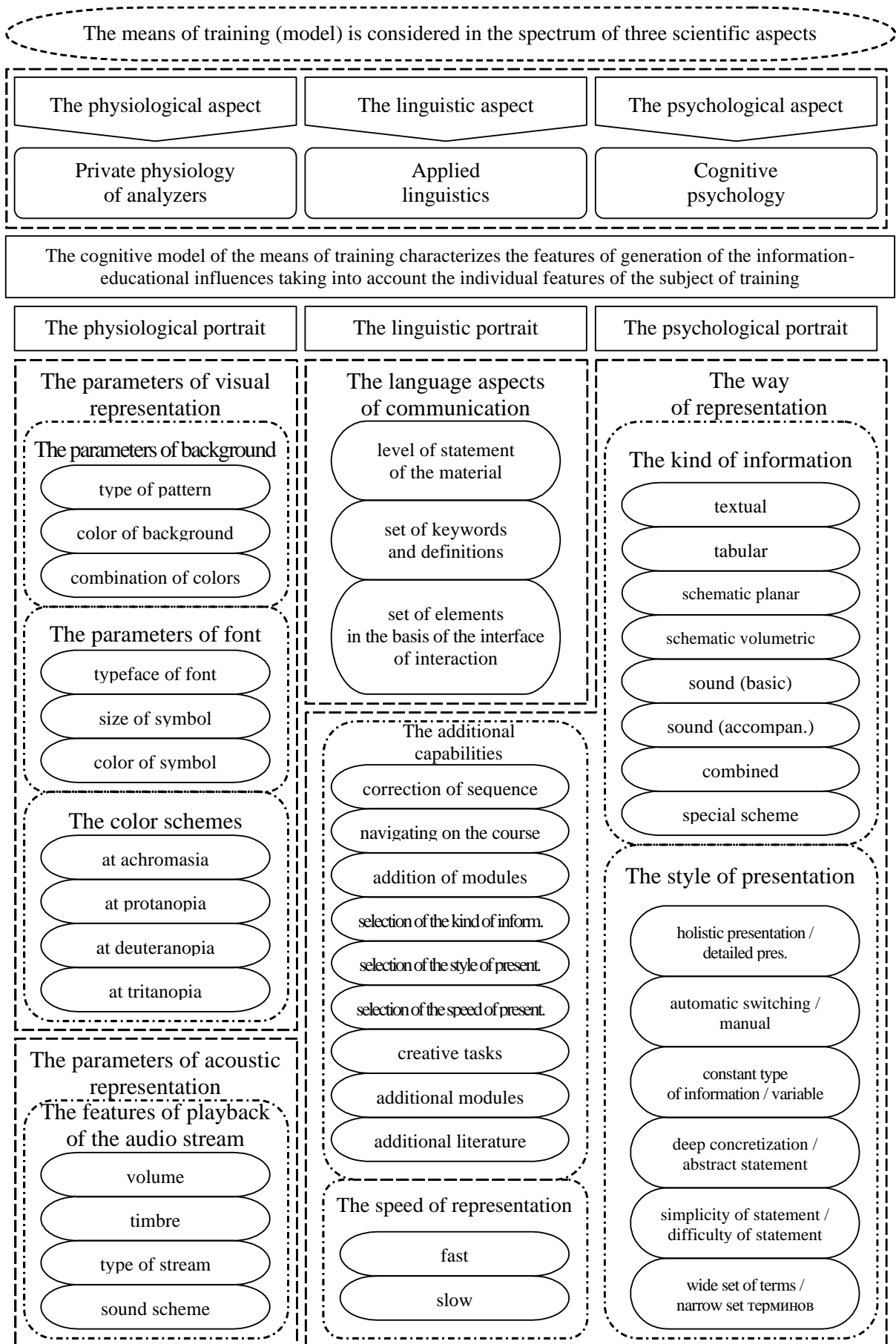
The parametrical CM of the subject of training (pic. 8) concentrates the parameters of the physiological, psychological and linguistic portraits, characterizing PCT.

The parametrical CM of the means of training (pic. 9) contains the parameters, characterizing the potentially possible types, kinds and features of the generated information-educational influences.

The contour of adaptation of IEE of ART system based on the parametric CM is technologically realized at the possibility of generation of the training influences on the basis of the parametrical CM of the means of training in coordination with PCT contained in the parametrical CM of the subject of training.



Pic. 8. The cognitive model of the subject of training



Pic. 9. The cognitive model of the means of training

For the automation of the tasks of research of the vector of parameters in the structure of the portraits of CM of the subject of training is used the program toolkit, developing on the basis of the architecture of the expert system and containing in the basis of database a set of applied methods on the scientific basis of private physiology of sensory systems, cognitive psychology and linguistics.

The estimation of efficiency of the introduction of the scientific results of research is carried out with using of the generally-accepted indicators of efficiency:

$$K = \{k_1; k_2; k_3\} = \left\{ Y_1 - Y_2; \frac{Y_1}{Y_2}; \frac{Y_1 - Y_2}{Y_2} 100\% \right\}$$

The coefficients respectively designate directly the absolute, comparative and relative indicators of efficiency, and a posteriori results of mathematical processing of the statistical data of a series of automated experiments are generalized in the table 1.

Table 1. The results of statistical processing of the data of experiment

The name of indicator	The number of experimental group of examinees							
	1	2	3	4	5	6	7	8
The experiment №1 (without using of CMT)								
The average point Y_1	3,850	3,414	3,224	3,678	4,036	3,643	3,790	3,645
ESD of av. point	0,867	0,178	1,958	0,879	0,577	0,783	1,679	1,047
The experiment №2 (with using of CMT, personal adaptation)								
The average point Y_2	4,041	3,674	3,357	3,786	4,157	3,853	3,821	3,743
ESD of av. Point	0,723	0,127	1,743	0,743	0,446	0,654	1,538	0,986
The results of research								
K_1	0,191	0,26	0,133	0,108	0,121	0,21	0,031	0,098
K_2	1,049	1,076	1,041	1,029	1,029	1,057	1,008	1,026
K_3	0,049	0,076	0,041	0,029	0,029	0,057	0,008	0,027
The changing of ESD	-0,144	-0,051	-0,215	-0,136	-0,131	-0,129	-0,141	-0,061

The proposed approach allows to realize the additional contour of adaptation based on the innovative parametrical cognitive models block, and also to carry out the analysis of the efficiency of functioning of IEE of ART system.