

UDC 004.67 (85) + 519.87

**THE BASIC DIAGNOSTIC MODULE IN THE AUTOMATED
TRAINING SYSTEM WITH THE PROPERTIES OF ADAPTATION
BASED ON THE PARAMETRICAL COGNITIVE MODELS BLOCK**

A.N. Vetrov

Saint-Petersburg city

The main diagnostic module realizes the automation of diagnostics of the level of residual knowledge of the contingent of trainees by means of using of the formed set of tests in the different subjects of studying, which are contained in the database

**The information-educational environment, the automated training system,
the diagnostic module, the cognitive modeling technology, the cognitive model,
the configurable function of estimation, the interval scale of estimation**

The introduction and setting of the problem

The modern level of development of the information technologies and the intensification of growth of the diverse sources of information initiate the introduction of the diverse means of automation in the various spheres of production and non-production activity of the post-industrial society, actualize the problem of system analysis of the information-educational environments (IEE), and also cause the potential need of research of the regularities of information interaction between the subjects and means of training for the monitoring of the controlled formation of knowledge of the trainees [1].

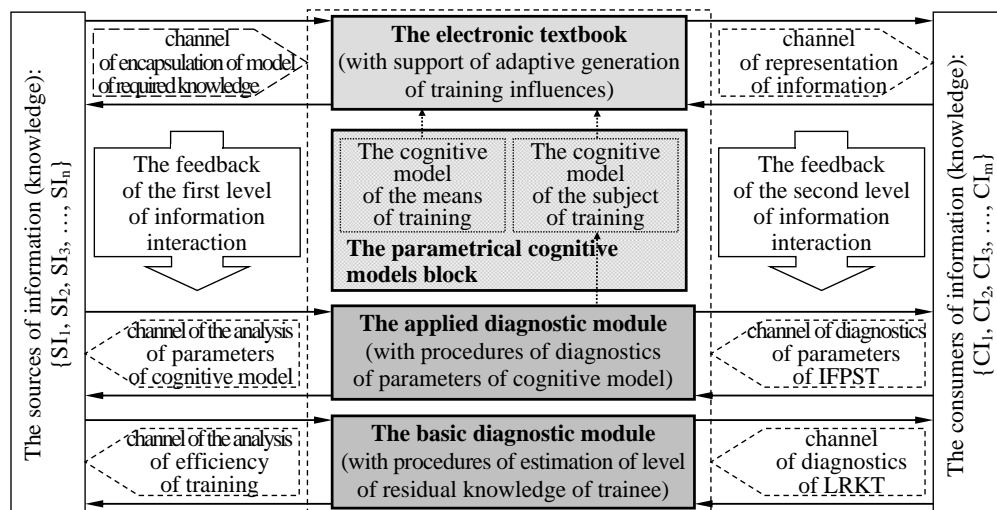
The testing of the level of residual knowledge of the contingent of trainees (LRKT) acts as the actual and difficult structured scientific-technical task, realizes by means of using of the diagnostic complexes and program modules, reduces to the presenting of previously predetermined sequence of question-answers structures of various tasks of test in a certain discipline based on the specified parameters of the algorithm of testing for the direct identification and estimation of the achieved LRKT, and also the abilities and skills developed by the examinees by means of the practical use of the diverse technical means of different profile and appointment.

As the set of solved tasks in course of testing is significantly expanded, the difficulty of the question-answers structures of tests and algorithms of supporting of the diagnostics of LRKT, than there is a need of development of the unified infological schemes of databases for the optimization of search, storage and extraction of structured data, and also the need of creation of constructors of tests for the formation of samples of the question-answers structures, which meet the requirements of accuracy, veracity, adequacy, validity, reliability, normalization, possibility of the mathematical processing by means of using of a set of the various methods of statistical analysis.

The features of automated training system with the properties of adaptation based on the parametrical cognitive models block

For the solving of problem of the system analysis of difficult objects, processes and phenomena the author:

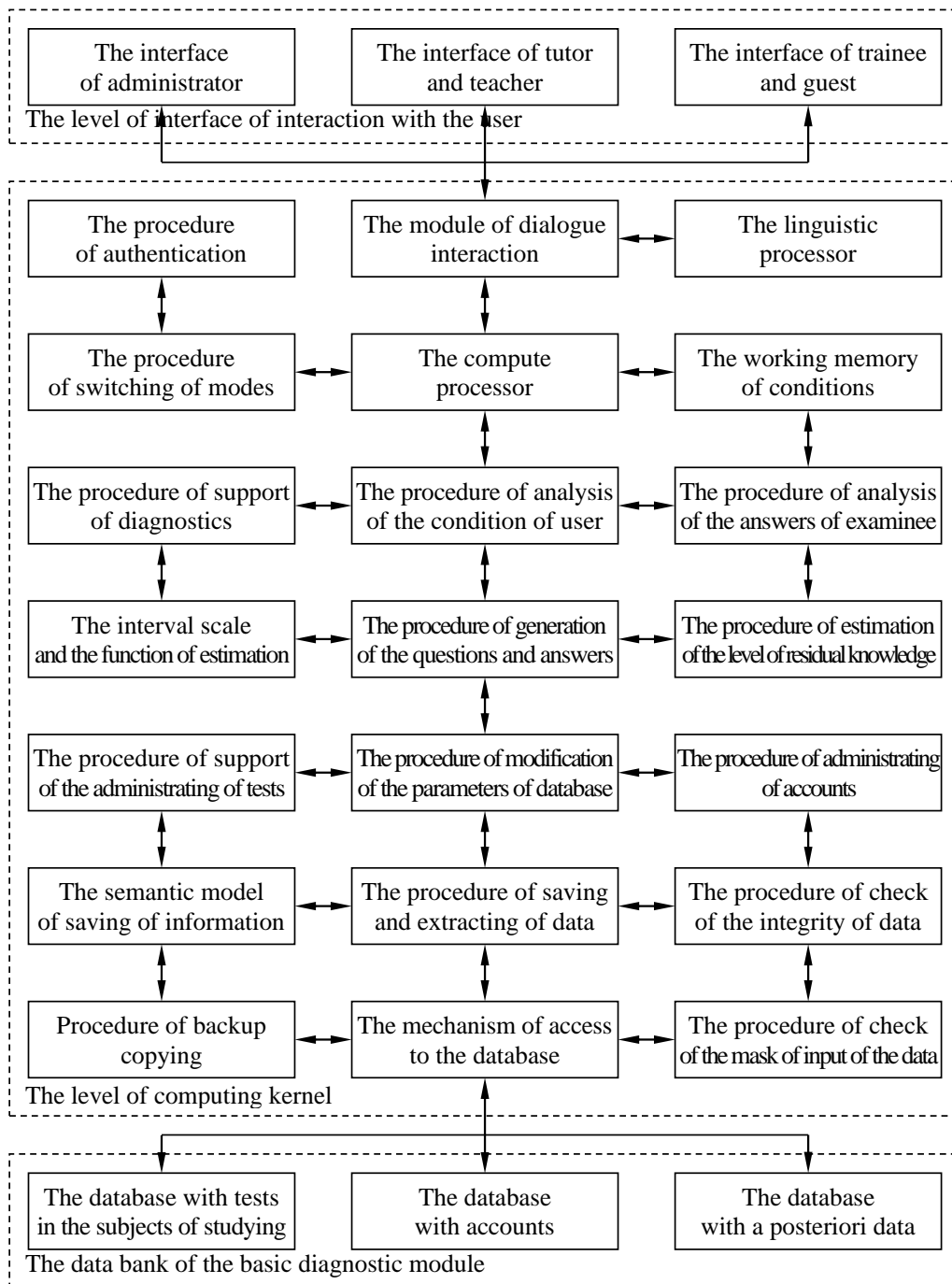
- it was developed the apparatus of the cognitive modeling technology (CMT) for the creation and modernization of IEE [2, 5, 8, 11, 12], and also for the research of information interaction of the subjects and means of training with the purpose of the increasing in the efficiency of functioning of the algorithms and procedures in the basis of the automated training systems (at distance) [3-5];
- the apparatus of CMT has been formed for the financial analysis of the results of economy activity and the efficiency of functioning of the organization, in particular the information centre of training, on the basis of the registers of accounting;
- the automated training system with the properties of adaptation based on the cognitive models (CM) [3-7, 9, 10] is created, acting as the closed contour with the six channels of information exchange at the two levels of information interaction, including:
 - the electronic textbook based on the adaptive representation of information fragments processor [7, 10] – the calculation of the optimal combination of values of the parameters of displaying of the information taking into account the individual features of the trainees (CM of the subject of training) and the technical capabilities of the means of training (CM of the means of training);
 - the parametrical CM block [2, 3-5] – accumulates CM of the subject of training and CM of the means of training, acts as the information basis of the system analysis of IEE;
 - the applied diagnostic module (DM) [3-6] – realizes the research of individual features of trainees by means of a set of tests for the diagnostics of sensory perception, processing and understanding of the content of information fragments;
 - the basic DM [3, 5] – provides the diagnostics of LRKT in the form of testing (pic. 1).



Pic. 1. The structural scheme of the automated training system with the properties of adaptation based on the parametrical cognitive models block

The architecture of the diagnostic module for the estimation of the level of residual knowledge of trainees

The architecture of the basic diagnostic module (DM) is made by the block-modular principle, includes a row of components, realizing the different functions (pic. 2).



Pic. 2. The generalized architecture of the basic diagnostic module

DM as the program for the personal computer combines two basics of functioning: the declarative – the interface and infological schemes of the database with the parameters of test for the subjects of studying and the database with the accounts of users and a posteriori data of testing; the procedural – the procedures and algorithms of loading, processing and unloading of the structured data at the basis of the interface, kernel and databases.

In the basis of the architecture of the basic DM can distinguish the several different structural components, which perform a certain set of various functions.

1. The level of interface of interaction includes the several various interfaces:

- the interface of administrator – allows to enter or modify the values of various parameters of tests and the accounts of users of the basic DM;
- the interface of tutor and teacher – allows to enter or modify the parameters of tests of the level of residual knowledge of the contingent of trainees in the subjects of studying, and also to view the parameters of the accounts of users and a posteriori data of testing of the level of residual knowledge of the contingent of trainees;
- the interface of trainee and guest – allows to realize the viewing of the textual and graphical content of formulations of all questions and variants of answers, and also directly provides the possibility of selecting to the examinee the normative one or several valid variants of answer on each question.

2. The level of the computing kernel includes the several processors and procedures:

- the module of dialogue interaction – provides the interaction between the various interfaces of users and the components of kernel of the basic DM;
- the procedure of authentication of user – realizes the input of parameters of the account of new user into the database and the registration of the existing user;
- the linguistic processor – realizes the switching between the localizations of interface of user for the displaying of the identifiers of the element of interface in a certain national or foreign language at the working with the basic DM;
- the procedure of switching of modes – provides the activation of one from modes;
- the computing processor – realizes the control of the flows of data, reflecting the parameters of test, the parameters of accounts of users, a posteriori data;
- the working memory of conditions – allows to store the intermediate and resultant values of all operands and operations in the course of the computational process;
- the procedure of analysis of the condition of user – realizes the continuous identification of condition of the user at working in the modes of administrating and diagnostics;
- the procedure of support of diagnostics – provides the support of functioning of the program in the mode of diagnostics of the level of residual knowledge of the contingent of trainees;
- the procedure of generation of questions and answers – directly provides the formation of a sequence of the question-answers structures for the further displaying in the mode of diagnostics according to the previously preset values of parameters of the algorithm of testing in the mode of administrating of the basic DM;

- the procedure of analysis of the answers of examinee – realizes the analysis of answers of examinee;
- the interval scale and the function of estimation – directly allows to determine the maximal and minimal permissible value of the sum of scored points, penalty points, the valid and incorrect answers on the questions, then to form the interval scale from a sequence of intervals for the determination of estimation of LRKT, and then to set the function of estimation for the determining of one-to-one correspondence of the sum of scored points with the estimation of LRKT on the exact scale or the quantity of valid answers on the questions with the estimation of LRKT on the rough scale;
- the procedure of estimation of LRKT – realizes the calculation of estimation of LRKT based on the sum of valid answers on the questions and the calculation of estimation of LRKT based on the sum of scored points for each valid variant of answer on the question by means of the exact scale;
- the procedure of modification of the parameters of database – allows to form the database;
- the procedure of support of the administrating of parameters of the accounts of users – directly realizes the capability of viewing, adding, deleting and modifying of the various parameters of accounts of users in the database;
- the procedure of support of the administrating of parameters of the test – the moving to the first, previous, next or last question, and also the adding of new and deleting of the existing, saving and canceling of made changes into the parameters of question;
- the procedure of saving and extracting of data – provides the input and output of data;
- the semantic model of saving of the information – allows to structure data;
- the procedure of check of the integrity of data – realizes the check of integrity of the structures of data on the machine storage of information in the process of saving and extracting;
- the mechanism of access of data – allows the users to receive the access to files on the machine storage, the local or network database as a shared resource;
- the procedure of backup copying – the archiving and backing up of temporary unused parameters of tests, accounts and a posteriori data;
- the procedure of check of the mask of input of the data – the analysis of coincidence of the mask of input of the information.

3. The level of the data bank of the basic DM with a posteriori data of testing:

- the database with the tests in the subjects of studying – contains the values of parameters of the structured set of question-answers structures of tests for the estimation of LRKT;
- the database with accounts – reflects the structured sequence of values of the parameters of accounts of the registered users;
- the database with a posteriori data – contains the values of parameters, reflecting the quantity of valid and incorrect answers on the questions, the level and estimation of LRKT.

The features of the structure of questions and answers in the structure of tasks for the testing

The structure of data of the task of a modern test task includes a row of important elements, which have a significant influence on the design of interface of the program realization:

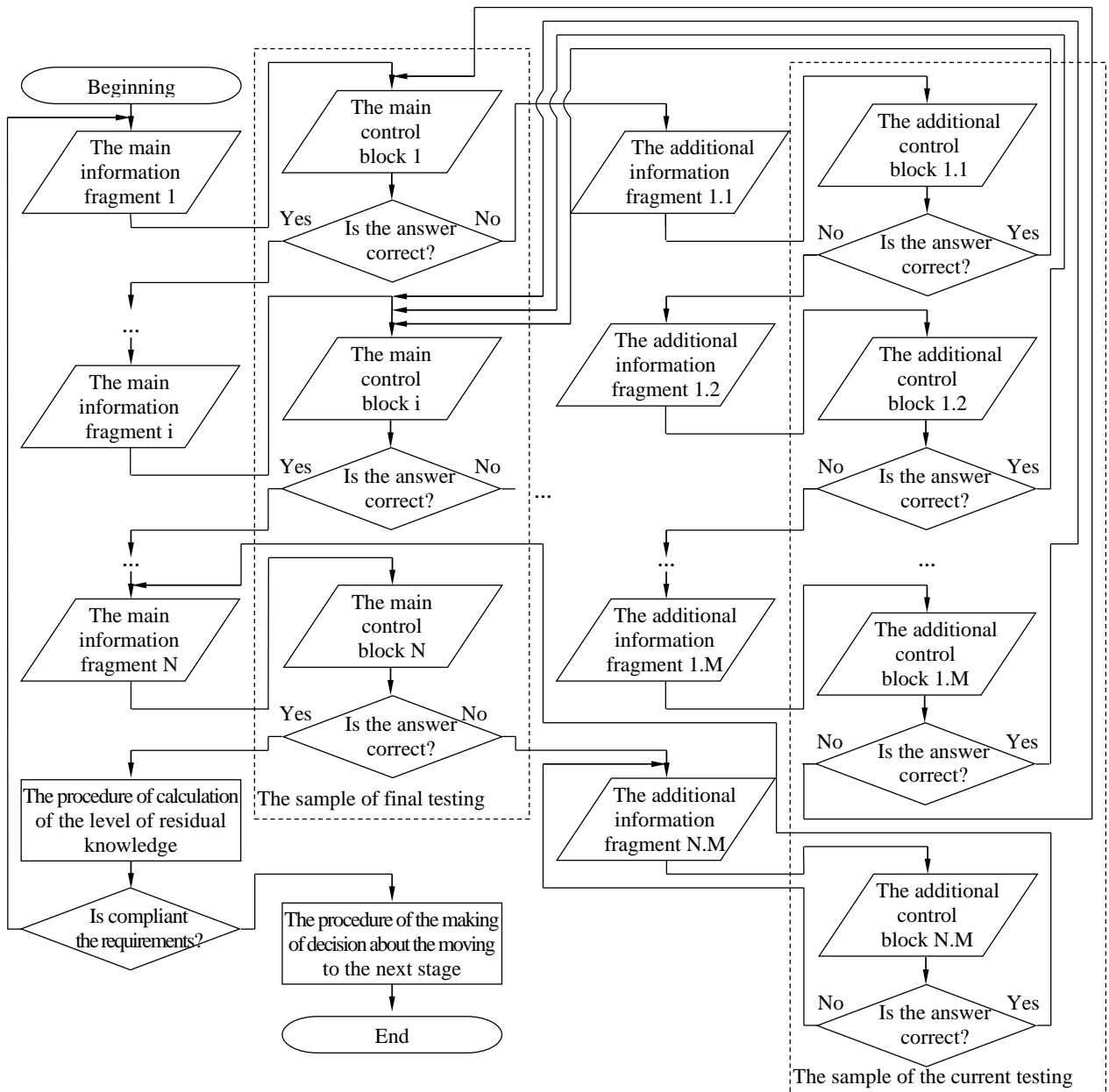
- the information elements at the basis of the structure of elementary question of the test;
 - the field of displaying of the number by order and the total quantity of the variants of answer;
 - the field of the textual content of the formulation of question in the structure of test;
 - the field of the graphical accompanying of the formulation of question in the sample;
 - the selector of setting of the parameters of displaying of the content of question;
 - the field of setting of the parameters of timer for the indicating of nominal value of the interval of time, limiting the development of the answer on the question;
 - the field of setup of the multimedia-accompanying for the playback of audio-stream;
 - the button of activation of the procedure of checking of the correctness of the answer on the question;
- the variants of answer acts as the main elements of the structure of each question;
 - the selector of quantity of the displayed variants of answer on the question;
 - the selector of setting of the parameters of content of the variants of answer on the question;
 - the selector of the way of selecting of the valid variant of answer on the question in the test;
 - the only normative variant of answer among the several proposed;
 - the several valid variants of answer among the several suggested;
 - the selector of the way of displaying of the variants of answer on the question in the course of testing;
 - the variant(s) of answer displays the system, and the examinee selects the valid;
 - the system displays the blank fields, and the examinee enters the variants of answer;
 - the field of the textual content of formulation of the variants of answer;
 - the field of the graphical accompanying of formulation of the variant of answer;
 - the field of nominal value of weight coefficient of the variant of answer for the realization of possibility of the estimation of LRKT using the different exact scales;
- the explanation acts as the additional element of the structure of each question;
 - the field of the textual content of the formulation of explanation to the question, which is displayed in the mode of diagnostics of LRKT at the incorrect answer;
 - the field of the textual content of the formulation of explanation for the displaying before the start of the cycle of testing on each individual test;
 - the field of the textual content of the formulation of explanation for the displaying in the status bar of window directly in course of the testing on the sample of questions.

The minimal required set of information fields of the structure of data of the test sufficient for the providing of storage and extraction of the information acts as the basis of the infological scheme of the database, which includes a set of tables with different relationships.

**The features of realization of the estimation of the level of residual knowledge
of the contingent of trainees by the basic diagnostic module**

The basic DM functions in parallel with the electronic textbook (pic. 3), but:

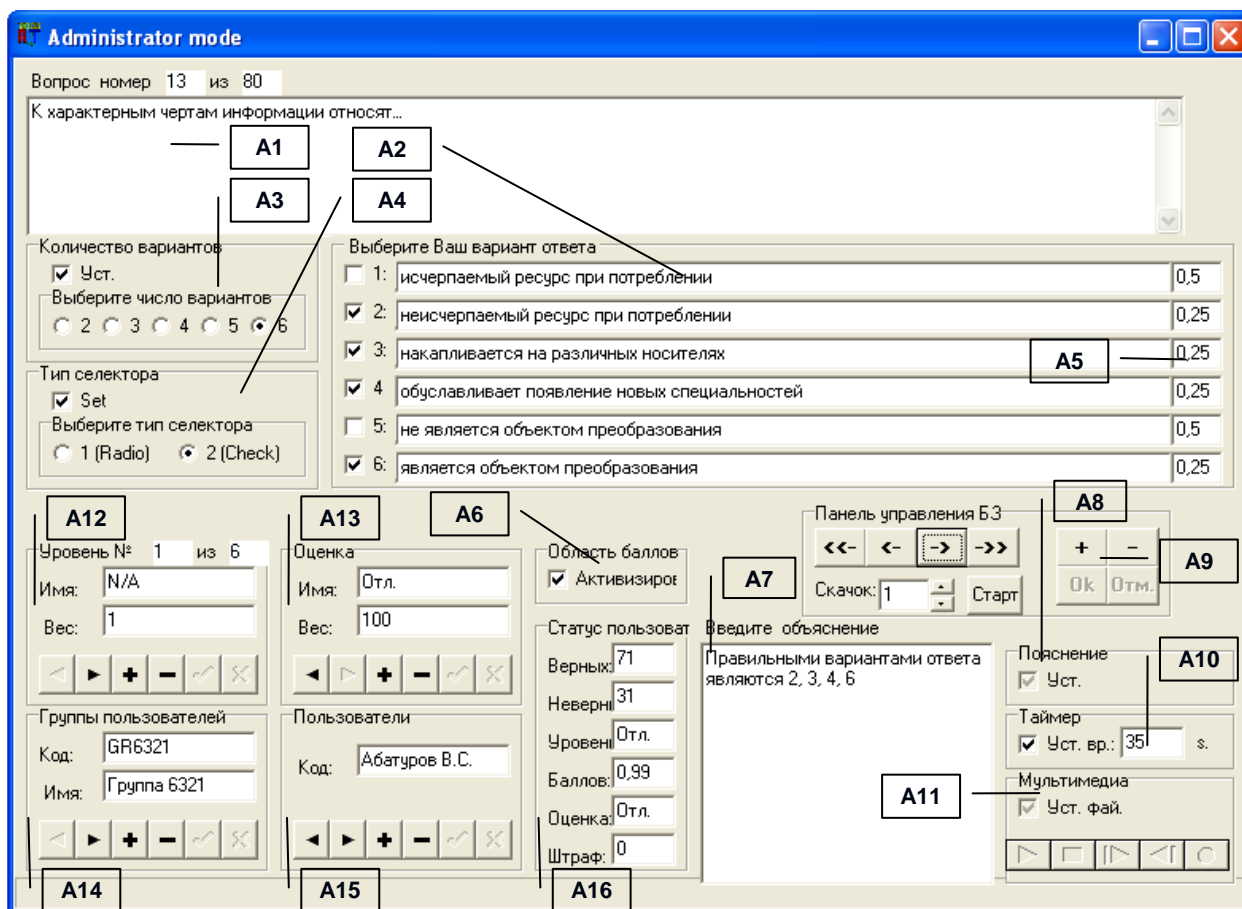
- the electronic textbook realizes the displaying of a sequence of information fragments, related to the main or additional block of information, which are mutually uniquely connected with the main or additional control block for the realization the current, intermediate or final testing;
- the basic DM provides the sequential displaying of control questions, and the algorithm of support of the mode of diagnostic calculates the estimation of LRKT based on scales.



Pic. 3. The algorithm of displaying of the information fragments and control questions of the main and additional blocks

The program realization of the mode of administrating of the basic diagnostic module

In pic. 4 presents the interface of the basic DM in the mode of administrating.



Pic. 4. The interface of the basic diagnostic module in the mode of administrating

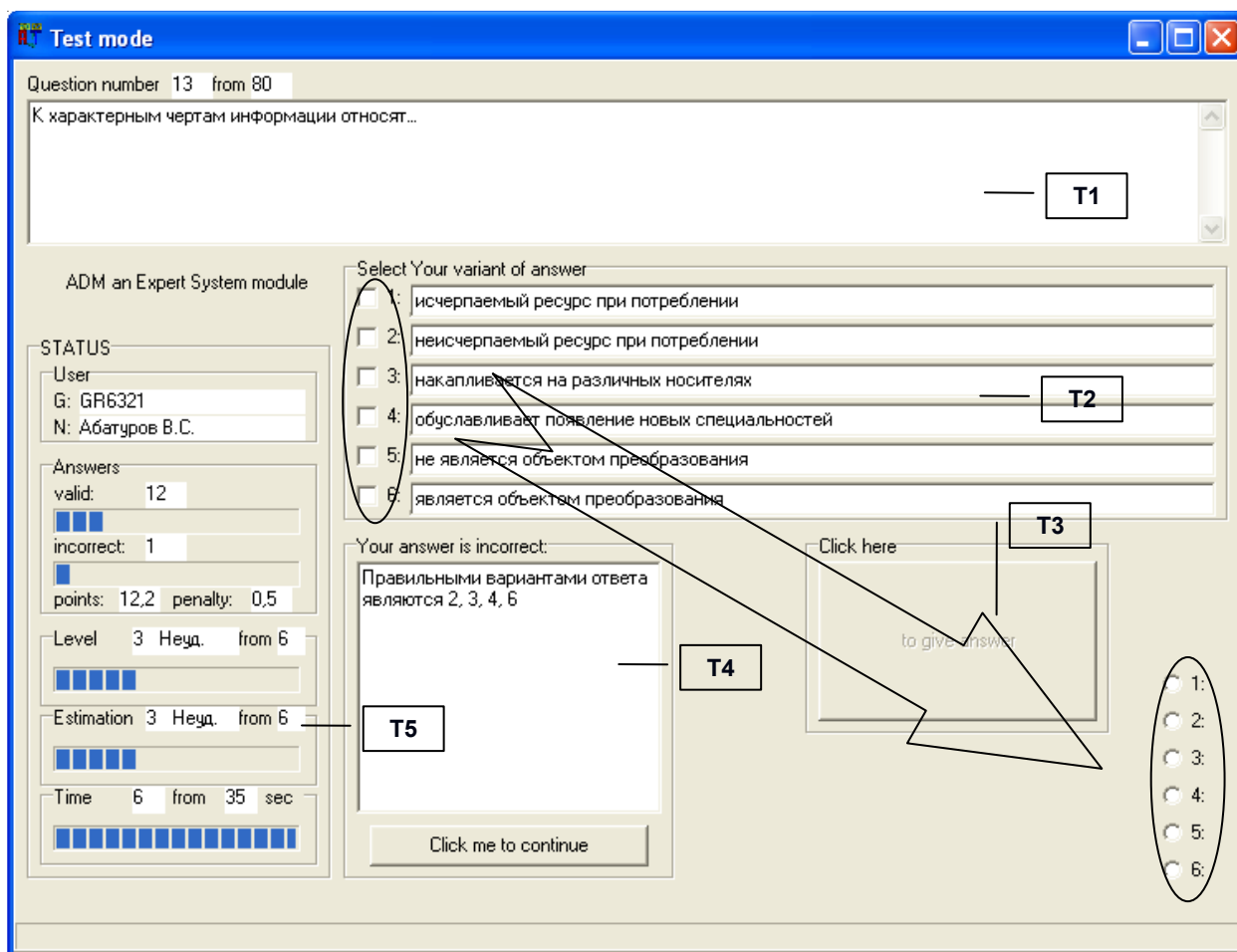
In the mode of administrating the user it is provided the potential possibility to view and modify the parameters of test for the estimation of LRKT in a specific subject of studying by means of using a row of the elements of interface:

- the indicator of question (A1) – the textual content of formulation of the question;
- the indicator of the variants of answer (A2) – the textual content of the variants of answer and the sign of correctness by means of marker of the type “point” or the type “flag”;
- the selector of quantity of the variants of answer (A3) – provides the user with the possibility of setting of the quantity of displayed variants of answer on the given question;
- the selector of the way of selecting of the valid variants of answer (A4): the type “point” – the selection of the normative only variant of answer; the type “check box” – the setting of several valid variants of answer among the suggested variants of answer on the question;
- the field of weight coefficients (A5) – allows to enter all nominal values of weight coefficients of each variant of answer on the questions in the structure of test by the proportional principle relative to the quantity of points for a certain question;

- the marker of activation of the algorithm of estimation of LRKT on the basis of weight coefficients (A6) – provides the possibility of input of the nominal values of weight coefficients of each variant of answer (A5) and realizes the activation of the exact scale of estimation (A13);
- the field of explanation (A7) – allows to enter the textual content of formulation of the explanation for its subsequent displaying to the examinee at each incorrect answer on the question in the mode of diagnostic of LRKT, at the same time the answer is considered valid, if the signs of correctness of all variants of answer on the question are coincide (if the match is incomplete, then on the coarse scale the incorrect answer to the question is fixed by the auto-incremental principle, and on the exact scale the nominal value of the sum of points and penalty points is calculated by the principle of summation);
- the marker of activation of explanation (A8) – provides the connection of the algorithm of displaying of the comments and explanations in case of each incorrect answer on the question;
- the navigator of question (A9) – realizes the transition to the first, previous, next or last question in the database of tests of LRKT, and also realizes the direct addition of a new or deletion of an existing question, the saving or cancellation of made changes in the different information fields of the structure of question;
- the timer (A10) – allows to set the status of activity and the nominal value for the limitation of the interval of time of the generating of the answer on the question in the structure of test;
- the multimedia (A11) – provides the direct possibility of playback a certain audio-stream from the file on the storage or carrier of information;
- the indicator of coarse scale of estimation of LRKT (A12) – allows to enter the list of identifiers and threshold values of the interval scale of estimation, which characterize the quantity of valid answers for the displaying of the next estimation of LRKT;
- the indicator of the exact scale of estimation of LRKT (A13) – allows to enter the list of identifiers and threshold values of the interval scale of estimation, which characterize the sum of the scored points for the valid variants of answers on the questions for the displaying of the next estimation of LRKT of the examinee in the mode of diagnostics;
- the indicator of group (A14) – allows to enter the list of groups of users;
- the indicator of users (A15) – realizes the input of the list of users by groups;
- the indicator of the status of examinee (A16) – for the selected examinee shows the nominal values of the quantity of valid and incorrect answers, LRKT on a coarse scale based on the sum of valid answers, the sum of scored points for all valid variants of answer, the estimations of LRKT on an exact scale based on the sum of scored points, the sum of penalty points for all incorrect variants of answer.

The program realization of the mode of diagnostics of the basic diagnostic module

In the pic. 5 presents the window of interface of the basic DM in the mode of diagnostics of LRKT.



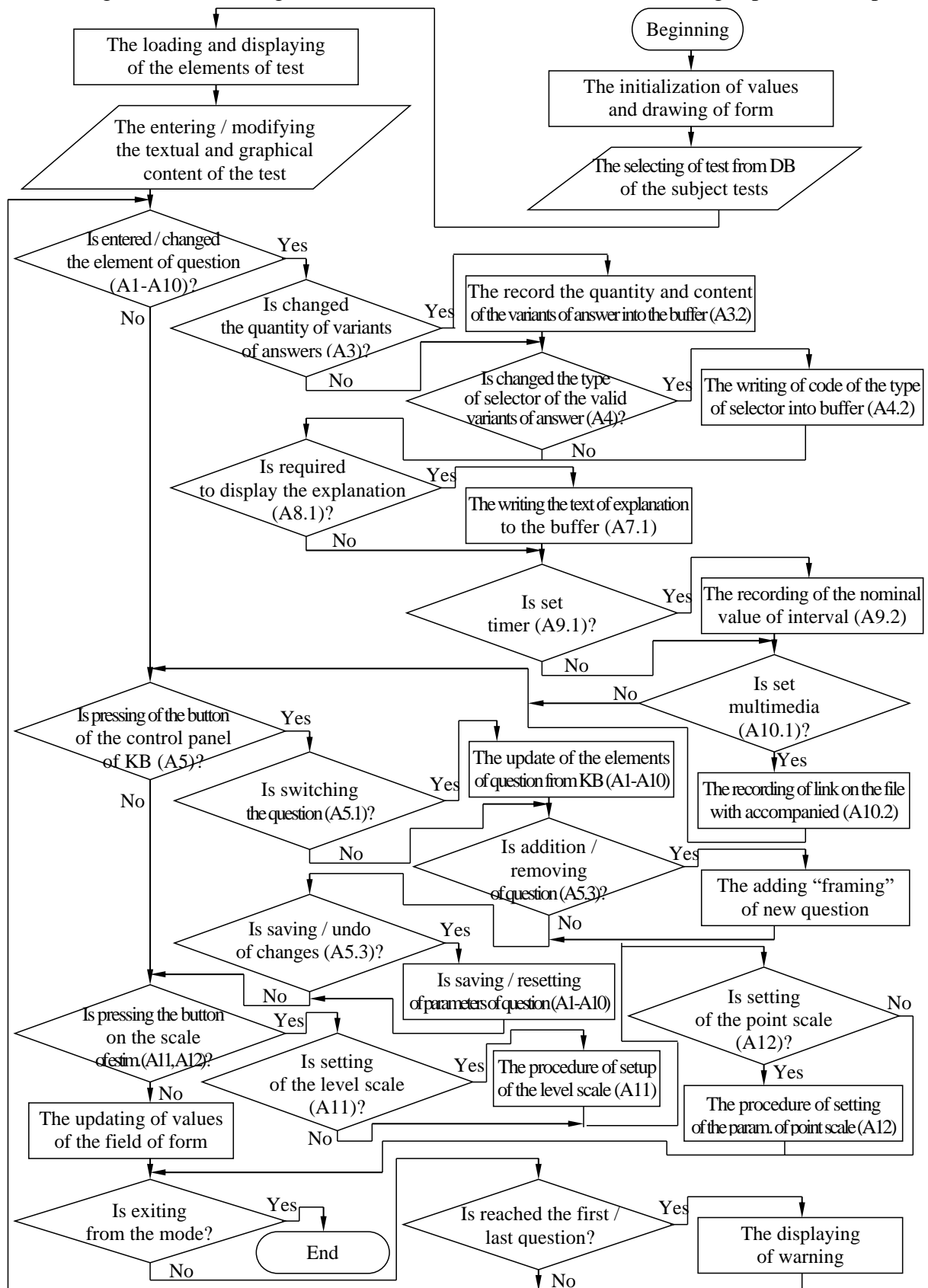
Pic. 5. The interface of the basic diagnostic module in the mode of diagnostics

In the mode of diagnostics the examinee is given the possibility of viewing the parameters of question and the variants of answer of each task of the test of LRKT in a certain subject of studying by means of using a row of elements of interface: the formulation of the question in the view of text (T1); the marker of the sign of correctness of the variants of answer and their formulation in the view of text (T2); the procedure of checking of the correctness of answer on the question (T3); the formulation of the explanation in the view of text on the incorrect answer on the question (T4); the status of user (T5), which includes the code of group and L.F.P. of the examinee, the quantity of valid and incorrect answers on the questions, the sum of scored points and the sum of penalty points, LRKT on a rough scale the based on the quantity of valid answers for each valid answer on the questions, the estimation of LRKT on a exact scale based on the sum of scored points for each valid variant of answer on the questions, the nominal value of the interval of time of the allotted and remaining on the answer to the question.

The results of diagnostics of LRKT in the form of testing by means of the basic DM are stored in the real scale of time into the database with a posteriori data.

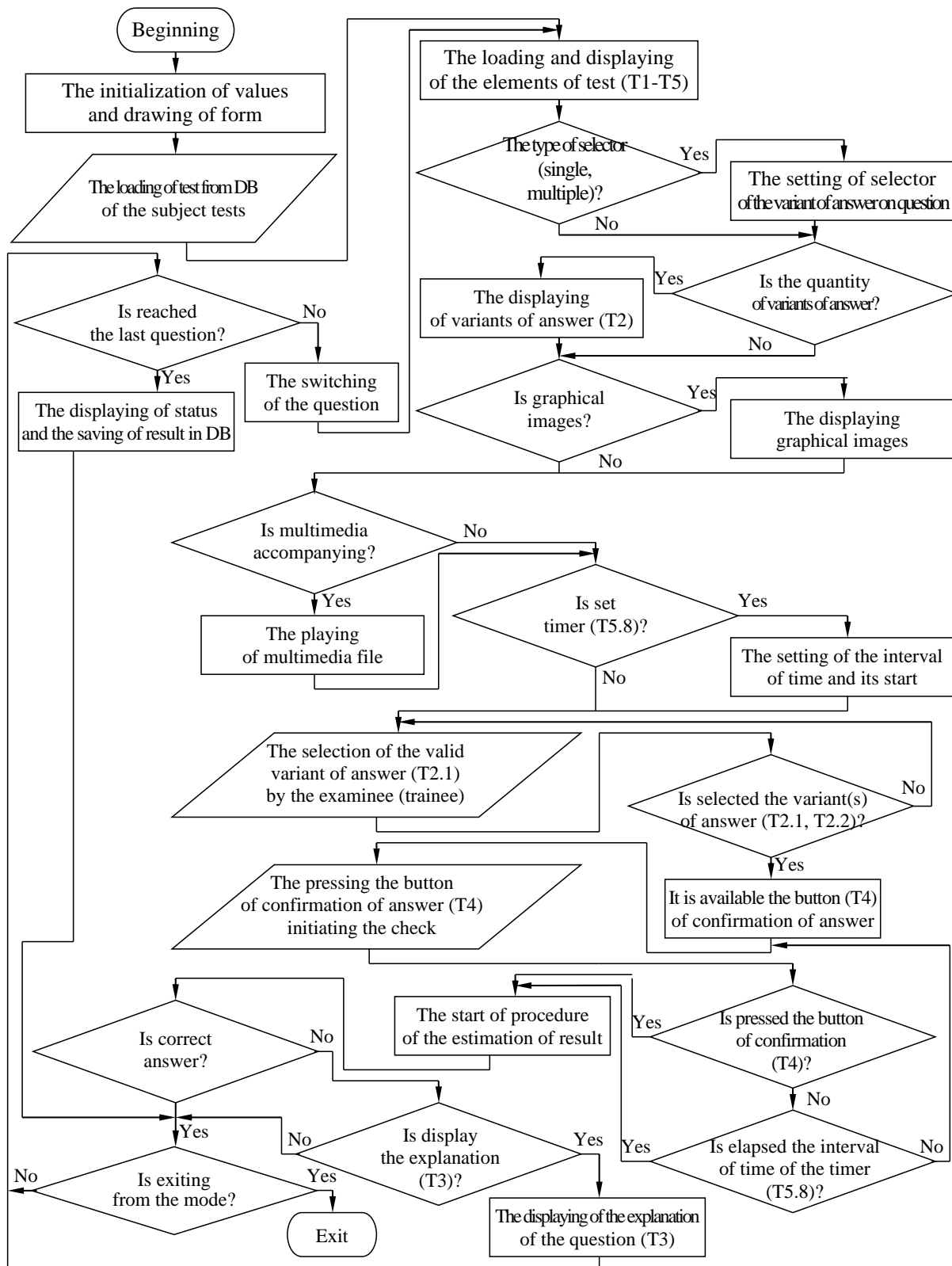
The algorithms of support of functioning of the basic diagnostic module

The algorithm of working of the basic DM in the mode of administrating is presented in pic. 6.



Pic. 6. The algorithm of functioning of the basic diagnostic module in the mode administrating

In pic. 7 presents the algorithm of working of the basic DM in the mode of diagnostics of LRKT by means of using two scales: the coarse – based on the quantity of valid answers on the questions; the exact – based on the sum of scored points for the valid variants of answer on the questions.



Pic. 7. The algorithm of functioning of the basic diagnostic module in the mode of diagnostics

The conclusions, the results of practical use and processing of a posteriori data

1. The automation of IEE is realized by means of the creation, introduction and use of hardware, software and algorithmic software, allowing the significantly to increase in the efficiency of production and non-production activity of specialists in the various spheres based on the innovations in the area of information technologies.
2. There is a loss of actuality of the traditional approaches, methods and technologies, that causes the emergence of the adaptive and individually-oriented environments and means.
3. Since 2003 y. in the result of many-years of scientific-research work and writing of the dissertation the author managed to develop the complex of programs for the automation of the tasks of research of IEE and the increase in the efficiency of ATS with the properties of adaptation based on the parametrical CM block, which includes: ET, the basic and applied DM.
4. The use of the block-modular principle in the complex of programs was approved for the providing of modernization by means of replacing of the various program modules, adding of new and removing outdated procedures of supporting of the diagnostics of parameters of CM.
5. The fact of the successful practical use of the previously developed electronic textbook based on the adaptive representation of information fragments processor and the basic DM, providing the testing of LRKT by means of tests was noted.
6. The technical description of DM for the various categories of users has been developed.
7. The databases of the basic and applied DM for the realization of testing are formed.
8. The practical use of the previously obtained scientific theoretical and practical results has been made in the learning process of “The international banking institute” since 2004 y. and “The Saint-Petersburg state electrotechnical university "LETI"” since 2003 y. according to the received acts about the practical use.
9. In 2006-2007 y. three copyright certificates for the two personal monographies and the dissertation (completed in 2006 y.) were received, in 2008 y. the author's certificate on the learning edition on the rights of textbook in the discipline “Informatics” for the students of first-year [12] was received.
10. The estimation of efficiency of the automated training system with the properties of adaptation based on the parametrical CM block was carried out using the generally-accepted indicators of efficiency (resultativity) of the technological process of automated formation of knowledge: $\mathbf{K} = \{k_1; k_2; k_3\} = \left\{ Y_2 - Y_1; \frac{Y_2}{Y_1}; \frac{Y_2 - Y_1}{Y_1} 100\% \right\}$, where the coefficients k_1 , k_2 , k_3 respectively denote the absolute, comparative and relative indicators of efficiency (resultativity) of the formation of knowledge of the trainees [12, 13], and the results of statistical processing of a posteriori data of a series of experiments are summarized in tabl. 1.

Table 1

The results of the primary statistical analysis of the resultativity of training

The indicator	The number of the group of trainee							
	1	2	3	4	5	6	7	8
The indicators of the resultativity of training for 2004 y.								
Size of sample	20	21	25	18	18	15	0	0
Average score Y_1	4,05	4,286	4,24	4,611	4,056	4,4	-	-
AQD of av. point	0,686	0,845	0,779	0,502	0,802	0,507	-	-
The indicators of the resultativity of training for 2005 y.								
Size of sample	24	22	24	25	24	22	23	21
Average score Y_2	4,333	4,046	4,375	4,16	4,042	4,091	4,696	4
AQD of av. point	0,817	0,785	0,824	0,8	0,859	0,811	0,559	0,894
The indicators of the resultativity of training for 2006 y. (with use of CMT in 3 groups)								
Size of sample	26	23	29	24	25	22	22	22
Average score Y_3	4,5	4,609	4,379	3,708	3,92	3,773	4,455	3,818
AQD of av. point	0,707	0,656	0,775	0,751	0,572	0,612	0,858	0,853
The results of the primary statistical analysis								
The indicators, reflecting the change of efficiency of training for 2004-2005 y.								
k_1	0,283	-0,240	0,135	-0,451	-0,014	-0,309	-	-
k_2	1,07	0,944	1,032	0,902	0,997	0,93	-	-
$k_3, \%$	6,996	-5,606	3,184	-9,781	-0,345	-7,023	-	-
Change of AQD	0,131	-0,06	0,045	0,298	0,057	0,304		
The indicators, reflecting the change of efficiency of training for 2005-2006 y.								
k_1	0,167	0,563	0,004	-0,452	-0,122	-0,318	-0,241	-0,182
k_2	1,039	1,139	1,001	0,891	0,97	0,922	0,949	0,955
$k_3, \%$	3,854	13,915	0,091	-	-3,018	-7,773	-5,132	-4,55
Change of AQD	-0,11	-0,129	-0,049	-0,049	-0,287	-0,199	0,299	-0,041

11. The primary statistical analysis of samples with a posteriori data did not reveal significant heterogeneities in the view of emissions and artifacts, the compliance with the normal law of distribution of characteristic values analytically and graphically is determined.

12. The application of the correlation and dispersion analysis did not reflect significant and interesting scientifically-reasonable tendencies, dependencies and regularities.

13. In the result of the performed regression analysis of a posteriori data the obtained values of the coefficient of multiple correlation ($CMC = 0.558$) and the coefficient of multiple determination ($CMD = 0.312$) indicate, that 31.2% of the dispersion

of the dependent variable \hat{Y}_i (the estimation of LRKT) is determined by the variation of the values of the coefficients (predictors) K_i , located in the obtained linear regression model $\hat{Y}(K_i)$.

The values of the initial (β) and standardized coefficients (β') of the linear regression model $\hat{Y}(K_i)$ are presented in tabl. 2-3. The constant is 4.653.

Table 2

The values of initial β and standardized coefficients β'

The predictor	Vozr	K_7	K_8	K_9	K_{14}	K_{15}	K_{16}	K_{17}	K_{18}	K_{19}
Value of initial β - coefficient	-0,006	-0,002	-0,156	0,121	0,064	-0,029	0,006	-0,074	0,025	-0,009
Standardized β - coefficient	-0,017	-0,010	-0,714	0,611	0,247	-0,104	0,034	-0,262	0,159	-0,052

Table 3

The values of initial β and standardized coefficients β' (continue)

The predictor	K_{20}	K_{21}	K_{22}	K_{23}	K_{24}	K_{25}	K_{27}	K_{28}	K_{29}	K_{45}
Value of initial β - coefficient	-0,026	0,001	0,035	0,013	0,009	-0,008	-0,111	-0,008	0,032	0,022
Standardized β - coefficient	-0,147	0,002	0,182	0,052	0,052	-0,113	-0,226	-0,018	0,172	0,037

The factor (the dependent variable) acts directly the resultativity of the formation of knowledge of the contingent of trainees Y , and the predictors in the obtained linear multiple regression model are: Vozr – age, K_7 – protanopia, K_8 – deuteranopia, K_9 – tritanopia, K_{14} – verbal intelligence, K_{15} – generalization, K_{16} – classification, K_{17} – analyticity, K_{18} – arithmetic counting, K_{19} – combinatorics, K_{20} – mnemonic and memory, K_{21} – planar mouse, K_{22} – volumetric imagination, K_{23} – verbal associativity, K_{24} – verbal originality, K_{25} – verbal selectivity, K_{27} – figurative associativity, K_{28} – figurative originality, K_{29} – figurative selectivity, K_{45} – the level of proficiency in the language of statement.

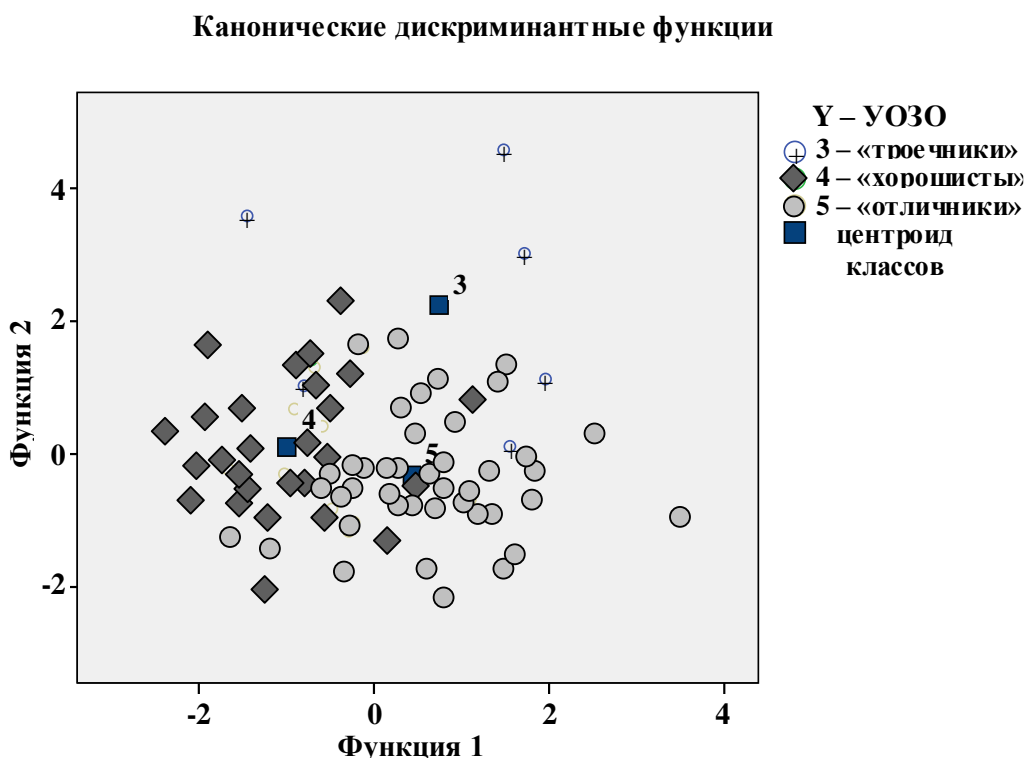
Then the equation of multiple regression takes the view:

$$Y = 4,653 - 0,006VOZR - 0,002K_7 - 0,156K_8 + 0,121K_9 + 0,064K_{14} - 0,029K_{15} + 0,006K_{16} - 0,074K_{17} + 0,025K_{18} - 0,009K_{19} - 0,026K_{20} + 0,001K_{21} + 0,035K_{22} + 0,013K_{23} + 0,009K_{24} - 0,008K_{25} - 0,111K_{27} - 0,008K_{28} + 0,032K_{29} + 0,022K_{45}$$

14. CMT allows to realize the additional contour of adaptation based on the parametrical CM block, and also quickly conducting the complex system analysis of IEE, directed on the increasing of efficiency of the information interaction between the subjects and means of training, the increasing of resultativity of the technological process of the formation of knowledge of the trainees in the process of functioning of ART system.

15. In the course of discriminant analysis the several groups of trainees were allocated in dependence from the dynamics of value of the indicator of the resultativity of training (the estimation of LRKT): “5” – the group of excellent-students; “4” – the group of good-students; “3” – the group of mediocre-students.

Pic. 8 represents the geometrical interpretation of the mutual relative arrangement of the centroids of classes, corresponding to the selected groups of trainees in the given space of coordinates of the two canonical discriminant functions.



Pic. 8. The centroids of three classes of trainees in the space of two canonical functions

The informativity of the both presented canonical discriminant functions is approximately the identical, and their resolution is significantly differentiated in relation to the given centroids of the classes: the first canonical discriminant function allows to distinguish the centroids of the classes mediocre-students and good-students relative to the centroid of the class excellent-students, but poorly distinguishes between the centroids of the classes mediocre-students and good-students classes; the second canonical discriminant function allows to distinguish the centroids of the classes of good-students and excellent-students relative to the centroid of the class of mediocre-students, but relatively poorly distinguishes between the centroids of the classes of good-students and excellent-students.

The complex of programs allows to realize the automation of the tasks of research and the system analysis of IEE for the intensification of information interaction between the subjects and means of training, and also to significantly increase in the efficiency of functioning of ATS with the properties of adaptation based on the parametrical CM block.

The literature

1. Vetrov A.N. The factors of success in the educational activity of modern HEI: The tendencies of development of the information environment of remote education / A.N. Vetrov, N.A. Vetrov; the coll. monography edited by the member-corr. of IHEAS I.N. Zakharov. – SPb.: IBI, 2004. – P.54-65 (148 p.).
2. Vetrov A.N. The factors of success in the educational activity of modern HEI: The cognitive model for the adaptive systems of remote training / A.N. Vetrov, E.E. Kotova; the coll. monography edited by the member-corr. of IHEAS I.N. Zakharov. – SPb.: IBI, 2004. – P.65-78 (148 p.).
3. Vetrov A.N. The features of the information environment structure of the adaptive RT systems / A.N. Vetrov, N.A. Vetrov // “Actual problems of economics and new technologies of teaching”: the materials of the IVth intern. sci.-pract. conf., S.-Petersburg city, the 15th-16th of March 2005 y. – SPb.: IBI, 2005. – P.45-46.
4. Vetrov A.N. The information environment of the automated training based on the cognitive models / A.N. Vetrov, E.E. Kotova, N.N. Kuzmin // The proceedings of IHEAS, №3(37). – M.: IHEAS, 2006. – 18 p.
5. Vetrov A.N. The environment of automated training with the properties of adaptation based on the cognitive models: Monography. – M.: Dep. in RAS. – 2007. – 256 p.
6. Vetrov A.N. The program complex for the research of the adaptive information-educational environment based on the cognitive models / A.N. Vetrov // “Modern education: contents, technologies, quality”: the materials of the XIIIth intern. sci.-pract. conf., S.-Petersburg city, the 19th of April 2007 y. – SPb.: SPbSETU, 2007. – P.142-144.
7. Vetrov A.N. The adaptive means of training in the automated educational environment based on the parametrical cognitive models block / A.N. Vetrov // “Quality management in modern High school (HEI)”: the materials of the Vth intern. sci.-method. conf., S.-Petersburg city, the 21st-22nd of June 2007 y. – SPb.: IBI, 2007. – P.110-113.
8. Vetrov A.N. The techniques and algorithms in the basis of the cognitive modeling technology / A.N. Vetrov // “Quality management in modern High school (HEI)”: the materials of the Vth intern. sci.-method. conf., S.-Petersburg city, the 21st-22nd of June 2007 y. – SPb.: IBI, 2007. -- P.86-89.
9. Vetrov A.N. The realization of the adaptive training in the automated educational environment based on the cognitive models / A.N. Vetrov // The proceedings of SPbSETU "LETI," Ed.1, 2007. – 9 p.
10. Vetrov A.N. The electronic textbook based on the adaptive representation of information fragments processor in the automated educational environment. – M.: Mechanical-engineering, VKIT №11, 2008. Dep. in VINITI of RAS. – 2008. – 15 p.
11. Vetrov A.N. The cognitive modeling technology in the automated educational environment. – M.: The bulletin of RUDN №4, 2008. Dep. in VINITI of RAS. – 2008. – 15 p.
12. Vetrov A.N. The report on SRW “The research of the environment of automated training with the properties of adaptation based on the cognitive models” for 2003-2005 year, conducted in the process of writing of the dissertation, SPb., 2006. – 300 p.

**ОСНОВНОЙ ДИАГНОСТИЧЕСКИЙ МОДУЛЬ В СИСТЕМЕ
АВТОМАТИЗИРОВАННОГО ОБУЧЕНИЯ СО СВОЙСТВАМИ АДАПТАЦИИ
НА ОСНОВЕ БЛОКА ПАРАМЕТРИЧЕСКИХ КОГНИТИВНЫХ МОДЕЛЕЙ**

А.Н. Ветров

г. Санкт-Петербург

Основной диагностический модуль реализует автоматизацию диагностики уровня остаточных знаний контингента обучаемых посредством использования сформированного набора тестов по разным предметам изучения, которые содержатся в базе данных

Информационно-образовательная среда, система автоматизированного обучения, диагностический модуль, технология когнитивного моделирования, когнитивная модель, конфигурируемая функция оценивания, интервальная шкала оценки