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THE APPLIED DIAGNOSTIC MODULE FOR THE DIAGNOSTICS OF PARAMETERS

OF THE COGNITIVE MODEL OF THE SUBJECT OF TRAINING

IN THE ADAPTIVE ENVIRONMENT

A.N. Vetrov

Saint-Petersburg city

The applied diagnostic module acts as the component of the automated training system with the properties of adaptation based the parametrical cognitive models, is intended for the automation of the process of research of the physiological, psychological and linguistic parameters at the basis of the cognitive model of the subject of training with the purpose of realization of the adaptive generation of educational influences by means of the use of the different means of training of a new generation, which allow taking into account the individual features of the trainees

The information-educational environment, the cognitive model,

the cognitive modeling technology, the applied diagnostic module

The introduction and setting of scientific task

The high rates of scientific-technical progress and the level of introduction of the innovations in the area of the information technologies initiates the solution of the private problems of informatization of the information-educational environments (IEE) of the modern educational centres and establishments [1, 5].

The creation, system analysis and improving in the efficiency of functioning of the components of IEE acts as the complex scientific-technical problem, as now new technologies of the supporting of the process of individually-oriented and the adaptive formation of knowledge of the trainees in the automated educational environments based on the means of training at distance are actively used, that initiates the need of taking into account of the applied scientific bases of cognitive informatics (R. Solso), private physiology of analyzers (V.M. Krol, Ch.A. Izmailov), cognitive psychology (V.N. Druzhinin) and applied linguistics (M.L. Gik) for the further scientific justification of revealed dependencies, regularities and relations.

For the system analysis and research of IEE the author proposes the developed structure of the automated training system (ATS) with the properties of adaptation based on the cognitive models (CM) [3, 4, 10], the cognitive modeling technology (CMT) [6, 9, 12], and also the parametrical CM block [2, 3, 6] as the information basis for the staging and conducting of the system analysis.

The formal description of the structure of the automated training system

with the properties of adaptation based on the cognitive models

In general view the structure proposed by the author of ATS with the properties of adaptation based on CM is formalized by means of using of the apparatus of classical theory of control (pic. 1).
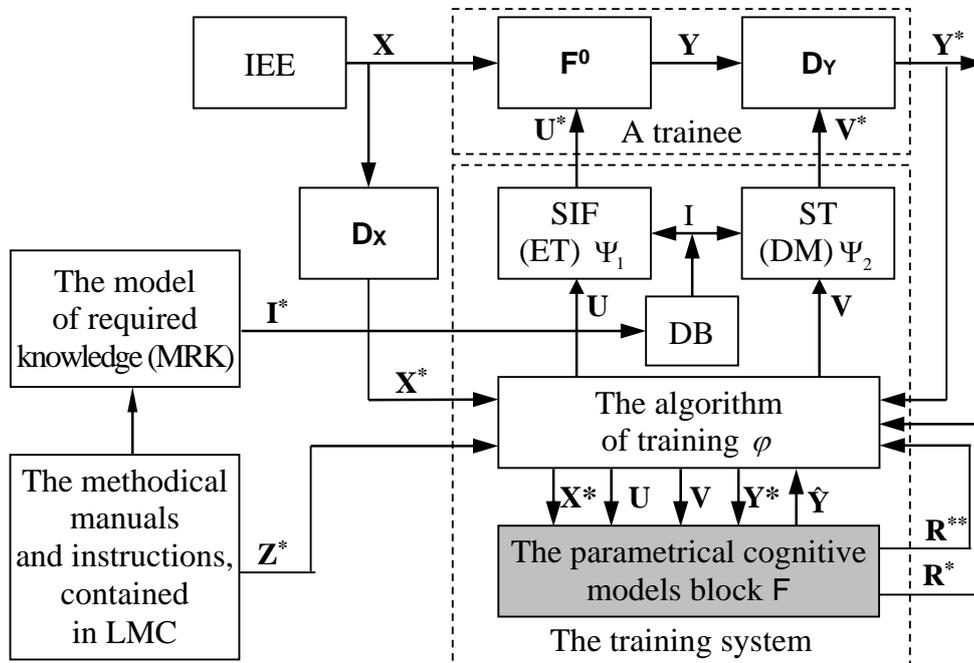
Pic. 1. The structural scheme of the automated training system

with the properties of adaptation based on the cognitive models

The presented on the scheme ATS with the properties of adaptation based on the parametrical CM block functions as the main integral component of classical or automated IEE and at the same time is structurally decompressed on the several diverse elements:

- the training system – realizes the generation of a sequence of educational influences: the information fragments, the questions of tests and the tasks of the techniques of research;

- the trainee – examines the content of information fragments and answers on the questions.

The training system realizes the generation of an ordered sequence of the information-educational influences, which reflect the content of the subject of training, at the same time the level of other influences of IEE is supposed to be negligible small for the purposes of certainty.

The trainee is characterized by a certain modifiable set of the individual physiological, psychological, linguistic and other features of personality of the subject of training (IFPST), which are contained directly in the basis of CM of the subject of training.

The proposed structural scheme of ATS with the block of CM uses a row of designations:

- the polynomial model of trainee ($\mathbf{F^0}$) – includes a set of various parameters and values of weight coefficients, which characterize a certain trainee in the environment;

- the sensor $\mathbf{Dx}$ – provides direct measurement of the level of influence of IEE;

- the sensor $\mathbf{Dy}$ – measures the estimation of resultativity of the formation of knowledge of the trainee;

- the methodical manuals – contain the instructions on the use of LMC with a structured set of information fragments, reflecting the content of the section, module, paragraph, page, each from which contains the blocks of different control questions;

- the database (DB) – contains the structured information, expressed in the data on relation to the subject area for a subsequent displaying to the final trainee;

- the model of required knowledge (MRK) – reflects the requirements of institutional bodies, regulating the politics in the sphere of education and consumers, tasks and purposes of training, the structured material on a certain or several subjects of studying;

- the algorithm of training (φ) – forms a sequence of the return values, containing links to training influences in DB and parameters their displaying ($\mathbf{U}$) by means of using (the developed by the author) of the adaptive representation of information fragments processor [6, 10], and also a sequence of the return values of links on the blocks of control questions ($\mathbf{V}$) corresponding to the different elements of the subject of learning;

- the shaper of information fragments (SIF) $\mathbf{\Psi_1}$ – realizes the individually-oriented generation of a sequence of training influences ($\mathbf{U^*}$) taking into account the links on the information fragment ($\mathbf{U_i}$) and the parameters of parametrical CM block ($\mathbf{R^*}$, $\mathbf{R^{**}}$);

- the shaper of test tasks (ST) $\mathbf{\Psi_2}$ – realizes the generation of a sequence of tasks from the database with the methods of research and the displaying of a sequence of the question-answers structures of test tasks ($\mathbf{V^*}$) taking into account links on the information fragments ($\mathbf{V_i}$);

- the parametrical CM block ($\mathbf{F}$) – contains a set of values of the repertoire of parameters of CM of the subject of training ($\mathbf{R^*}$) and CM of the means of training ($\mathbf{R^{**}}$), which characterize respectively IFPST and the potential technical capabilities of the means of training at the generating of a sequence of information fragments by the means of training.

The main technical means of generating of the information fragments and the measuring the condition of trainees in ATS with the properties of adaptation based on the parametrical CM are acting:

- the adaptive electronic textbook [3, 6-8, 10, 11] -- realizes the individual-oriented generation of an ordered sequence of diverse educational influences by means of the using of the adaptive representation of information fragments processor, functioning on the basis of the parametrical CM block, which includes CM of two main types: CM of the subject of training and CM of the means of training;

- the main diagnostic module (DM) [3, 6, 7, 10] – realizes the automation of the process of testing of the level of residual knowledge of the contingent of trainees by means of using of a previously formed set of tests in the various subject areas;

- the applied DM [3, 6, 7, 10] – provides the automation of the process of diagnostics of the individual physiological, psychological, linguistic and other features of the contingent of trainees in the form of testing on the basis of a previously formed set of the applied methods of research, contained in the database and information storage;

- the parametrical CM block [2, 3, 6, 10, 12] – realizes the additional contour of adaptation, allows taking into account a row of the individual features of the contingent of trainees, acts as the information basis for the conducting of the complex system analysis of the information environment of ATS with the properties of adaptation based on the parametrical CM, includes:

  - CM of the training subject – aggregates a set of parameters, reflecting the individual features of perception, processing and understanding of content of a sequence of information fragments, stated in a certain language of statement;

  - CM of the means of training – accumulates a set of parameters, characterizing the potential technical capabilities of a certain means of training (the adaptive electronic textbook) at the generating of diverse of the information fragments by the various ways, which correspond to a module, a section, a paragraph and reflect the previously structured content of several subject areas.

The presented components of ATS with the properties of adaptation based on CM are programmatically realized by means of using of the integrated RAD (Rapid Application Development) environment of object-oriented programming Borland C++ Builder in the language of high-level C++.

The preliminary, organizational, technological, technical, methodical,

operational and scientific-research preparation of diagnostics

The procedure of diagnostics of the individual features of the contingent of trainees by means of use of the applied DM acts as the complex scientific-technical process, which includes a set of various iterations and requires the certain preparation (pic. 2).

The application of the source of information (expert and book)	The structuring of data and the highlighting of sections, subsections and paragraphs	The structuring of data on a set of information fragments	The introduction to the compliance to the block of information of the block of control questions

The preliminary preparation of the automated testing of individual features

The preparation of the computing centre and classes	The deployment of hardware and software	The installation of software of the warehouse of data	The installation of programs of the diagnostic module

The organizational preparation of the automated testing of individual features

The formation of the actual set of the parameters of CM	The allocation of a sequence of the stages (gaps) of research	The selection of the methods of research for the diagnostics of a set of parameters	The preparation of cards for the registration of a posteriori data

The technological preparation of the automated testing of individual features

The selection of available procedures for the realization of diagnostics	The automation of new procedures for the research of new parameters	The integration of all selected procedures of diagnostics into the program	The debugging of the applied diagnostic module

The technical preparation of the automated testing of individual features

The collection of details about the applied diagnostic module	The selection of the purposes, tasks and functions of each from procedures of diagnostics	The development of technical description for the personnel	The development of methodical support for the subject specialists

The methodical preparation of the automated testing of individual features

The short brief before the carrying out of diagnostics	The giving of cards for the registration of the nominal values of indicators	The tracking of stages of the cycle of automated testing	The automated and manual registration into the database and on the cards

The operational preparation of the automated testing of individual features

The formation of samples based on a posteriori data	The analytical and graphical correspondence of the normality of distribution	The selection of methods for the mathematical processing	The interpretation of dependencies received based on the statistical methods

The scientific-research preparation of the automated testing of individual features
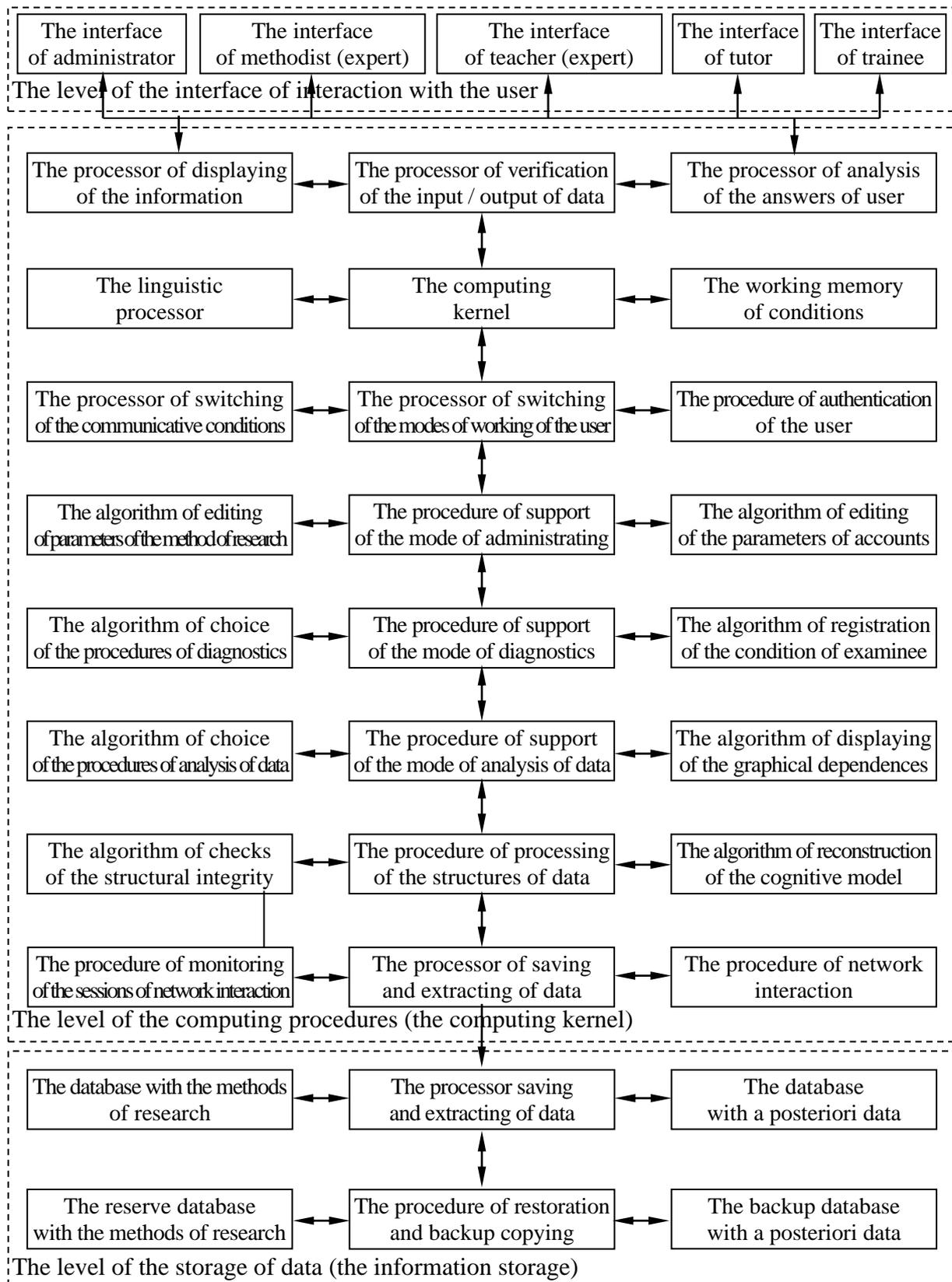
Pic. 2. The classification of preparatory actions

before the studying of individual features of the contingent of trainees

The features of the structure of the applied diagnostic module for the automation

of research of the individual features of the contingent of trainees

The applied DM is intended for the realization of automation of the process of research of the individual features of personality of the contingent of trainees, is made by the block-modular principle, at the same time each its component is located at a certain level of the proposed architecture and realizes a row of functions and a set of tasks in the period of execution of its program realization:

- the level of the interface of interaction with the user – includes the several different interfaces of interaction for the working of the several categories of users in the program, prevails the declarative basis of functioning at the considering of the dynamic forms;
    - the interface of administrator – provides the capability of viewing and editing the parameters of all methods of research, the accounts of users and a posteriori data of research of IFPST study by the administrator and available experts;
    - the interface of methodist – realizes the possibility of viewing of the values of parameters of the cognitive model of the subject of training for the substantiation of all reasons of difficulties of the information exchange in the process of the formation of knowledge of the certain trainees;
    - the interface of instructor – provides the possibility of modification of the parameters of the method of research in the form of test and allows to change the parameters of displaying of a sequence of question-answers structures for the realization of a subsequent testing;
    - the interface of tutor – realizes the possibility of working of an assistant of teacher;
    - the interface of trainee – provides the possibility of passing of the diagnostics of IFPST;
- the level of computing kernel – contains in its basis the several various processors and procedures, which provide to the user the performing of a row of functions and tasks, in this case the procedural basis of functioning is predominant, directed on the realization of extracting, saving and processing of information, contained in the database with the parameters of the method of research, a posteriori data and the accounts of users;
- the level of data storage – provides the saving of diverse information, expressed in data, related to the methods of research and the accounts of users, provides the backing up and recovering of the actual and damaged information.

The hierarchical branched three-level architecture of the applied DM is presented on pic. 3 and includes a set various components, located on the several levels.

The interface of administrator	The interface of methodist (expert)	The interface of teacher (expert)	The interface of tutor	The interface of trainee

The level of the interface of interaction with the user

The processor of displaying of the information	The processor of verification of the input / output of data	The processor of analysis of the answers of user
The linguistic processor	The computing kernel	The working memory of conditions
The processor of switching of the communicative conditions	The processor of switching of the modes of working of the user	The procedure of authentication of the user
The algorithm of editing of parameters of the method of research	The procedure of support of the mode of administrating	The algorithm of editing of the parameters of accounts
The algorithm of choice of the procedures of diagnostics	The procedure of support of the mode of diagnostics	The algorithm of registration of the condition of examinee
The algorithm of choice of the procedures of analysis of data	The procedure of support of the mode of analysis of data	The algorithm of displaying of the graphical dependences
The algorithm of checks of the structural integrity	The procedure of processing of the structures of data	The algorithm of reconstruction of the cognitive model
The procedure of monitoring of the sessions of network interaction	The processor of saving and extracting of data	The procedure of network interaction

The level of the computing procedures (the computing kernel)

The database with the methods of research	The processor saving and extracting of data	The database with a posteriori data
The reserve database with the methods of research	The procedure of restoration and backup copying	The backup database with a posteriori data

The level of the storage of data (the information storage)

Pic. 3. The general architecture of the applied diagnostic module

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The architecture of the applied DM includes the several special procedures and algorithms:

- the processor of displaying of information – provides the direct displaying of preset parameters of the question-answers structures of test tasks for the realization of control testing (the developed adaptive representation of a sequence of information fragments processor is used in the electronic textbook);

  o the procedure of processing and displaying of the parameters of question – allows to realize the displaying of a sequence of question-answers structures of the method of research according to the predetermined parameters of the algorithm of testing in the mode of administrating;

    ▪ the algorithm of displaying of the number of question by order and the total quantity of questions;

    ▪ the algorithm of displaying of the textual content of the question and the variants of answer;

    ▪ the algorithm of displaying the graphical content of the question and the variants of answers;

    ▪ the algorithm of playback of multimedia accompaniment at the displaying of question;

    ▪ the algorithm of limiting of the interval of time of the displaying of each from the questions;

    ▪ the algorithm of displaying of the parameters of the status of the examinee – realizes the displaying of a set of parameters, characterizing IFPST and LRKT in the process of testing using the formed set of the methods of research and tests;

  o the procedure of activation of the subsystem of explanation – displays the different comments;

    ▪ the algorithm of displaying of the explanations directly before the execution of the block of question linked with the section – provides the displaying of a short instruction to the examinee before each block of homogeneous questions for the correct generation of an answer (the link between the blocks of control questions, explanations and information fragments is given by the semantic model of saving and extracting information in the basis of the architecture of the adaptive electronic textbook [3, 6, 8]);

    ▪ the algorithm of displaying of the explanations in the status bar of the interface window – provides the displaying of short messages in the status bar of the window of program;

    ▪ the algorithm of analysis of the answers of user and the activation of the subsystem of explanation – realizes the analysis of the correctness of the variants of answer of the examinee and initiates the displaying of a certain explanation to the question in case of the incorrect answer;

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o the procedure of calculating of the status of examinee – provides the calculation of a set of nominal values of a set of indicators, characterizing the physiological, psychological, linguistic and other individual features of the personality of the contingent of examinees, which act as the various parameters of CM of the subject of training [3];

- the algorithm of analysis and comparation of the list of the variants of answer of the user and reference answers – realizes the comparison of the variants of answer of the user with the valid variants of answer of the expert on each from the questions of the method of research;

- the algorithm of calculating and displaying of the sum of valid answers of the examinee on the questions of test – realizes the calculation of the sum of valid answers of the examinee on a sequence of questions, which entering into the basis of the method of research or test;

- the algorithm of calculating and displaying of the sum of scored points for each valid variant of answer on the question of test – provides the counting of the sum of scored points for each (selected by the examinee) valid answer on the question in the test;

- the algorithm of selection and accounting of the function of estimation and scale of estimation of the examinee – provides the connection of a certain function of estimation and scale of estimation;

- the algorithm of coarse estimation based on the sum of valid answers on the questions – realizes the calculation of nominal values of indicators in the context of the used method of research and the nominal of estimation of the level of residual knowledge of the contingent of trainees based on the quantity of valid answers on the list of questions of the test;

- the algorithm of exact estimation on the basis of the sum of scored points for each valid variant of answer on the question – provides the calculation of nominal values of a set of indicators in the context of the used method of research and the nominal of estimation of the level of residual knowledge of the contingent of trainees based on the different preset weights coefficients for each from the variants of answer of the task;

- the algorithm for storing and displaying nominal values of a set of indicators as the result of diagnostics – realizes the formation and saving of the parameters of status of the user in the database with a posteriori results of testing of IFPST and LRKT according to the used method of research or test;

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- the processor of verification of input / output of data – realizes the control of the flow of input and output of the structured data between the computational procedures and information fields, which are located on the different forms of interface of the applied DM;
  - the algorithm of checking of the correctness of the structure of the input and output flow data – the comparison of data with the received masks of input of the information in the basis of the applied DM;
  - the algorithm of checking of the structural integrity of data – realizes the checking of correctness of the used and transmitted elements of the structures of data between the components of the architecture of the applied DM in the course of working of the users in the various modes;
- the computational kernel – realizes the centralized control of the input and output flows of information, provides the processing of the structures of data in the mode of administrating, diagnostics and analysis of a posteriori data, supports the network interaction;
- the processor of analysis of the answers of user – realizes the verification of preset variants of answer of the expert with the selected or entered variants of answer of the examinee in the different information fields of the form of interface of the program in the mode of diagnostics;
  - the procedure of processing and displaying of the parameters of question – in the mode of diagnostics realizes the displaying of a given sequence of control questions taking into account the previously preset parameters of the algorithm of testing in the mode of administrating;
    - the algorithm of displaying of the textual content of question – realizes the selection, loading and conclusion to the examinee of the formulation of a certain question in the structure of the test;
    - the algorithm of displaying of the graphical content of question – provides the loading of graphical image, which accompanies a specific question of the test;
    - the algorithm of displaying of the multimedia accompaniment of question – realizes the playback of the audio and video-streams, recorded in the various files to the examinee;
    - the algorithm of accounting of the interval of time of the displaying of question – allows to account the nominal value of the interval of time of the displaying of certain question;
  - the procedure of processing and displaying of parameters of the variants of answer to the question – in the mode of diagnostics realizes the direct displaying of the list of the variants of answer on each question of the test taking into account the previously determined parameters in the mode of administrating;

- the algorithm of editing of the textual content of the variant of answer – allows to change the text, which acts as the formulation of the variants of answer on the question;

- the algorithm of editing of the graphical content of the variants of answer – realizes the installation of graphic images to all variants of answer on each question;

- the algorithm of modifying of the type of selector, the function of estimation and the scale of estimation – allows the user to specify the type of selector of the variants of answer on the question (the only valid variant of answer from the several proposed or the several valid variants of answer from a row of proposed), and also to set the quantity of points scored for each valid variant of answer on the question, chosen by the examinee or to set the threshold values on the intervals of the scale of estimation for the allocation of the sum of scored points to the corresponding nominal value of the estimation of the level of residual knowledge of the examinee at the performance of test (in the context of the method of research);

- the algorithm of setting and editing of the nominals of weight coefficients – allows to set the nominal values of weight coefficients for a subsequent calculation of the indicators of test, the sum of scored points and the sum of penalty points;

o the procedure of processing of the events, initiated by the user on the panel of navigation – realizes the processing of presses on the buttons of control at the working of user in the mode of administrating of the parameters of the method of research and in the mode of diagnostics;

- the algorithm of switching to the first, previous, next or last question – realizes the unconditional transition to the first, previous, next or last (displayed to the administrator) question from the database of the applied DM;

- the algorithm of saving of the parameters of question and canceling of the made modifications – realizes the saving of parameters of the question into the database of the applied DM and provides the cancellation of the made changes in all information fields of the interface;

- the algorithm of checking of the compliance of data in the information fields to the input mask – realizes the checking of correctness of the structures of data, entered by the user;

- the algorithm of displaying of the explanations of appointment of the functional keys – realizes the displaying of certain pop-up hints about the appointment of different keys;
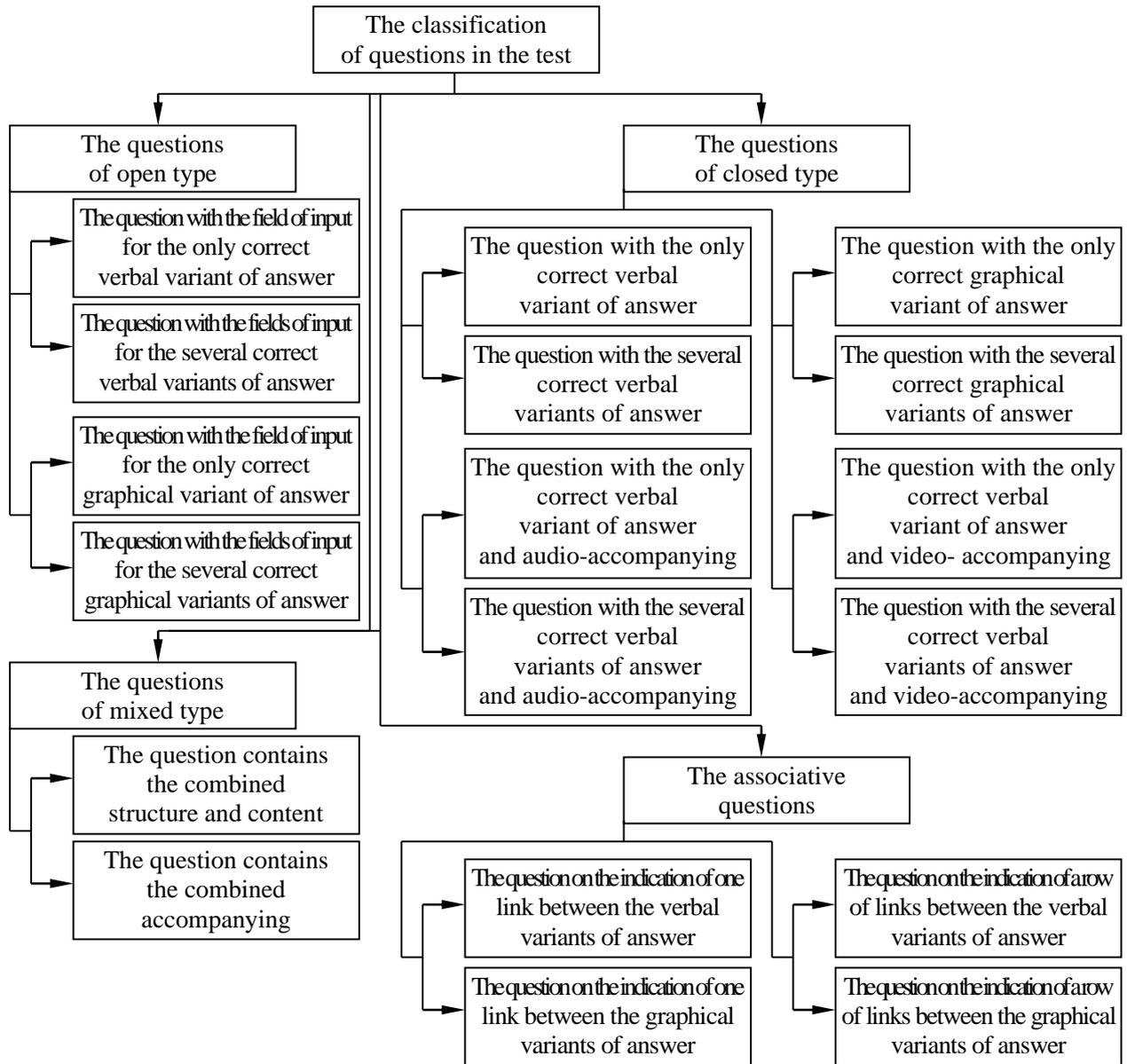
- the working memory of conditions – realizes intermediate storage of the values of parameters, which are not used by the computing processor in the limits of the working cycle;

- the linguistic processor – provides the switching of language at the displaying of identifiers of various elements, located on the interface forms of the applied DM and realizes the selection of a certain localization of the used method of research;

  o the procedure of selection of the localization of the method of research and the interface of application – provides the possibility of selection of the language for the displaying of parameters of the method of research and the identifiers of various elements of the interface of the applied DM;

    ▪ the algorithm of selecting of the localization of interface of the applied DM and the used method of research (test) – allows the user to select a specific language for the displaying of identifiers of the elements of interface on the forms in the different modes;

    ▪ the algorithm of loading of parameters of the method of research (test) – realizes the loading of the different parameters of the method of research for the providing of the process of testing;

    ▪ the algorithm of sorting of parameters of the method of research (test) – realizes the sorting of parameters of a sequence of question-answers structures of the used method of research or test in a sequential or arbitrary order;

    ▪ the algorithm of loading of the identifiers of the element of interface – provides the loading of all names of various elements of the interface in a certain language;

  o the procedure of formation of the textual content of comments – realizes the switching and displaying of all explanatory inscriptions in a certain language;

    ▪ the algorithm of formation of the textual content of pop-up hints to the elements of interface – the output of description of the elements of interface in a given language;

    ▪ the algorithm of formation of the textual content of hints, displayed in the status bar of the interface window of the applied DM – provides the systematic displaying of the auxiliary inscriptions in the status bar to the examinee;

    ▪ the algorithm of formation of the textual content of hints displayed before each block of questions in the process of testing – realizes the output of clarifications on the performance of each block of questions based on the method of research;

- o the procedure of formation of the textual content of the question and variants of answer;
  - ▪ the algorithm of formation of the textual content of question – provides the representation of the textual content of question in a certain language;
  - ▪ the algorithm of formation of the textual content of the variants of answer on the question – the representation of the textual content of the variants of answer on the questions of test;
- o the procedure of formation of the identifiers of various elements of the interface;
  - ▪ the algorithm of formation of the identifiers of elements on the forms of the interface of the applied DM – the content of inscriptions of the elements of interface in a certain language;
- • the processor of switching of the communication conditions – supports the constructing of the structure of communicative act, consisting from a sequence of communicative steps between the user and the interface of the applied DM in the different modes of working;
  - o the procedure of selection of the strategy and sequence of carrying out of dialogue – allows to set the kind of strategy and sequence of compliance of the elements of dialogue with the user;
    - ▪ the algorithm of selection of the strategy of dialogue with the user in the information environment of automated training – realizes the switching of strategies of the carrying out of dialogue;
    - ▪ the algorithm of formation of a sequence of communicative steps of the dialogue – realizes the possibility of creation of the communicative episodes from a row of steps;
    - ▪ the algorithm of analysis of the correctness of a sequence of communicative steps – realizes the check of correctness of all performed actions of the user;
    - ▪ the algorithm of switching of steps in the limits of the communicative act – realizes the possibility of viewing of a sequence of answers, entered by the examinee;
- • the processor of switching of the mode of working of user – realizes the selection of a certain mode of working of one from the users and the initial initialization of its parameters;
  - o the procedure of authentication of the user – realizes the authorization and differentiation of the rights of access of the users to the different modes of functioning of the applied DM;
    - ▪ the algorithm of registration of a new user in the database with accounts – realizes the automated addition of various parameters of the account of each new user directly at the initial registration;

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- the algorithm of registration of the existing user – provides the input of parameters of account and the end-to-end identification of registered user;

- the algorithm of sorting, adding, deleting and modifying of parameters of accounts – provides the possibility of switching and editing of parameters of the groups and nominal users, and also a posteriori data of testing;

- the algorithm of viewing and editing of a posteriori data of testing – the viewing and modifying of values of the key indicators of the status of examinee;

- the procedure of support of the mode of administrating – provides the direct execution of all functions of a certain user in the mode of administrating;

  - the algorithm of changing of the parameters of test – the modification of the textual and graphical content of the formulations of question and the variants of answer, the quantity and type of selector of the sign of correctness of the variants of answer, the interval of time of the displaying of question;

  - the algorithm of editing of the parameters of the accounts of users – allows to view the date and time of carrying out of the testing on the basis of the selected method, to change the code and identifier of group, L.F.P., age, gender, password, IFPST, LRKT;

- the procedure of support of the mode of diagnostics – provides the testing of IFPST;

  - the algorithm of selection of the procedure of diagnostics – the connection of the method of research;

  - the algorithm of registration of the parameters of condition of the examinee – the recording into the database;

- the procedure of support of the analysis of data – the viewing and processing of a posteriori data;

  - the algorithm of selection of the procedure of analysis of data – the mathematical analysis of data;

  - the algorithm of displaying of the graphical dependencies – the interpretation of data;

- the procedure of processing of the structures of data – the analysis of the parameters of information fields;

  - the algorithm of checking of the structural integrity of data – the non-destructive control of data;

  - the algorithm of reconstruction of CM – the modifications of the first and second levels of the structure of CM;

- the processor of saving and extracting of data – realizes the loading and unloading of data;

  - the procedure of monitoring of the sessions of network interaction – traces the sessions of access;

  - the procedure of network interaction – controls the process of access to the applied DM;

- the processor of saving and extracting of data – the access to the database of the applied DM;

  - the procedure of archiving and backup copying – the backing up of data;

  - the procedure of recovering of the corrupted structures of data and information.

The classification of the answers of user, supported by the applied diagnostic module

For the realization of the procedure of automated testing in the environment of automate d training based on CM are used the several types of control questions in the structure of the test (pic. 4).

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                    ┌─────────────────────────┐
                    │   The classification     │
                    │  of questions in the test│
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The classification of questions in the test

The questions of open type

The question with the field of input for the only correct verbal variant of answer

The question with the fields of input for the several correct verbal variants of answer

The question with the field of input for the only correct graphical variant of answer

The question with the fields of input for the several correct graphical variants of answer

The questions of closed type

The question with the only correct verbal variant of answer

The question with the several correct verbal variants of answer

The question with the only correct verbal variant of answer and audio-accompanying

The question with the several correct verbal variants of answer and audio-accompanying

The question with the only correct graphical variant of answer

The question with the several correct graphical variants of answer

The question with the only correct verbal variant of answer and video- accompanying

The question with the several correct verbal variants of answer and video-accompanying

The questions of mixed type

The question contains the combined structure and content

The question contains the combined accompanying

The associative questions

The question on the indication of one link between the verbal variants of answer

The question on the indication of one link between the graphical variants of answer

The question on the indication of a row of links between the verbal variants of answer

The question on the indication of a row of links between the graphical variants of answer

Pic. 4. The classification of questions, used in the course of testing

The questions of open type provide the possibility of entering of the free answer of user in the special information field or several information fields on the form of interface.

The questions of closed type do not allow the possibility to the user to enter the variants of answer in the free form, therefore involve the use of selectors of the sign of correctness for the realization of selection of the normative single or several valid variants of answer.

The questions of combined type may comprise the hybrid structure and content.

The set of special procedures of diagnostics of the individual features of the contingent of trainees based on the cognitive modeling technology

The applied DM contains the special procedures for the realization of diagnostics (pic. 5).
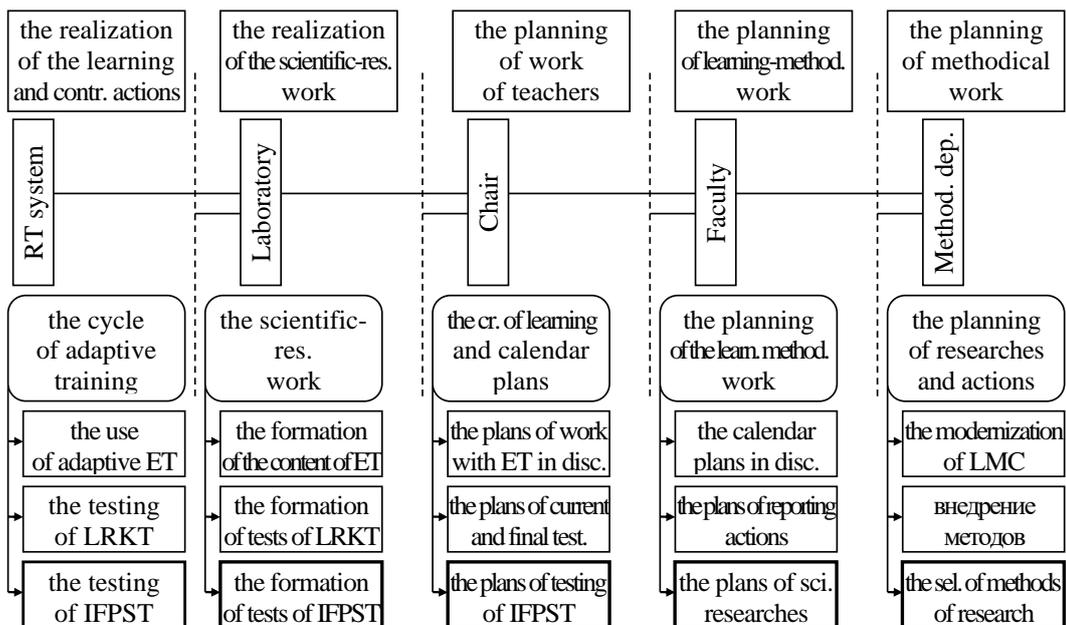
The set of procedures for the research of parameters of the physiological portrait	The set of procedures for the research of parameters of the psychological portrait	The set of procedures for the research of parameters of the linguistic portrait

The procedures of research of the visual sensory system

The algorithms of revealing of the anomalies of perception of space (m. of Sivtsev D.A., perimeter, stereoscope)
- acuity of vision
- field of vision
- binocular vision

The algorithms of revealing of the anomalies of color vision (m. of Rabkin E.B., Yustova E.N.)
- achromasia
- protanopia
- deuteranopia
- tritanopia

The algorithms of revealing of the anomalies of accommodation (the tables with symbols)
- astigmatism
- myopia
- hypermetropia

The procedures of research of the auditory sensory system

The algorithms of revealing of the absolute acoustic sensitivity (the generator and synthesizer of sound)
- upper threshold
- lower threshold

The algorithms of revealing of the absolute acoustic sensitivity (the synthesizer of sound)
- upper interval
- average interval
- lower interval

The procedures of research of the intellectual abilities

The algorithms of diagnostics of the convergent abilities (m. of Amhauer R.)
- verbal intelligence
- classification
- associativity
- mathem. abilities
- combinatorics
- generalization of concepts
- mnemonics and memory
- planar thinking
- volumetric imagination

The algorithms of diagnostics of the divergent abilities (m. of Mednik S.A., Torrens E.P.)
- verbal originality
- verbal associativity
- verbal uniqueness
- verbal selectivity
- figurative originality
- figurative associativity
- figurative uniqueness
- figurative selectivity

The algorithms of diagnostic of the type learning-ability
- implicit
- explicit

the algorithms of diagnostic of the cognitive styles
- field-dependence / field-indep.
- impulsivity / reflexivity
- rigidity / flexibility
- concretization / abstraction
- cognitive simplicity / difficulty
- categorical narrowness / width

The procedures of research of the linguistic abilities

The algorithms of diagnostics of the level of proficiency in the national language of statement (m. of "The institute of philology" of "SB" of "RAS")
- proficiency in the nat. language

The algorithms of diagnostics of the level of proficiency in the foreign language of statement (m. of "The Colchester educational centre")
- proficiency in the language

The algorithms of diagnostics of the level of proficiency in the dictionary of terms and key definitions (m. of the auxiliary test in the certain discipline)
- proficiency in terms

The algorithms of diagnostics of the level of proficiency in the elements of interface of the program means in the training system (m. of the auxiliary test in a certain program)
- proficiency in the interface

The algorithms of diagnostics of the level of proficiency in the terms in the area of the information and communication technologies (m. of the auxiliary test in the theory of information)
- proficiency in the terms of IT

see the structure of the cognitive model of the subject of training [3, 6, 12]

Pic. 5. The procedures of research in the basis of the applied diagnostic module

The features of practical use of the applied diagnostic module

The technological process of the controlled formation of knowledge of the contingent of trainees in ATS based on CM acts as the structurally difficult and includes the technological gaps and stages (pic. 6):

- the development of the learning-methodical complex and the selection of the methods of research of IFPST – the methods of research of IFPST are subject to the automation and inclusion into the database;

- the planning of the learning-methodical work and the development of scientific researches – the plans of scientific researches are oriented to the analysis of the problem environment and the selection of actual set of parameters for the inclusion into the experimental CM for the diagnostics;

- the planning of working of the teacher and the development of the plans of testing of IFPST – the creation of a complex of regulated measures, oriented on the setting up of a series of experimental researches of the information interaction of the subjects and means of training, which allow to provide the system analysis of IEE and ATS based on CM;

- the realization of SRW and the formation of tests of IFPST – the selection of a set of the methods of research of the parameters of CM of the subject of training CM for their subsequent automation in the view of the special procedures, which are stored in the database with the purpose of realization of the testing;

- the realization of learning and control actions, the carrying out of testing of IFPST – the organizational and technical preparation of automated testing of IFPST.

| the realization of the learning and contr. actions	the realization of the scientific-res. work	the planning of work of teachers	the planning of learning-method. work	the planning of methodical work
RT system	Laboratory	Chair	Faculty	Method. dep.
the cycle of adaptive training	the scientific-res. work	the cr. of learning and calendar plans	the planning of the learn. method. work	the planning of researches and actions
the use of adaptive ET	the formation of the content of ET	the plans of work with ET in disc.	the calendar plans in disc.	the modernization of LMC
the testing of LRKT	the formation of tests of LRKT	the plans of current and final test.	the plans of reporting actions	внедрение методов
the testing of IFPST	the formation of tests of IFPST	the plans of testing of IFPST	the plans of sci. researches	the sel. of methods of research

Pic. 6. The organizational and technological modifications of the information environment of the educational establishment using the applied diagnostic module

The entering of the structured data related to a certain method of research and the data of accounts of users into the database of the applied DM is carried out in the mode of administrating, and the automated research of various IFPST in the form of testing is carried out directly at the working of examinee in the mode of diagnostics.

In the pic. 7 presents the interface of the applied DM in the mode of administrating of the parameters of the method of research of the convergent intellectual abilities of CM of the subject of training.
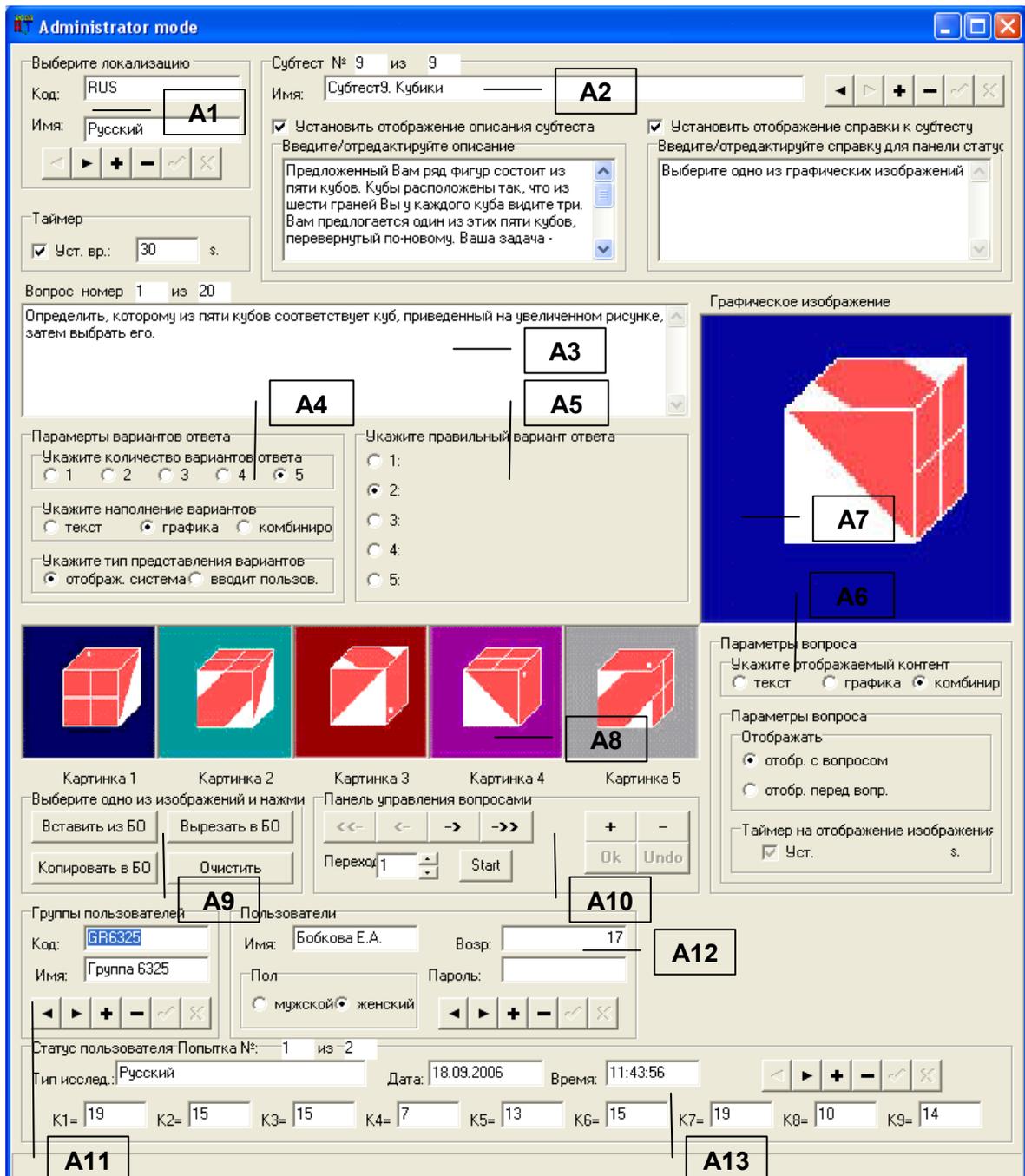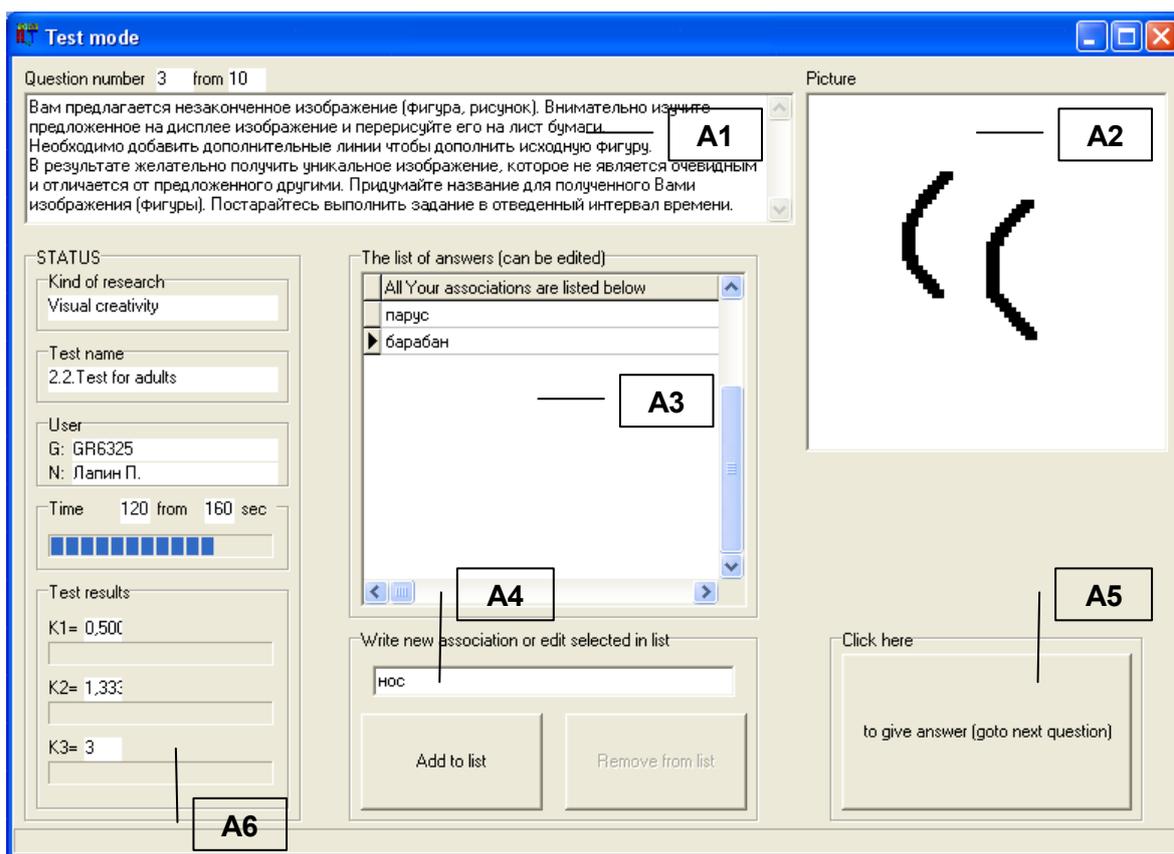

Pic. 7. The interface of the applied diagnostic module in the mode of administrating

of the method of research of the convergent intellectual abilities of Amthauer R.

For the administrating of the database with the parameters of the method of research and the accounts of users applying a row of elements of interface: the field of editing the list of localizations of the method of research (A1); the field of editing of the list of names of the blocks of questions (subtests), the selector of the sign of displaying and the field of the textual content of formulation of the explanation outputting before each subtest in a separate pop-up window in the course of diagnostics, the selector of the sign of displaying and in the field of the textual content of formulation of the explanation, outputting in the status bar of the interface window in mode of diagnostics (A2); the field of editing of the textual content of the formulation of question (A3); the control panel with the selector of quantity, the type of content and the way of selecting of the variants of answer on the question in the mode of diagnostics (A4); the sign of correctness and the list of textual contents of the variants of answer on the question (A5); the control panel with the selectors of the type of content of the question, the way of displaying of the question, the nominal value of the interval of time of the displaying of formulation of the question (A6); the panel of editing of the graphical content of the question (A7); the panel of editing of the graphical content of the variants of answer on the question (A8); the control panel of the graphical images of the variants of answer (A9); the control panel of switching to the first, previous, next and last question with the possibility of adding, deleting, saving and cancelling of made changes to the information fields (A10); the panel of editing of the code and name of group (A11); the panel of editing of the parameters of accounts of users (A12); the panel of displaying of a posteriori data of examinees with the possibility of switching of attempts (A13).

The row of designations of subtests and parameters are used: K_1 – "Logical selection", verbal intelligence; K_2 – "Search of common signs", generalization; K_3 – "Search of verbal analogies", analyticity of thinking; K_4 – "Classification of concepts", classification; K_5 – "Arithmetic tasks", arithmetic accounting; K_6 – "Number rows", combinatorics; K_7 – "Mnemonics and memory", mnemonics and memory; K_8 – "Flat figures", flat thinking; K_9 – "Cubes", volumetric imagination.
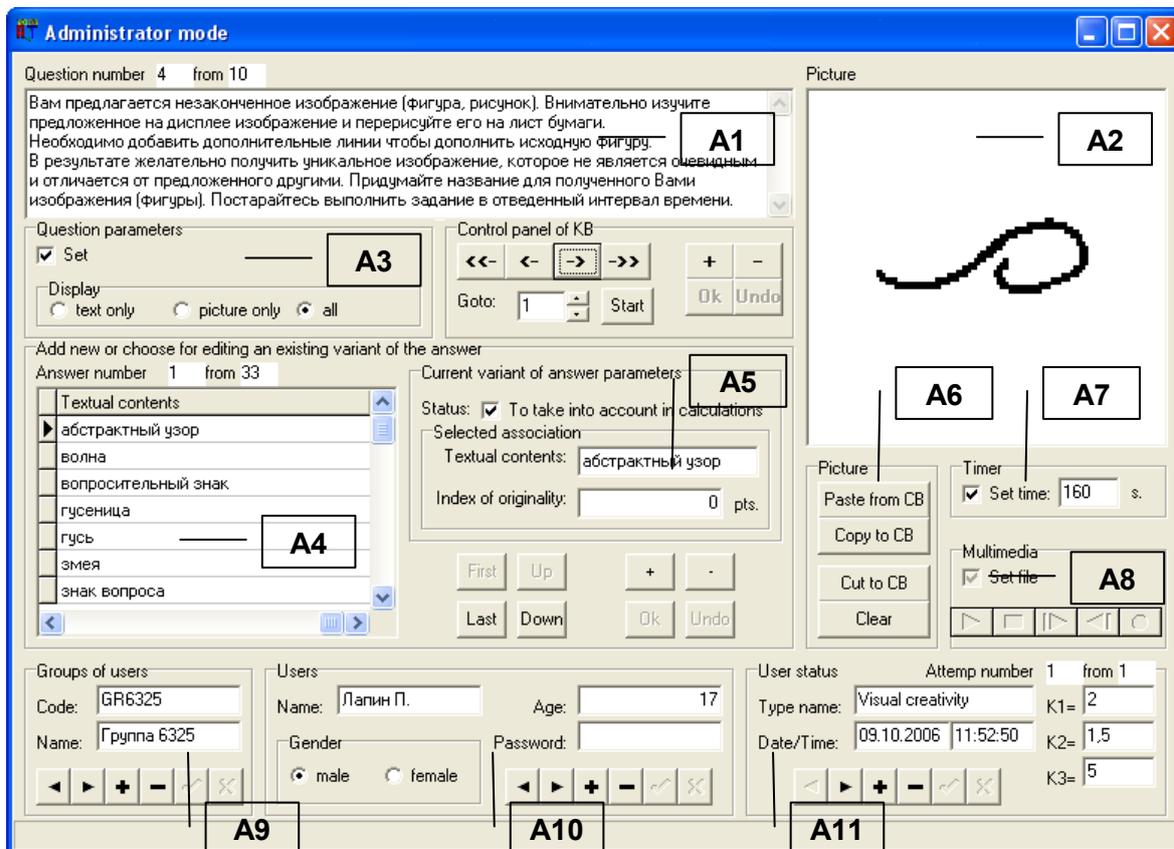
The interface of the applied DM in the mode of diagnostics of figurative creativity (pic. 8) contains: the field of indication of the number by order, the total quantity and the text of formulation of the question (A1); the field of indication of the graphical image with the stimulus (A2); the field of indication of the list of the variants of answer entered by the user (A3); the field of indication of the selected or entered by the user of the variant of answer on the question with the capability of adding and deleting (A4); the button of confirmation of the list of answers of the examinee, initiating the transition to the next question (A5); the status of examinee (A6).

Test mode

Question number 3   from 10

Вам предлагается незаконченное изображение (фигура, рисунок). Внимательно изучите предложенное на дисплее изображение и перерисуйте его на лист бумаги. Необходимо добавить дополнительные линии чтобы дополнить исходную фигуру. В результате желательно получить уникальное изображение, которое не является очевидным и отличается от предложенных другими. Придумайте название для полученного Вами изображения (фигуры). Постарайтесь выполнить задание в отведенный интервал времени.   **A1**

Picture   **A2**

STATUS

Kind of research
Visual creativity

Test name
2.2.Test for adults

User
G: GR6325
N: Лапин П.

Time   120 from   160 sec

Test results

K1= 0,500

K2= 1,333

K3= 3

A6

The list of answers (can be edited)
All Your associations are listed below
парус
► барабан   **A3**

A4

Write new association or edit selected in list
нос

Add to list   Remove from list

Click here   **A5**

to give answer (goto next question)

Pic. 8. The interface of the applied diagnostic module in the mode of diagnostics

of the divergent intellectual abilities (the methods of Torrens E.P., Mednik S.A.)

In pic. 9 presents the interface form of the applied DM in the mode of administrating of the parameters of the method of research of the figurative creativity: the panel of editing of the textual content of the formulation of question (A1); the panel of editing of the graphical image, accompanying the question (A2); the panel of setting of the parameters of displaying of the question (A3); the panel of entering of the list of the variants of answer (A4); the panel of editing of the status of accounting of the variant of question in the calculations, the name and index of originality of a certain variant of answer (A5); the control panel of graphical image (A6); the panel of editing of the period of time of the displaying of question (A7); the control panel of multimedia accompanying (A8); the panel of editing of the list of codes and names of the groups of users (A9); the panel of viewing and editing of the parameters of accounts of users (A10); the panel of viewing and editing of a posteriori data of diagnostics with the capability of switching between the different attempts (A11).

The database in the basis of the developed applied DM provides the storage of parameters of the used methods of research, all parameters of accounts of users and the obtained in the result of passing of the automated diagnostics of a posteriori data of the examinees.

Pic. 9. The interface of the applied diagnostic module in the mode of diagnostics
of the divergent intellectual abilities

The current and resulting a posteriori data is automatically stored in the database.

The conclusions and statistical regularities based on a posteriori data

1. The practical use of the obtained scientific and practical results has been carried out in the learning process of "The international banking institute" since 2004 y. and "The Saint-Petersburg state electrotechnical university "LETI"" since 2003 y., in the course of carrying out of the researches have been received the acts about the practical use and three copyright certificates.

2. The estimation of efficiency of the adaptive ATS based on CM was carried out using the generally-accepted indicators of efficiency (resultativity) of the process of automated

formation of knowledge of the contingent of trainees: $\mathbf{K} = \{k_1; k_2; k_3\} = \left\{ Y_2 - Y_1; \frac{Y_2}{Y_1}; \frac{Y_2 - Y_1}{Y_1} 100\% \right\}$,

where coefficients k_1, k_2, k_3 respectively denote absolute, comparative and relative indicators of efficiency (resultativity) of the formation of knowledge [3, 6, 10], and the results of statistical processing of a posteriori data of a series of experiments are generalized and summarized in tabl. 1.

Table 1

The results of 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 point Y_1	4,05	4,286	4,24	4,611	4,056	4,4	-	-
AQD 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 point Y_2	4,333	4,046	4,375	4,16	4,042	4,091	4,696	4
AQD 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 point Y_3	4,5	4,609	4,379	3,708	3,92	3,773	4,455	3,818
AQD 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 in the 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 in the 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	-10,865	-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

3. In the result of the 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') were calculated and the linear regression model $\hat{Y}(K_i)$ was obtained, where the constant is 4.653. In the result the equation of multiple regression is formed as the following view:

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

The factor (dependent variable) acts the resultativity of training 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} – analyticity of thinking, K_{17} – classification, K_{18} – arithmetic account, K_{19} – combinatorics, K_{20} – mnemonic and memory, K_{21} – planar thinking, K_{22} – volumetric imagination, K_{23} – verbal originality, K_{24} – verbal associativity, K_{25} – verbal selectivity, K_{27} – figurative originality, K_{28} – figurative associativity, K_{29} – figurative selectivity, K_{45} – the level of proficiency in the language of statement of the material in the information fragments.

4. CMT allows to realize the additional contour of adaptation based on CM block, and also to conduct the complex system analysis of IEE, directed on the increasing in the efficiency of functioning of ART system and the resultativity of the process of the formation of knowledge of the trainees.

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

Pic. 10 reflects the geometrical interpretation of the arrangement of the centroids of classes, corresponding to the selected groups of trainees in the space of coordinates of the two canonical functions.
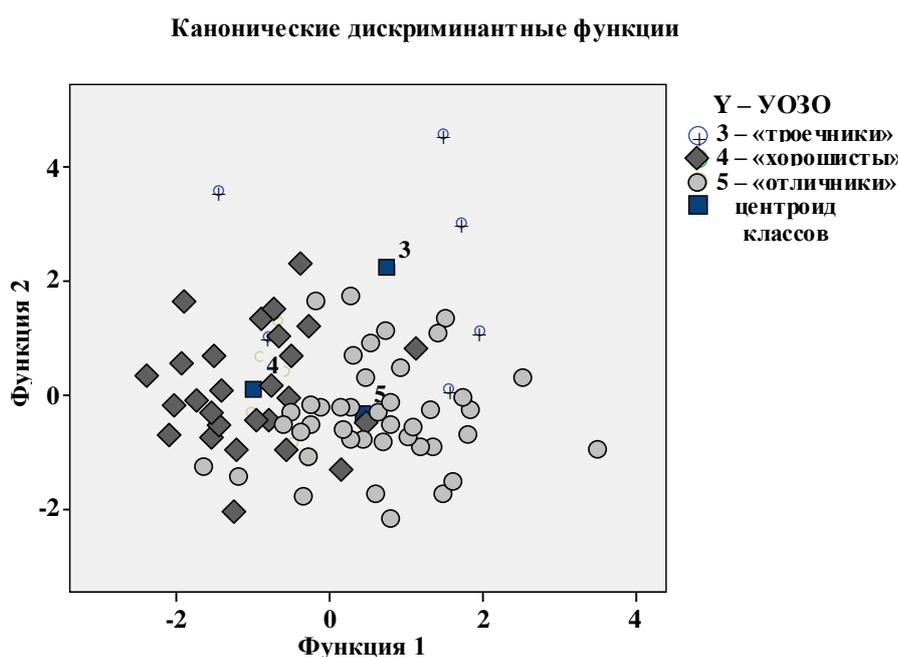
Pic. 10. The centroids of three classes of trainees in the space of two canonical functions

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А.Н. Ветров

ПРИКЛАДНОЙ ДИАГНОСТИЧЕСКИЙ МОДУЛЬ ДЛЯ ДИАГНОСТИКИ ПАРАМЕТРОВ КОГНИТИВНОЙ МОДЕЛИ СУБЪЕКТА ОБУЧЕНИЯ В АДАПТИВНОЙ СРЕДЕ

Прикладной диагностический модуль выступает компонентом системы автоматизированного обучения со свойствами адаптации на основе параметрических когнитивных моделей, предназначен для автоматизации процесса исследования физиологических, психологических и лингвистических параметров в основе когнитивной модели субъекта обучения с целью реализации адаптивной генерации образовательных воздействий посредством использования разных средств обучения нового поколения, которые позволяют учитывать индивидуальные особенности обучаемых

Информационно-образовательная среда, когнитивная модель,

технология когнитивного моделирования, прикладной диагностический модуль