OSTIS-2015
(Open Semantic Technologies for Intelligent Systems)

УДК 004.02:519.816

INTELLECTUAL MEANS OF AUTOMATION OF MANAGEMENT OF TRAINING

M.Z.Babamukhamedova, M.Yu.Doshchanova, K.A.Djangazova[*]

[*] *The Tashkent university of information technology,*
Tashkent, Republic Uzbekistan

malikadoshanova@mail.ru

Предложен гибридный подход реализации интеллектуального управления индивидуализированным процессом обучения на основе синергетической модели управления, применение которого в создании образовательных сред позволяет повысить эффективность функционирования среды, улучшить её адаптивные свойства, придать целенаправленный и активный характер. Особенностью предложенного подхода является создание средств автоматизации управления обучением с учётом интегративных тенденций в условиях компетентного обучения.
Keywords: computer aided control system for teaching, synergetic model of teaching control, individual teaching trajectory, intellectual control, integrated teaching.

Introduction

The present stage of evolution of the automated training systems is characterized by a steady tendency to formation of the scientifically educational environments making a basis of functioning of scientifically educational space in the conditions of formation of an information society. The methodology of construction of scientifically-educational environments is at a formation stage, is based on methodology of working out of computer training systems, systems of various forms of electronic training on the basis of a principle of the complex decision didactic, technological, information, etc. the problems directed on creation of conditions for maintenance of computer support of process of rendering of qualitative educational services.

One of important indicators of quality of educational services is degree of personification of support of process of training which is in turn defined by adaptability and controllability of system of training. The Scientifically-educational environment as the difficult organizational-technical system which functioning is directed on the individualized management of process of formation defined competences, consists of co-operating subsystems, management automation with which demands perfection of models and methods of its working out. Therefore and unresolved the problem of perfection of models and methods of automation of system engineering of management of training in scientifically-educational environments is actual.

Features of training as operated process, consist that along with formalized and semi structured the class of problems of the mixed type which use both analytical, and heuristic models of the account of preferences exists problems in the conditions of the incomplete information. Such problems are characterized by accident of external influences, aprioristic incompleteness of the information, uncertainty of the purposes. Therefore, for management of training use of artificial intelligence techniques is expedient.

Therefore, considering conceptual changes in methodology of system engineering of automated management on the basis of application intellectual a component for the decision of not formalized and badly structured problems, and also complication of didactic requirements of the individualized training, within the limits of the allocated problem, one of unresolved problems is the problem of synthesis of the hybrid scheme of intellectual transformations for automation of management by process of the individualized training.

1. Synergetic model of management of training

The analysis of a difficult complex of system of didactic requirements to the scientifically-educational environment taking into account dynamics of the basic tendencies of their development, and also the account of features of training as operated process, and tendencies of development of the theory of management of difficult systems, allows to draw a conclusion on expediency of application synergetic the approach in creation of a control system by training [1].

The Synergetic model of the management [2], which main principles organically correspond to features of process of training, allows to form operating influences on the basis of research of a tendency of self-development of the trainee. The model constructed within the limits of the given approach synergetic managements of training displays two-class structure «knowledge and abilities» with a vector of conditions (x, y) and a management vector (h, U) [3]:

$$\frac{dx}{dt} = fUy, \quad \frac{dy}{dt} = c(1-U)xy, \qquad (1)$$
$$\frac{d}{dt}(Ux+(1-U)y) = \frac{h(t)}{1+r} + \frac{c-f}{1+r}(Ux+(1-U)y),$$

where $h(t)$ - speed of granting of the information, r - resistance factor to didactic process, f - forgetting factor, c - conclusion factor, U - a part of time which has been taken away on accumulation of knowledge and abilities, x, y - normalized volumes of the saved up knowledge and abilities.

Optimization of management by training is reached on the basis of the account of distribution of a vector of intelligence that provides bases of the individualized training. Realization of the offered model by means of intellectual management is carried out on the basis of the analysis of necessary intellectual transformations of the information on parametres of basic elements synergetic models.

2. The Structurally functional scheme of management

It is possible to present training process by set of the unified cyclic actions directed on management by following elements of the maintenance: an educational element (*EE*) - a subject matter - (*SM*) the competence (*CMP*) a set (system) competence (*SCMP*). Control over success is defined according to diagnosticity the set vector of purpose C [4]:

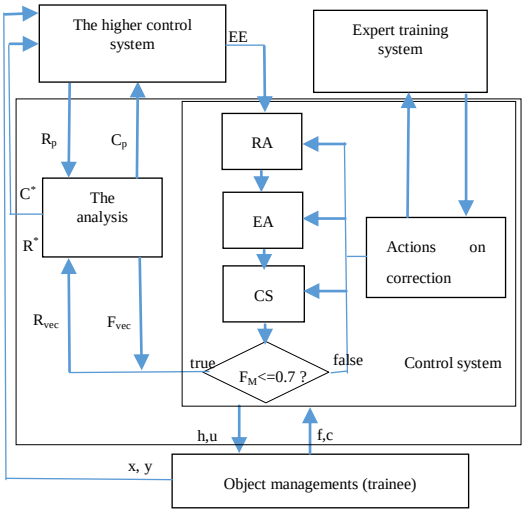
$$C=\{N_{HE},U,A,M,F_M,F_S\} \qquad (2)$$

where N_{HE} - quantity of educational elements (*EE*); U - level of mastering *EE*: $U\in\{1,2,3,4\}$; A - an exponent of abstraction *EE*: $A\in\{1,2,3,4\}$; M - an exponent of sensibleness of mastering *EE*: $M\in\{0,1,2,3\}$; F_M - factor of mastering *EE*: $0 \le F_M \le 1$; F_S - factor of skill of mastering *EE*: $0 \le F_S \le 1$.

All components of a vector of the purpose can be presented in a numerical kind. According to recommendations [4] purpose of training can be formulated as follows: to study the set educational elements (*EE*) at level of mastering of activity U with factor of mastering F_M, degree of abstraction A, factor of skill F_S at level of sensibleness M. Such formulation of the purpose is diagnostic set.

On the basis of the offered way of formalization of training it is possible to define two basic structures of object of management. In the first - «one teacher - some trainees» the teacher carries out functions of measurement of results of training of each trainee, compares their set C, the decision on necessary operating influence makes and realizes it. In such system automation of managerial processes promotes elimination of an information overload of the teacher. Functions of such automated control system *EE – ACS EE* (fig. 1) the following:

1. Reception of the entrance information from the higher control system - identifier *EE*, a vector diagnostic set purpose C, time of studying *EE*;
2. Reception of the entrance information from the trainee - values of parametres of intelligence: f - forgetting factor and c - conclusion factor;
3. Maintenance of performance of training actions under the chosen scenario which obligatory stages rough actions (*RA*), executive activity (*EA*), a control stage (*CS*), correcting actions concern;
4. Performance of auxiliary calculations of success of achievement of the purpose - formation of vector F_{vec} and transfer of these parametres to model of the trainee;
5. Transfer to the higher control system of the information on a vector of conditions (x - relative volume of the saved up knowledge; y - relative volume of the saved up abilities).

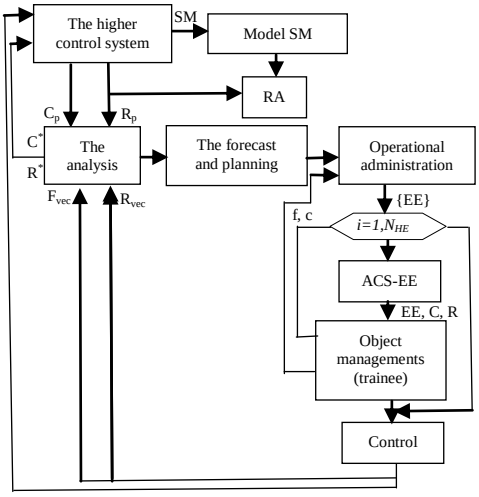


Drawing 1- Scheme ACS-EE

It is possible to carry their weak formalization, absence of means of exact measurement, heuristic character of interrelations to features of entrance, target and operated parametres between results of training and actions on time distribution. Therefore, most an effective remedy of management of such scheme is neuro-indistinct management [5].

Automation of management by process of training EE on the basis of intellectualization use is directed on reception of individual distribution of time, the account of features of a vector of intelligence of the trainee, hence - on improvement of quality of operating decisions without an overload of the teacher.

The management block this process is a component of all other levels of training. The greatest efficiency can be reached in the presence of interrelation with the expert training system, which conclusion recommendations about correction are.



Drawing 2 - Scheme ACS-SM

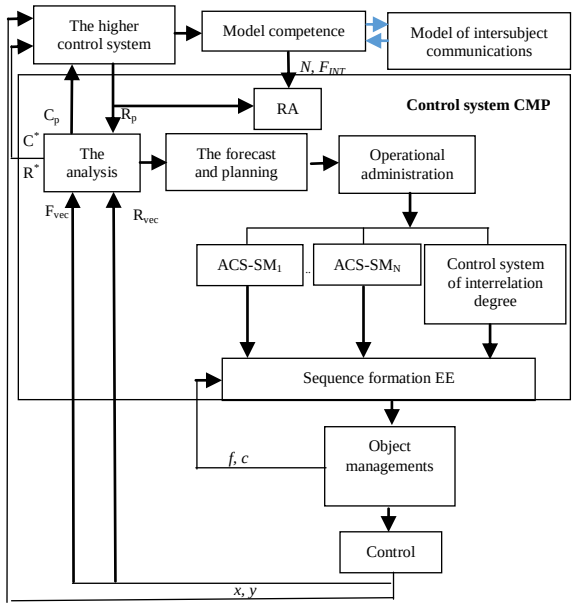
The block of management of training to a subject matter – ACS SM (fig. 2) differs from previous that contains procedures of definition of admissible sequences of training *EE*, a choice next *EE* on the basis of the account of logic interrelations, temporary restrictions. The basic functions of the block the following:

1. Reception of the entrance information from the higher control system - logic structure *SM*: list *EE* with a vector diagnostic set purpose *C*, time of studying *SM*;
2. Sequence Definition (generally - several) *EE* which studying makes an overall aim of studying *SM*;
3. Forecasting of achievement of the purpose for set time the concrete trainee on the basis of its characteristics of development of a material;
4. Planning of sequence EE on the basis of the account of restriction of resources (for example, time);
5. Support of process of an operational administration, as cyclic process of a consecutive call ACS - EE;
6. Control of success of achievement of the purpose - formations of vector F_{vec}, real time of training R_{vec} and transfer of these parametres to the analysis block;
7. Transfer to the higher control system of the information on a vector of conditions (x - relative volume of the saved up knowledge; y - relative volume of the saved up abilities);
8. Divergence Definition between planned and actual indicators:

$$C^*=(C_P-F_{vek})/C_p\ ;\quad R^*=\ (R_p-R_{vec})/R_p\ . \qquad (3)$$

Except features of managerial process *EE*, it is necessary to carry procedures of the forecast and planning which are expedient for carrying out on the basis of application of means of intellectual management to features of management *SM*. A basis for decision-making on formation of recommended sequence *EE* is the information received from experts-teachers. This information is indistinct, characterizes degree of logic interrelation between *EE*. Therefore, procedures of the forecast and planning demand application intellectual a component of converters of the information.

The second structure of object of management - «some teachers - one pupil». Here as the training purpose the maintenance component, which should be generated at the given grade, level should be used. Management of formation process competences - ACS-CMP (fig. 3) is in relation to previous (ACS-SM) - the higher system. The Structurally functional scheme of this block contains calls subordinated ACS-SM those disciplines which studying leads to formation of the certain competence. Feature of the given scheme is the interrelation between system of intersubject communications and model of the competence, which realizes the corresponding intellectual converter on the basis of nejro-indistinct clustering.



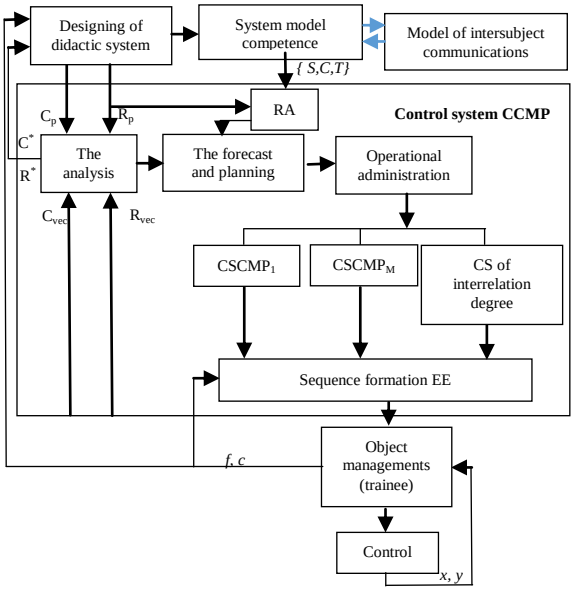
Drawing 3 - Scheme ACS-CMP

The basic functions, which are carried out ACS-CMP, the following is:

1. Reception from the senior control system of the identifier of the formed competence;
2. Definition on the basis of model competence identifiers of corresponding subject matters, the purposes, training terms;
3. Definition of the most expedient intersubject communications for formation of the certain competence, transfer to the count of training of value of factor of integration F_{INT};
4. Forecasting of achievement of the competence in a definite time;
5. Planning of vectors of the purposes and training time on each subject matter, their correction on the basis of use of intersubject communications and redistribution;
6. Formation of individual sequence *EE* on the basis of the account of a vector of intelligence of model of the pupil;
7. Call of subordinated systems ACS-SM for each of certain subject matters;
8. Realization of regulation by degree of interrelations during formation of an individual trajectory of training;
9. Control over degree of achievement of the

certain competence, definition of actual indicators of time, achievement of the purpose, a condition vector (*x*, *y*).

Management of process of formation of system competence - ACS-CCMP (fig. 4) is carried out on the basis of sequence of calls of subordinated control systems ACS-CMP with use of the intellectual converter which for each quantum of time forms the best, from the point of view of the account of parametres of a vector of intelligence, influence on competence formation.



Drawing 4 - Scheme ACS-CCMP

Thus, control system ACS-CCMP carries out transformations of the entrance information on the purpose, training time to the information for choice systems ACS-CMP, that is works as the switch. ACS-CCMP carries out following basic functions which define its structure:

1. Definition of requirements to projected didactic system for system formation competence according to the qualifying characteristic;
2. Formation of the maintenance for realization of process of formation of a set competence *{S}*;
3. Definition of system of intersubject communications, which according to experts are the most expedient at formation corresponding competence;
4. Call of subordinated systems ACS-CCMP and a control system of interrelation degree;
5. Formation of individual sequence *EE*;
6. Optimization of the individualized distribution of time for studying of the interconnected subject matters, forming the competence;
7. Transfer to the higher system (in environment which forms requirements to system competence) result of a divergence with diagnostic an object in view of training and allocated time of training.

Thus, management realization by all complete process of training as operated, it is carried out on the basis of the enclosed structure of calls of the subordinated control systems realizing training according to hierarchy of objects of training. The detailed description of each of systems features of their entrance and target data allow to draw a conclusion concerning expediency of automation of all process on the basis of realization of intellectual transformations. One of the basic elements providing an individualization of training, the control system of degree of integration of the maintenance for which functioning working out of structurally parametrical model of system of intersubject communications is necessary is.

The entrance data for construction of the count of training are structures of subject matters, which in the given statement of problems are formed on the basis of the unified model of the monosubject subject matter having hierarchical structure which parametres are defined by degree of intrasubject interrelations.

The model allows on the basis of the received opinions of experts on expediency of interrelations between *EE* in the form of binary indistinct relations to display them in the form of the indistinct count. The analysis of features of such count has allowed to allocate four basic types of the tops, which composition by certain rules indistinct product allows to form educational blocks automatically. The educational block represents auxiliary logic formation in structure *SM*. Parametrical filling of structure of the educational block (*EB*) is carried out on the basis of application max-min compositions of indistinct binary relations.

The received model makes a basis for the further formation of model of system of intersubject communications.

Conclusion

The hybrid approach of realization of intellectual converters of the structurally functional scheme of automation of a control system is offered by the individualized training constructed on a basis synergetic of model.

Feature of the offered approach is creation of means of automation of management by training with the account integrative tendencies in conditions competent training. Efficiency of use of the offered approach is investigated.

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