Using Automation Object Model For Analysis And Design Of Specific Distance Learning Systems

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Construction of mathematical models of DLS

Mathematical modeling involves the development of formal models for DLS, allowing to describe their state depending on control actions and, therefore, solve the problem of control - searching of acceptable control actions that will lead system to the desired state.

As a result carried out a general theoretical study of DLS model:

- analysis the model of DLS (study of the behavior of participants at the DLS or other control mechanisms);
- synthesis of optimal control actions (searching admissible controls with optimal efficiency; searching of admissible controls, transforming DLS in a given state);
- study the stability of solutions (the study of optimal solutions depending on the model parameters, the theoretical study of the adequacy of the real system model).

Real DLS is described in formal terms of socio-economic systems management theory: given the composition and structure of the DLS, the objective functions and the set of admissible strategies of participants in the system, their awareness, functioning.

The system to represent a collection of data of a subject area, the aim of which is to develop the process of learning his diagnosis, and management of the learning process itself (holding test sessions). Thus, the functioning of information system of distance learning has the purpose of data transmission (knowledge), training subject - the learner. This fully applies to the system in which the student has to manage its activities in the process of acquiring knowledge, ie, become in subject position.

Consequently, DLS must include the teacher information about subject area and process data, the method of student teaching (methodological skills). In this context, subject knowledge represents knowledge of the teacher about training course structure during the learning process. They are formed by a teacher on the basis of state educational standards, based on his personal experience.

The subject knowledge model of DLS can be represented as a graph, shown in Figure 1.1

The vertices of this graph is a set of subject knowledge - arc of the graph represent the structure of subject knowledge. Vertices and arcs relates to sets in accordance with the teacher's perceptions on the learning process.

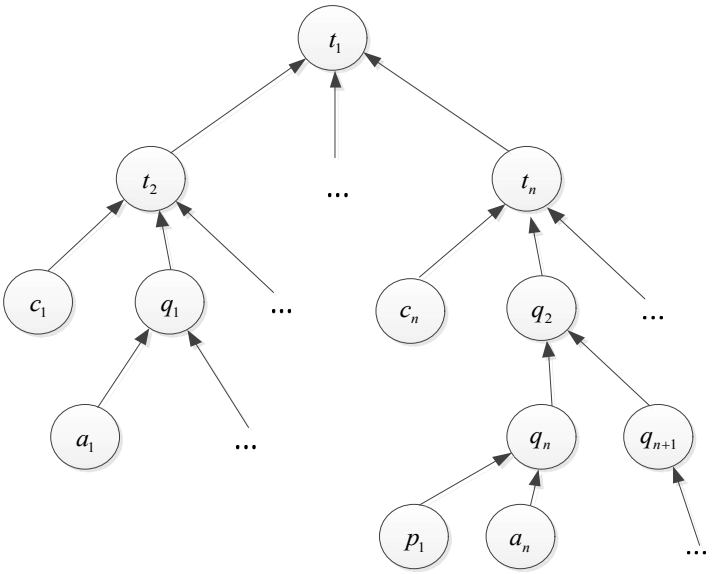

Figure 1.1 – Mathematical model of DLS subject knowledge

t_1 – mathematical model of DLS subject knowledge;

c_1 – topics presentations;

q_1 – question or sub-question of theme;

a_1 – answers for questions;

p_1 – question prompts;

Model of personal knowledge, then, would be presented on graph having the form in Figure 1.2. The vertices of this graph are the aggregate of personal knowledge - set of graph arcs F represent the structure of subject knowledge.

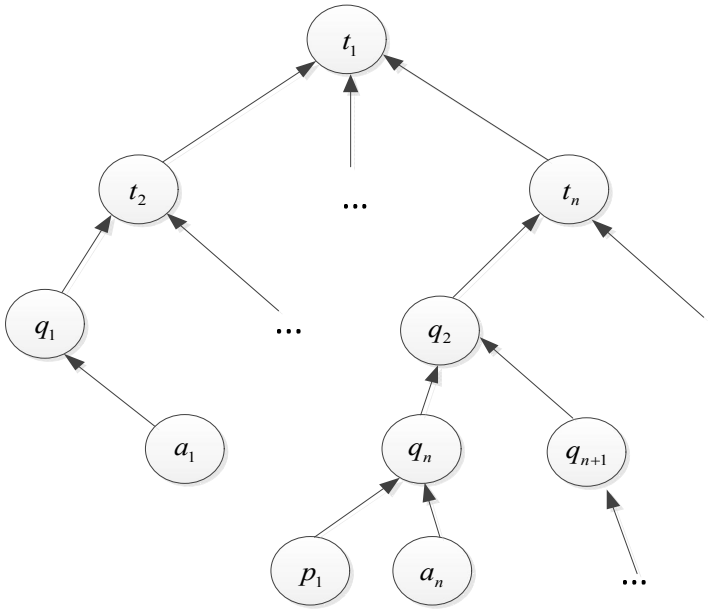

Figure 1.2 – Mathematical model of the personal knowledge of DLS

The vertices of these graphs are determined by constructing subsets E - subject knowledge:

$t \subset T$ – set, which characterizes the degree of development of the students in this subject (course);

$q \subset Q$ – set, which characterizes the level of students knowledge;

$a \subset A$ – set that characterizes the degree of knowledge of the issue;

$p \subset P$ – set, which characterizes the degree of ignorance of the issue learner

On the basis of these provisions will evaluate the effectiveness of a distance learning system, which can be determined by the following parameters:

- The total costs at ensuring the DLS. Also here can be attributed the costs of organizing training system – Z_{Σ} ;
- The average time that was spent on the student's learning process – E_{CP} ;
- The quality of student learning (personal knowledge), which can be defined by some estimation at the exam time – O

Lets imagine aggregative mathematical model of the DLS in a graph type:

$$G = (D, S, Y, W, X) \quad X = (Z, O, E)$$

where D - complex of defining set of methodical system of training options;

S - the general characteristics of a contingent of students;

Y - general characteristics of teacher (teachers);

W - characteristics of the network to which characterizing the topology and features of the process of information exchange;

X - vector index (efficiency) DLS.

As part of the general problem let's distinguish three groups of objectives of the study:

The objective assessment of the stability of the DLS and the calculation of achieved performance values Z, O, E (DLS should perform its tasks in the given performance range).

There conducted testing of the DL model, parameters are specified, the compliance of the objectives of DLS training in high school in the interests of its validation and certification.

Refine the structure of the sets:

$D = (d_1, d_2)$. Where d_1 – controlled parameters; d_2 – fixed parameters;

$W = (w_1, w_2)$. Where w_1 – network controlled parameters of DL; w_2 – network fixed parameters of DL.

Managed options DLS: d_1^1 - methods and means of teaching, methods of organization of educational work with the use of electronic educational resources; d_1^2 - parameters of the model of interdisciplinary knowledge.

Task of optimization the quality of learning:

$$O = \max O[D, S, Y, W, X]$$

where $Z_{\Sigma} \le Z_{\max}$; $E_{\min} \le E \le E_{\max} : B^0$ - permissible range of variation of parameters d and w.

On the basis of the implementation of DLS model is required to determine the maximum score of student at a given time and with constraints on the involved resources and corresponding optimal extremum values of changeable parameters d_1 and w_1.

This task is expedient to formulate the design of DLS, appearing at the opening of new areas of training of students or to adjust the basic educational training programs.

The problem of minimizing the total cost of tuition**:**

$$Z = \max Z[D, S, Y, W, X]$$

where $O_{CP} \le O_{\min} \quad E_{\min} \le E \le E_{\max} : O_{\min}$ – threshold level of medium ranking.

Based on the implementation of the model is required to determine the minimum total cost of scientific-methodical and organizational support, necessary to obtain the desired quality of education at a fixed time and at a limited total resources, as well as the corresponding extremum value and variable parameters d_1 and w_1.

The problem of minimizing the average training time:

$$E = \min E[D, S, Y, W, X]$$

where $O_{CP} \le O_{\min}$; $Z_{\Sigma} \le Z_{\max}$

Based on the implementation of the model it's required to determine the minimum time required to obtain the desired quality of training and restrictions on the resources O involved and the corresponding extremum value and variable parameters d_1^* and w_1^*.

This problem occurs at the stage of the basic educational program and curriculum development in areas of training (distribution of training time between the disciplines of resources).

As the most advanced math schemas involved to build simulation models DLS, we can specify:

- statical test method;
- applied methods of systems (networks) queuing;
- mathematical apparatus of artificial neural networks;
- Methods of network planning and management (network graphics).

The analysis shows that the probability of DLS-based Markov model processes with obvious merits which has limited ability in the aspects of research performance as the DLS information system.

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