A New Model of Distance Learning Branched Organization

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Abstract - Recent trends and the development of information services make it necessary to introduce distance learning. In this paper we consider the problem of developing a model of distance learning branched organization. We describe existing distance learning platforms and analyze their functionalities and compare them. The result is a developed new general model of distance learning branched organization. The proposed model represents a definite graph structure and makes it possible to improve the quality and effectiveness of learning process management.

Keywords - distance learning; platform; models; branched organization; pathway; graph structure; discipline; module.

I. INTRODUCTION

Modern informatization of education can be defined as a leading direction of increasing the effectiveness of the educational process, which is one of the main factors for improving the quality of education. The phenomenon of informatization of education is unique in its influence on educational theory and practice. Information technologies act simultaneously as a pattern of development of educational systems, the realization principle of educational services, the imperative and priority of educational activities of a society, a state and an individual [1].

Today, **the world economy**, built on knowledge, became a reality. The exponential growth of knowledge and the radical technological changes associated with this define the problems of acquiring knowledge, mastering knowledge in the professional environment and the education of the next generations in another way. Information technology (IT) is a fundamental component of implemented changes. Today, education goes beyond the traditional meaningful and operational, organizational and geographical frameworks that have been established over the centuries. This is an imperative of progress and competitiveness. Lifelong learning is becoming a critical element in the sustainable development of a society [2].

The rapid development of computer services and information technologies, in particular, digital and fiber-optic ones, the widespread introduction of these technologies in all spheres of public life accelerated integration and communication processes, provided new, more productive possibilities for processing electronic data. These technologies are rapidly advancing us to the information society of the future and to a quite close knowledge society [3].

The scientific and technical revolution of the 20th century radically changed the classical university model of education and introduced a new educational paradigm, the aim of which is not the assimilation of a certain amount of knowledge, but the transfer and constant generation of information. The new educational paradigm corresponds to the distance model of the organization of the educational process, which is focused on the system integration of existing forms of education by creating a mobile information and learning environment. Such an environment provides the spatial and temporal flexibility of distance learning, and it is versatile for world educational systems.

Distance learning has gone from education in the form of correspondence, using primarily printed materials, to the worldwide movement with the latest computer and media technologies. In the early 1980s, distance learning objectives were grant programs with the possibility to receive a diploma; the fight against illiteracy in developing countries; the possibility of staff training for economic growth; enrichment of educational programs in nontraditional educational institutions. New technologies, globalization and new ideas of teaching students with the help of new generation textbooks and manuals, e-learning tools, the educational material of which can be saved, reproduced and presented using modern technical means (computer, multimedia projector and touch-board), challenged the traditional approaches in distance learning practice [4].

Today, due to the spread of distance learning, increasing attention is paid to the development and implementation of

information technologies in the educational process. When using distance learning systems, the following concepts of distance learning platforms are applied – software that allows posting materials, communicating and control students' knowledge, and managing the course and learning processes [5].

In view of the above, the aim of the article is to develop a general conceptual model of a branched distance course, based on a comparative analysis of modern distance education platforms.

II. ANALYSIS OF EXISTING DISTANCE LEARNING SYSTEMS

Today, there are a large number of developed distance learning platforms; therefore, researchers are interested in the issues of their functionality in terms of the ability to create branched courses.

The article discusses the functionality of the most common distance learning platforms, such as Lotus, Blackboard, Redclass, ATutor, Claroline, Dokeos, LAMS, Moodle, OLAT, OpenACS.

The results of the analysis of distance learning platforms are presented in Table I.

TABLE I. COMPARATIVE ANALYSIS OF DISTANCE LEARNING PLATFORMS

	Lotus	Blackboard	Redclass	ATutor	Claroline	Dokeos	LAMS	Moodle	OLAT	OpenACS
Profile	-	+	+	+	-	-	+	+	+	-
Forum	+	+	+	+	+	+	+	+	+	+
Chat	+	+	+	+	+	+	+	+	+	+
Glossary	-	+	-	-	-	-	-	+	+	+
Wiki	-	-	-	-	-	+	+	+	+	+
Email	+	+	+	+	+	+	-	+	+	+
Testing system	+	+	+	+	+	+	+	+	+	+
Course Management	+	+	-	+	+	+	+	+	+	+
Planning (calendar)	+	+	+	-	+	+	-	+	+	+
Search	-	+	-	+	-	-	-	+	+	+
Group work	+	-	-	-	+	+	+	+	+	-
Assistance	+	+	+	+	+	-	+	+	+	-
Developer	USA	USA	Russia	Canada	Belgium	Belgium	Netherlands	Austria	Switzerland	Germany
Terms of distribution	paid	paid	paid	free	free	free	free	free	free	free
Branched organization of the educational process	-	-	-	-	-	-	-	-	-	-

The above-mentioned systems are mainly educational process management systems, the learning process of which has a **linear structure.**

Under such training, educational materials are divided into modules and after their consecutive studying, the system offers the control question (in the possible form of an exercise). Linear programs are designed to ensure that all students receive the same task sequence and should complete the same steps. Such programs should correspond to abilities of weak learners.

In another case, what if the educational material of a certain discipline for different groups of students has a different level of depth, that is, the discipline can be a major for some specialties, while others only need to study the main points of the educational material. In such cases, the authors suggest applying a branched organization of the educational process.

III. THE CONCEPTUAL MODEL OF DISTANCE LEARNING BRANCHED ORGANIZATION

The organization of branched learning is appropriate for the effective organization of students' educational process.

In the developed model, it is proposed to use the principles of branched learning to the disciplines that are studied at the students' request. However, these disciplines will be presented in the form of distance courses. The comprehensive range of these disciplines can be represented using the graph structure; the name of such structure will be a D-graph structure.

At the same time, it is necessary to remember that in order to study certain disciplines of choice, it is necessary to already know certain basic disciplines. Thus, the nodes of a D-graph are not only the disciplines chosen by a particular student, but also basic disciplines connected with them.

In fact, a D-graph is a directed graph, the nodes of which are disciplines, and arcs are connections between them.

But, unlike the usual digraph, the nodes except the unique number I have a few attributes, namely:

- C is the name of the discipline;
- D is the type of node, D = 0 is the main discipline, D = 1 is the discipline of the student's choice;
- B is the set of properties of the node, which include the following attributes:
- L is the number of lectures;
- Lab is the number of laboratory classes;
- P is the number of practical classes;
- T is the presence of an individual work or a term paper, if K = 0, then the course does not imply either a term paper or an individual work, K = 1 is the individual work, K = 2 is the term paper;
- I is the type of control, I = 0 is the test, I = 1 is the differential test, I = 2 is the exam.

Moreover, each connection also has its own attribute – b – the minimum score which allows proceeding to the study of a next discipline.

D-graph G = (O, P) is given by a finite set of disciplines O and a set of relations between them P: $P \subset N \times O \times O$ where N is the set of natural numbers.

Each of the vertices of the D-graph O is described by attributes:

$$A(O)=\left\{I, N, C, B=\left\{\begin{matrix} Л_{1..M}, Лаб_{1..M}, П_{1..M}, K_{1..M}= \\ \{0,1,2\}, I_{1..M}=\{0,1,2\} \end{matrix}\right\}\right\} \quad (1)$$

where M is the set of natural numbers.

In addition, the D-graph at each of its vertex will be associated with a database of students, in which the following information should be stored:

- Information about students studying this discipline;
- Information about points that each student received on the discipline.

At the same time, to study some disciplines, it is enough to study only one of the disciplines, while for others it is necessary to study several disciplines at once.

Consider an example of such a D-graph (Fig. 1).

Disciplines that are mandatory to study are noted in the illustration in gray. In addition, this example shows that in order to study discipline D_4, it is necessary to study disciplines D_3 and D_2.

Each connection on a D-graph, as already mentioned, has its own weight b_i – the minimum score which allows proceeding to the study of the next discipline.

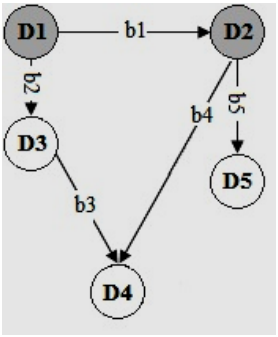

Figure 1. An Example of a D-Graph

Let us form the rule of transition from one node to another for the z^{th} student:

$$p_k=(o_i,o_j)\wedge P(b_k)\{b_z \geq b_k\} \quad (2)$$

where b_z is the score that the z^{th} student got after studying the 1st discipline D_i.

It should be noted that each of the disciplines can be represented using the graph G (V, E) with many vertexes V – the module of a discipline (thematically completed part of the educational material), and with many edges E – ordered pairs of numbers [q, p] of adjacent vertices, that is:

$$E=[p_1,q_1],[p_2,q_2],...,[p_m,q_m] \quad (3)$$

Obviously, the adjacent vertices (V_{i-1}, V), $i=\overline{1,m}$ of the graph G (V, E) reflect homogeneous entities, and the relationship between the vertexes $V_i \in V, i=\overline{1,m}$ and the edges $e_j \in E, j=\overline{1,n}$ is the relationship between heterogeneous entities. Due to this, besides the adjacency relation between the vertexes of the graph, there is also the conjugation relation, which is called incidence in mathematics.

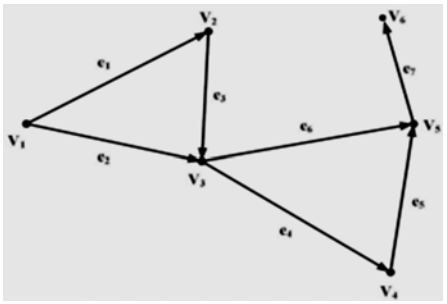

Figure 2. Oriented Graph of Distance Learning Branched Organization.

The sequence of studying modules of a discipline is geometrically interpreted by a directed graph (orgraph) G (V, E), etc., the vertexes of which V_1, V_2, ..., V_m are called nodes, and oriented edges e_1, e_2, ..., e_n are the arcs.

For six modules m = 6, n = 7, there is a simple digraph that does not have strictly parallel arcs and loops (Fig. 2).

Graphically, the general model of distance learning branched organization, taking into account the multitude of studied disciplines, can be represented as follows (Fig. 3).

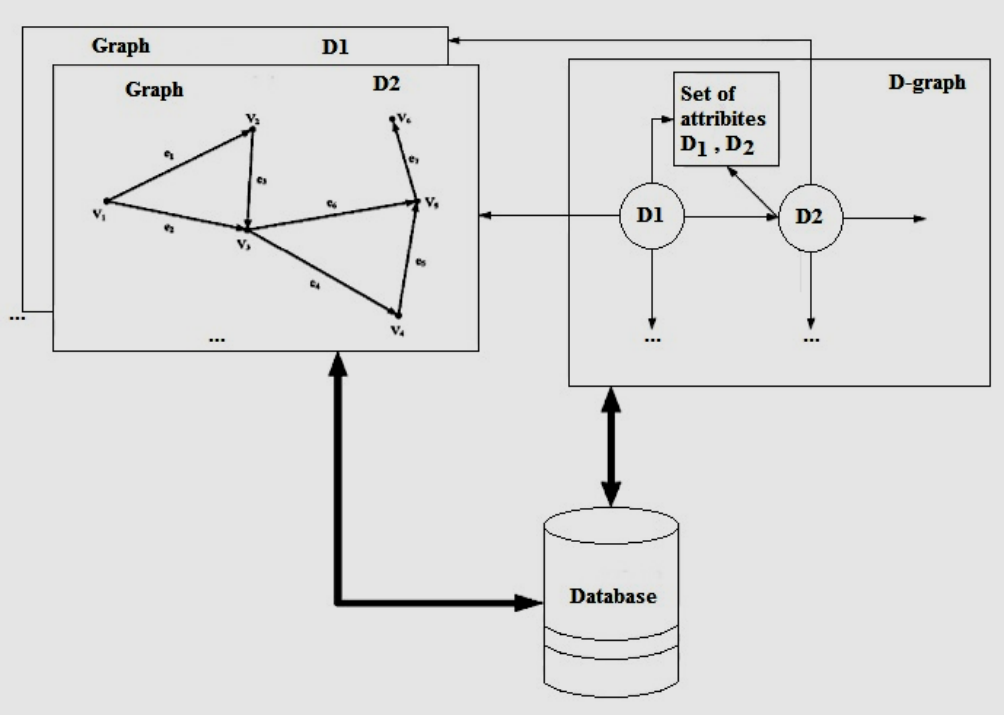

Figure 3. Graphic representation of the general model of Distance Learning Branched Organization

To implement the model, it is advisable to develop a separate module "Learning Pathway" in the Moodle system, which provides ample opportunities to support the training site, users and created training courses. Also, it reduces the administrator's influence to a minimum and ensures a high level of security [6-7].

The first priority of the Learning Pathway module is to provide an opportunity for a student to choose the sequence of studying a number of disciplines, and the learning pathway will be constructed taking into account the mandatory study of the necessary disciplines preceding the chosen one.

Let us formulate the basic requirements that this module should meet, taking into account the requirements for a student and the requirements of a teacher.

From a student's point of view, this module should meet the following requirements:

1. Reflect all possible learning pathways for a particular student.

2. The module should reflect the whole possible learning pathway when choosing a particular discipline.

3. After a student completes the discipline, the module should offer disciplines for further study, taking into account the already chosen pathway.

4. The module should derive student scores from all studied disciplines.

From a teacher's point of view, the module should meet these requirements:

1. The teacher can view and edit lists of students and records of all students' scores.

2. The teacher can set the connection of his discipline with other disciplines.

3. The discipline itself must also be described as a graph, the nodes of which are certain blocks (modules) of the discipline.

IV. SUMMARY AND CONCLUSION

The use of D-graphs in the development of a management system of distance learning branched organization will allow improvement in the efficiency of the educational process of students by creating for each student their own learning pathway. In this case, the learning pathway will be understood as a certain D-graph subgraph, which includes the disciplines (nodes) selected by the student. In the future, the proposed model can be implemented as a separate module "Learning Pathway" for the Moodle distance learning system.

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