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Resource management in distance and mobile education systems

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The relevance of the study is due to the fact that the support of management information processes of distance and mobile education is associated with the problem of effective distribution of system resources used in the transmission and processing of educational information. Methods and models of pre-resource planning should be aimed at more efficient use of info-communication data transmission environment with low bandwidth, as well as to solve the problem of a limited number of simultaneous users (sessions) of the educational process.

The aim of the study: is a comprehensive analysis and development of methods of resource management in the organization and operation of distance and mobile education systems.

Scientific novelty of research: formalization of information management processes in the system of distance and mobile education, taking into account the resource constraints of the educational system, the requirements of effective management.

The authors conducted a study of existing information systems that control distance and mobile education. We proposed an improved integrated approach to the formation of requirements and automation of modern systems of distance and mobile education.

Key words and phrases: information system, remote and mobile education, automation of management.

1. Introduction

The processes of Informatization of society could not but affect the development of educational systems. The use of modern network information technologies in the educational process has greatly contributed to making learning as accessible, open and popular as possible by the wider society. At the same time, training, initially associated with the accumulation, transformation and replication of knowledge, that is, information, the very content of its goals and objectives contributes to the development of new services, the expansion of management, communication and information fields [1–4].

In the conditions of rapid development of methods and forms of training, the key point of application of modern information and communication technologies, mechanisms and controls should be the direction of automation of information processes of remote network training [5, 6]. Among the factors that characterize the timeliness of such a decision today can be called the rapid development of the global Internet in terms of expanding the telecommunications field and management capabilities, the increasing need for the transfer of bulk educational content, as well as the growth of computer equipment in the education industry [7–10].

On the other hand, we note that the support of management information processes of distance and mobile education is associated with the problem of effective distribution of system resources used in the transmission and processing of educational information. Methods and models of pre-resource planning should be aimed at more efficient use of infocommunication data transmission environment with low bandwidth, as well as to solve the problem of a limited number of simultaneous users (sessions) of the educational process, which put the existing systems of distance and mobile learning.

2. Theoretical Study

The modern distributed educational system is characterized by an increase in the variety of types of transmitted traffic in favor of the traffic of multimedia data, in particular, widely used in the online form of distance and mobile learning.

A comprehensive solution to the problem of management of the educational system is associated with the development of evidence — based methods to ensure effective management of resources necessary to provide quality educational services and provide support for a given quality of service, administration and adaptive management in educational systems [11–13].

In contrast to the arbitrary distribution of infocommunication resources, a special case is the management of resources in the systems and networks of remote and mobile education. Information processes of distance and mobile learning are characterized by determinism, poseansnoe loading, a certain consumption of network resources, which allowed to use as a mathematical basis for solving the problems of the theory of the schedule.

Additional significance and an indicator of the weak development of the topic is the lack of comprehensive work on the management of a distributed system of distance and mobile education in the presence of limited infocommunication resources. Studies aimed at the creation and theoretical justification of these methods of resource optimization in the organization of the educational process are in demand both at present and in the foreseeable future of the development of educational systems [14–17].

3. Problem statement

To achieve the goal in the study were set and solved the following main tasks.

1. The analysis of the systems of distance and mobile education in terms of implementation of learning management and support of standards of formalized description of educational content, scenarios and forms of learning. The classification of modern systems of distance and mobile education on the basis of the level of support for the requirements of standards.

2. The analysis of models, structures of information management flows and traffic systems of distance and mobile education, taking into account the deterministic nature of the broadcast of educational content through the channels of the educational system.

3. The method of formalized description of educational content and learning algorithms for use in the automated process of learning management and the development of a model of traffic processing system in the system of distance and mobile education.

4. New conceptual and functional models of management in the system of distance and mobile education, taking into account the resource limitations of the educational system, the transmission of educational data, the recommendations of the architecture of technological educational systems, the requirements of effective management, taxonomy levels of learning.

5. Algorithms of automated control of the learning process in the system of distance and mobile education for different variants of the organization and parameters of the educational process are developed.

6. Models and methods of dynamic management of infocommunication resources distribution in the organization of management information process of distance and mobile education are developed.

7. A set of mathematical models for the probabilistic evaluation of educational process indicators to implement effective management of resources of distance and mobile education, as well as methods of collection and processing of statistical data for calculations using the proposed models.

8. Simulation experiments were performed to evaluate the results obtained in the thesis.

4.   Operating model

In General, the construction of software and hardware complex, is an organizational and technical problem, in relation to which the choice of the method of playback of online remote and mobile education, is associated with the solution of the little-studied problem of formation of the organization of management of the broadcast of educational information in real time.

In the organizational plan of formation of hardware and software complex of preparation and creation of courses is connected with a problem of formation of the corporate portal intended for implementation of educational activity in a global network. As part of such a portal can be divided into three main functional layers that determine the effectiveness of its functioning [18, 19]:

− interface layer (communication layer), which establishes the expressive capabilities of the portal in terms of obtaining, processing and reproduction of educational information of a certain type;

− a layer of basic infrastructure (network layer), containing basic services that work with the Internet, mail, video conferencing, management of data transfer transactions; as well as support for security systems, administration services, etc.;

− application integration layer (functional layer) responsible for the content of the portal.

Since the organization of information exchange is based on the client/server organization of information resources of the system (in which the process of data exchange between the client and the portal becomes centralized), the content management of the portal consists, firstly, in regulating the functioning of the application server and, secondly, in determining the moments (priority) of information exchange, based on the type and volume of traffic transmitted in comparison with the current load of technical means employed in ensuring the appropriate information and communication exchange.

The task of managing the organization and control over the translation of educational information is time-consuming, since the characteristics of communication channels can vary depending on the territorial location of students and their technical capabilities. Therefore, a preliminary analysis of the possible options for the distribution of the

current bandwidth of communication channels, taking into account the qualitative and quantitative characteristics of electronic training materials is a fundamentally important stage, prior to the transfer and processing of information flows in the networks [20–22].

In this regard, it draws conclusions about the need for pre-planning the allocation of network resources in a joint transfer of certain amounts of priority and non-priority traffic, during the implementation of the interruptible and non-interruptible educational work. The implementation of such a plan could be proactive redundancy of certain channels (connection repackaging method) and/or traffic prioritization.

The main components of the organization of information management system of distance and mobile education (SDME) are the task of discipline and algorithm of classes in each of the disciplines, the number of students involved in the disciplines, as well as the value of performance (resource intensity) of network technical means SDME. The utilization means to characterize the adequacy of distributed SDME for the tasks.

Based on the results of the analysis of the structure, information and management processes in the SDME was created a number of models and algorithms underlying the management system of distance education. CA ERWin Process & Data Modeler tools were used to develop the process models and database of the information system for SDME management support. A functional model of each process of the network system of distance education was built in the form of a set of elements — subprocesses that interact with each other. Figure 1 shows the top-level context diagram of the functional model.
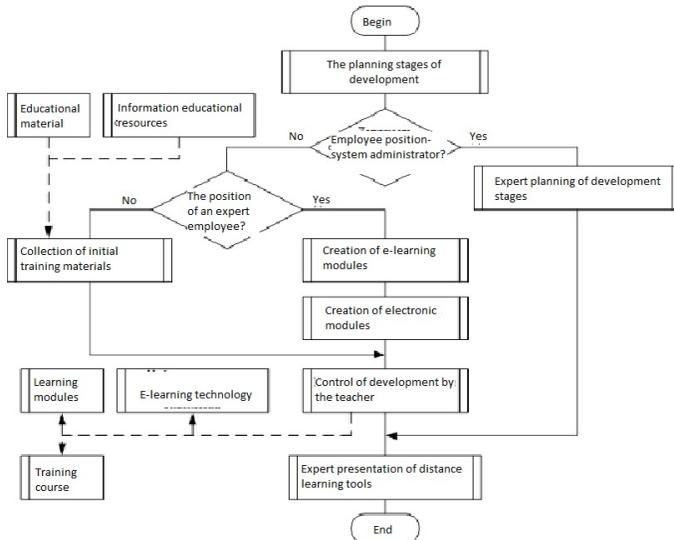

Figure 1. Context diagram of the top level of the functional model

On the basis of the functional model the diagram of variants of use of processes of functioning of information system of support of management of SDME was developed.

The next step is the development of algorithms for execution of the main processes. Figure 2 shows the interaction algorithm of the "Create tools BEFORE" process.

Described database model implemented using IDEF1X methodologies and CASE-tools CA ERWIN Data Modeler. The first step was to determine the entities and relationships between them, identified in the course of a multidimensional analysis of the subject area. ER-, KB-, FA- and T-models of the database were formed on the basis of the identified relationships and data on the presence of key attributes of entities.

Based on the transformational database model of the SDME management support system, a DBMS model was developed in the form of XML-code. The interpretation of

Figure 2. The algorithm of interaction of the process "To Create tools SDME"

this code allowed us to obtain a database scheme in the format of DBMS 1C: Enterprise at the physical level.

Thus, all the necessary models and algorithms were created to implement the information system to support the management of SDME — an effective tool for the distribution of infocommunication resources.

5. Conclusions

In the framework of the study the problem of assessing and improving the efficiency of integrated resource management in a complex distributed socio-economic system — the system of distance and mobile education is solved, and the following results have scientific novelty and practical significance:

1. The analysis of the systems of distance and mobile education in terms of implementation of learning management and support of standards of formalized description of educational content, scenarios and forms of learning. The classification of modern systems of distance and mobile education on the basis of the level of support for the requirements of standards.
2. The analysis and development of models, structures of management information flows of distance and mobile education, taking into account the deterministic nature of the broadcast of educational content in the segments of the educational system.
3. The developed method of the formalized description of the educational content and algorithms of control of the learning process for use in the automated educational process and in the development of management models for remote and mobile learning.
4. New conceptual and functional models of resource management in the system of distance and mobile education, taking into account the resource constraints of the educational system.

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