Management of a unified automated information system for continuing education

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Abstract

The article deals with the problem of accessibility of opportunities for personal and professional development, the search for high-quality and relevant educational resources that meet the trends of professional requirements. The possibility of improving the quality of educational content, the development of technologies and formats of educational information on the basis of competitive demand for educational resources are considered in the article. The authors give an example of the development of an automated information system of continuous and open education. Functional requirements to the automated environment are formulated, models of business processes are created and the variant of database design is considered. General program interfaces for information interaction with third-party information systems that provide automation of the organization's activities, providing educational services were developed. The authors of the article give examples of technological solutions for automation of organization and support of continuous and open education.

The purpose of the study: development of a model of a unified information environment for open and continuing education.

Scientific innovation of the research: the development of a model of a unified information environment for open and continuing education, which will make it possible to organize a single window of access to continuing education courses of various educational organizations and other structures, to inform stakeholders about the activities within the framework of further vocational education in accordance with specialization, to organize and conduct distance learning technologies, as well as carry out automated collection of results of participation in measures tricks.

Keywords

continuous education, informatization of education, information environment, management subsystem, e-learning

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1. Introduction

Automation of continuing professional education, namely the creation of a unified information environment for continuing education (hereinafter — AIS) will make it possible to make educational services available both for educational institutions and organizations of the Russian Federation that provide educational services for mass use. The openness of educational programs (parts, modules), their user orientation, the visibility and accessibility of content, will create competitive conditions, which, of course, should determine the improvement of the quality of educational programs, as well as the economic efficiency of the educational process [1, 2, 3, 4, 5].

AIS will allow not only to create one-window access to the information resources of educational organizations and other structures, to support the educational process using electronic distance technologies, as well as to carry out automated collection of learning outcomes and participation in additional education activities, to generate supporting documents on the success of modules, courses learning [6, 7, 8, 9]. In addition, AIS will provide not only a user-friendly selection of educational resources, but also automate the search for suitable courses and modules existing in AIS, based on a dynamically developing matrix of competencies, as well as analyze related competencies. AIS is an automated aggregator of educational resources of various external systems, corresponding to certain rules when organizing automated information interaction.

Having analyzed the business processes of the AIS organization, as well as the generated data streams, the model was created, which is shown in Figure 1.

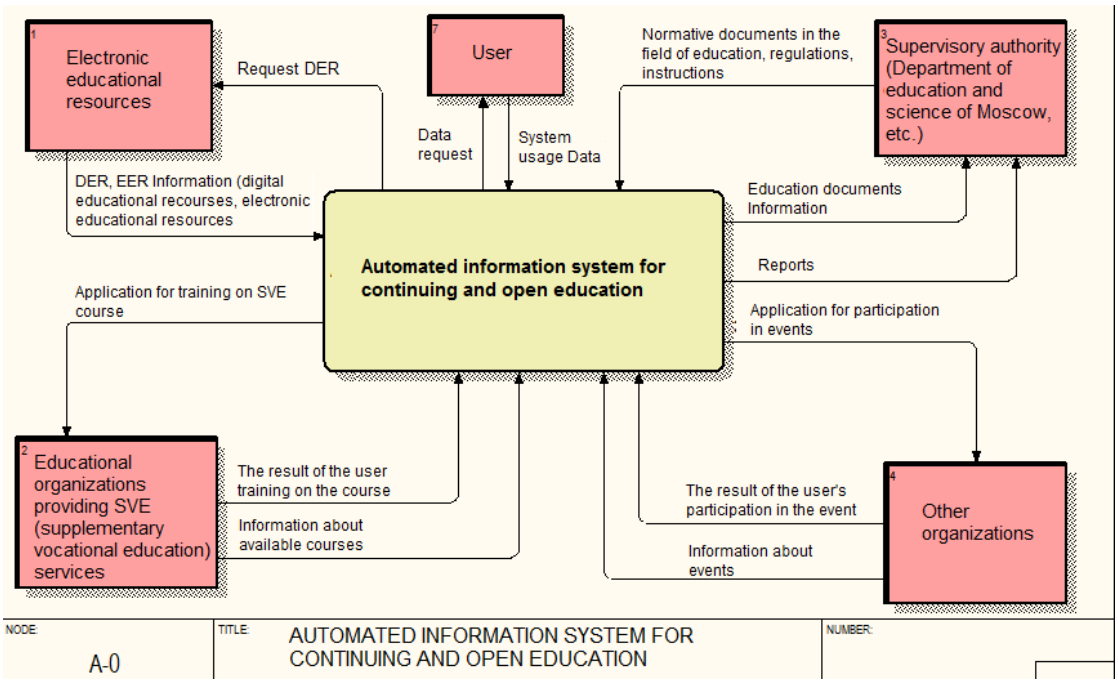

Figure 1: Context diagram of the top level of the functional model AIS

After describing the system as a whole, a decomposition diagram for detailing the context

diagram was created. This process is called functional decomposition, and the diagrams that describe each fragment and fragment interaction are called decomposition diagrams. After decomposition of the context diagram, a decomposition of each large fragment of the system into smaller ones was created, and so on, until the desired level of description detail was reached.

In this diagram, all the necessary elements were displayed, including processes, drives and data streams, and those data streams that were entered at the previous level of the hierarchy must be processed by processes at the current level of the hierarchy.

The decomposition diagram is based on the method of functional decomposition, which, in turn, consists in decomposing (dividing) the system into functional subsystems, which, in turn, are divided into subfunctions, i.e. — on tasks and so on to specific procedures. At the same time, the system maintains a holistic view in which all the constituent components are interconnected.

The decomposition diagram contains related works, that is, child works that have a common parental work. The daughter diagram, or context diagram of level *A*0 of the business process model of the information system is graphically presented in Figure 2.

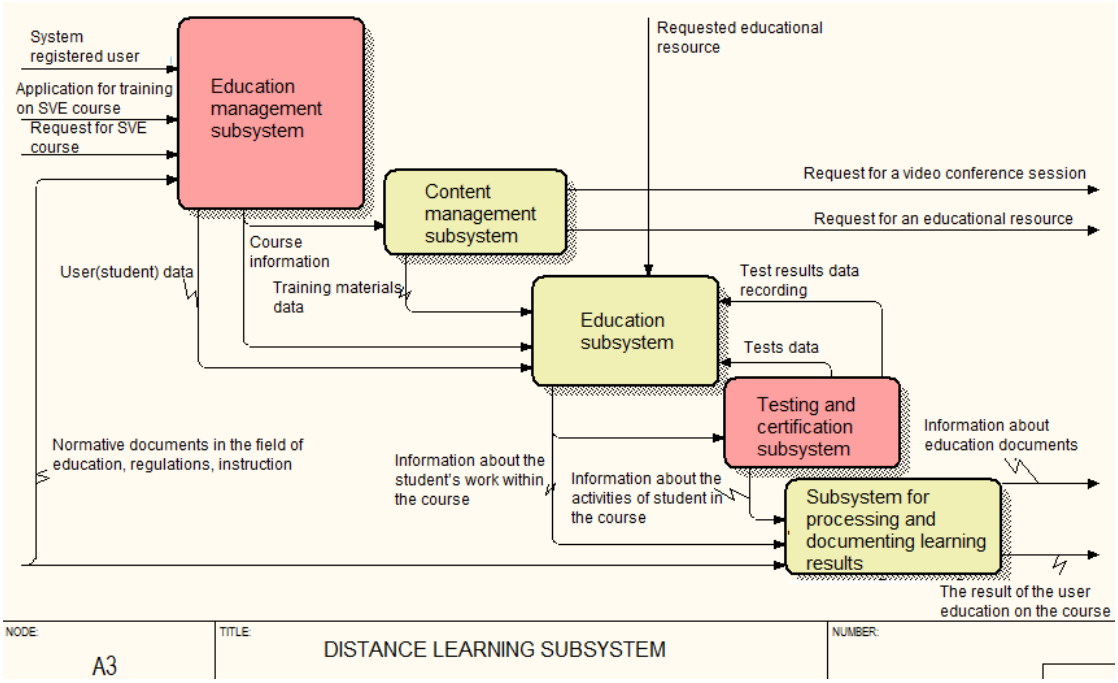

Figure 2: Context diagram (Distance learning subsystem)

According to the analysis, the main automation processes for providing and organizing the educational process are automated by the distance learning subsystem shown in Figure 2.

To determine the basic functions of AIS, each of the subsystems is decomposed and we obtained the following processes:

- Create a training course.
- Download training materials.

- Enroll system users in training courses.
- Organize the learning process.
- Complete the course of study for students.
- The data drives are:
  - Library of training courses.
  - Library of course materials.

As a result of decomposition we obtained the following processes:

- Study the training material.
- Answer test questions of the course.
- View academic performance.
- Create a portfolio of the system user.

The data drives are:

- Register of progress of the system user.

Incoming data streams:

- Requested educational resource.
- Data on course.
- Student data.
- Data on training materials.
- Data on test tasks.
- Record data about test results.

Outgoing data streams:

- Information about the student's work in the course.

Decomposition of each fragment into a more elementary one allows to define and study the main functions of AIS: business processes, incoming and outgoing flows, interaction of components.

2. Physical and logical models of AIS

To export entities and attributes in the CA ERWin Process Modeler environment, select the File|Export|ERWin (BPX) menu item, in the "save as" dialog box that appears enter the name of the exported entity file and click "save".

To import entities and attributes, create a new project in the CAERWin Data Modeler environment and select the File|Import|From CAER Win Process Modeler menu item, select the folder in which the imported file is located in the "Open File" dialog box, select it, and click "Open".

Figure 3 shows the selection of imported entities and attributes.

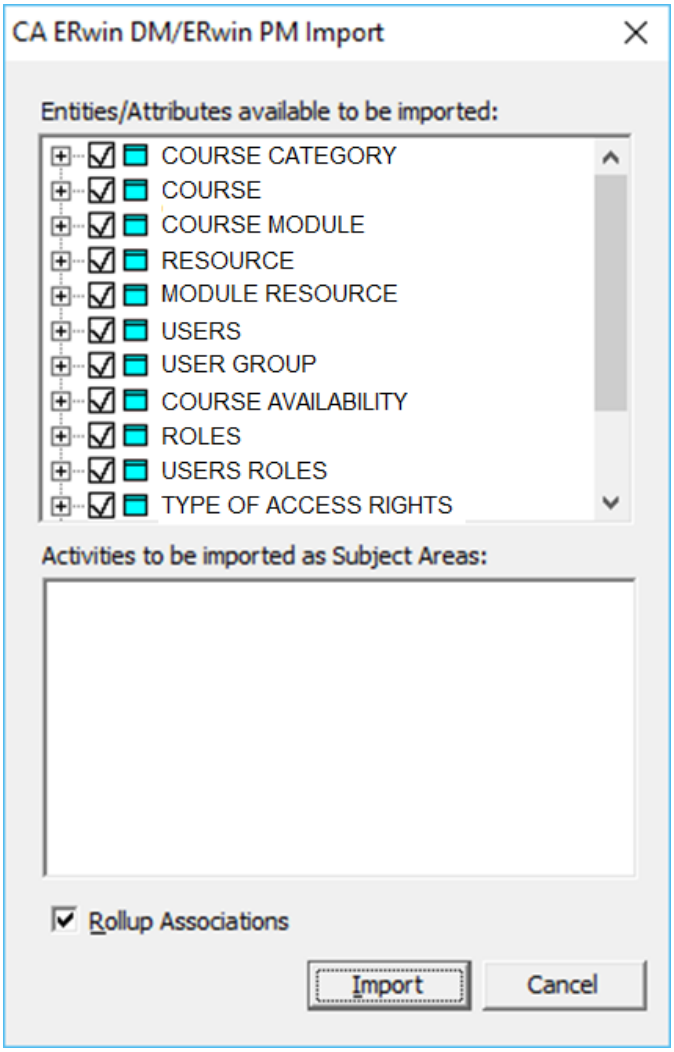

Figure 3: Selection of imported entities and attributes

In the "CA ERWin Data Modeler" dialog box that opens, select the check boxes for the entities and attributes to be imported and click the "Import" button.

After importing entities and attributes, a model was generated.

At the stage of logical design takes into account the specifics of a particular data model, but may not take into account the specifics of a particular database.

Entity data and its definitions of the developed data model, as well as the relationships between entities, are reflected in the Table 1 and the Table 2, respectively, as a result of a multidimensional analysis of the subject area.

As a result, an ER chart can be generated.

The key-based data model (KB — model), besides the entities and relationships, includes key entity attributes: primary (PK) and foreign (FK).

Table 1
Entities and definitions

Name of entity	**Definition**
Course category	Data on categories of training courses
Course	Data on training courses
Course module	Data on course modules
Resource	Resource data for modules and training courses
User group	Data on user training groups
Course availability	Data on the availability of training courses to users
Users	Data about users of the System
Access rights	Data on user access rights
Roles	Data on user roles in the System
Users roles	Data on assigned roles to users
Type of access rights	Data on access rights levels

Table 2
Data on identified relationships between entities

Parent entity	**Child entity**	**Name of relationship**	**Type of relationship**	**Relationship semantics**
Course Category	Course	C–C	N 1:M	Belongs to
Course	Course module	C–M	N 1:1	Consists of
Course module	Module resource	M–R	N 1:M	Includes
Module resource	Resource	R–R	N 1:1	Boots to
User group	Course availability	G–A	N 1:M	Has
Users	Course availability	G–A	N 1:1	Have
Users	User roles	U–R	N 1:M	Have
Roles	Users roles	U–R	N 1:M	Possess
Users	Access rights	A–R	N 1:M	Have
Type of access rights	Access rights	A–R	N 1:1	Assigns to
The object of the distance education system	Access rights	SDO–R	N 1:M	Has

To determine the primary and foreign keys of entities as a result of the analysis of the subject area, the following basic laws were identified:

- Each course category includes training courses.
- Each course category has a unique number.
- Each category course includes the category course.
- Each course consists of course modules.
- Each course has a unique number.
- Each course module includes module resources.
- Each course module has a unique number.
- Each module resource contains a resource.
- Each module resource has a unique number.
- Each user has roles.
- Each user has a unique number.
- Each user has access rights.
- Each user group has users.
- Each user group has a unique number.
- Each user group has course availability.
- Each user has course availability.

The full attributive model assumes the most detailed representation of the structure of the designed database and includes all entities, attributes, relationships. A detailed description of the attribute allowed the formation of a FA model of the subject area. If at the stage of logical design the specifics of a particular data model are taken into account, but the specifics of a particular DBMS may not be taken into account, then at the stage of designing a physical model the features are taken into account.

When developing a physical data model, it is necessary to take into account the selected database management system. The physical model contains information about all database objects. Since there are no standards for database objects (for example, there is no standard for data types), the physical model depends on the specific implementation of the DBMS. Consequently, several different physical models can correspond to the same logical model. If in the logical model it does not matter which particular data type the attribute has, then in the physical model it is important to describe all the information about specific physical objects — tables, columns, indexes, procedures, etc. [10, 11, 12, 13, 14].

To build a transformational model, it is necessary to determine the domains of the attributes of entities, the areas of their permissible values, as well as data types.

Table 3 shows the necessary data and examples of values used in the tadabase.

3. Data Model

The result is a transformational model, Figure 4, focused on the format of the selected DBMS and includes all entities, attributes, their data types, constraints of integrity and consistency control.

Table 3
Entities and definitions

Code of domain	Name of domain	Description of domain	Type
D1	Serial number	Integer, takes unique values	integer
D2	Data	DD.MM.YYYY — date, where DD — two digits, number (01 to 31) MM — two digits, month (01 to 12) YYYY — four digits, year (0000 to 9999)	date
D3	Variable character string 25 characters long	The set of character values of variable length is not more than 25 characters. Selects one value from the specified set	varchar(25)
D4	Variable character string 50 characters long	The set of character values of variable length is not more than 50 characters. Selects one value from the specified set	varchar(50)
D5	Variable character string 100 characters long	The set of character values of variable length is not more than 100 characters. Selects one value from the specified set	varchar(100)
D6	Blob	Blob with a maximum length of 65535 bytes	BLOB

The T-model contains information about each database table with the table name, the names of the columns (columns) of the table, their data types and restrictions on uniqueness, control and an indefinite value, taking into account the selected DBMS [15, 16, 17, 18, 19].

Next, a DBMS model was developed in the form of SQL code. Its interpretation made it possible to obtain a database schema in the MS SQL Server database format at the physical level [20, 21, 22, 23].

Importing a DBMS model in the form of SQL code, we derived a detailed database for AIS. Here is an example of several basic tables of the resulting database. For the implementation of AIS we have chosen a freely distributed software – Moodle platform, it is important that the software expertise on this product is widely developed, the refinement of functionality is carried out in the programming language PHP.

4. Conclusion

According to the results of the decomposition of each subsystem, the basic requirements for the educational process support system were identified. However, despite the fact that the distance learning subsystem is the central functional module of the AIS and allows you to automate the basic management and information processes, it is not the only one, since the AIS is an environment that provides a whole range of functionality.

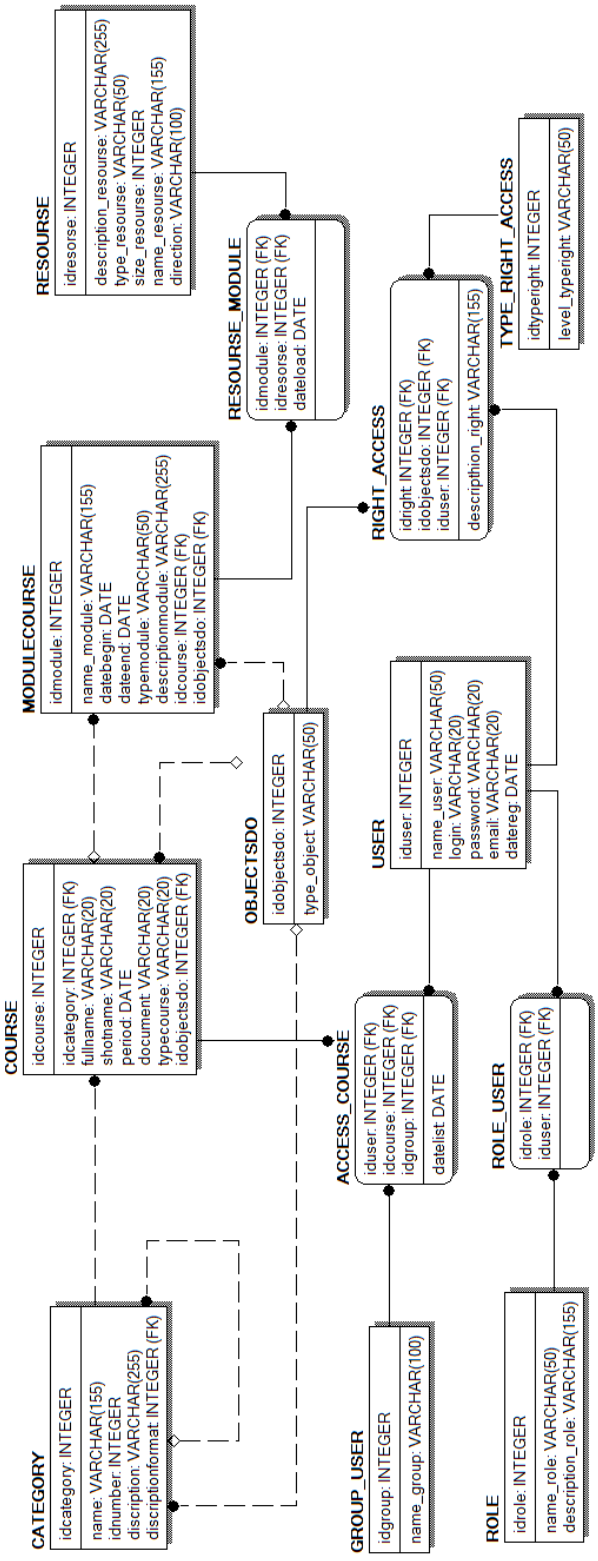

Figure 4: Transformation model (T-model)

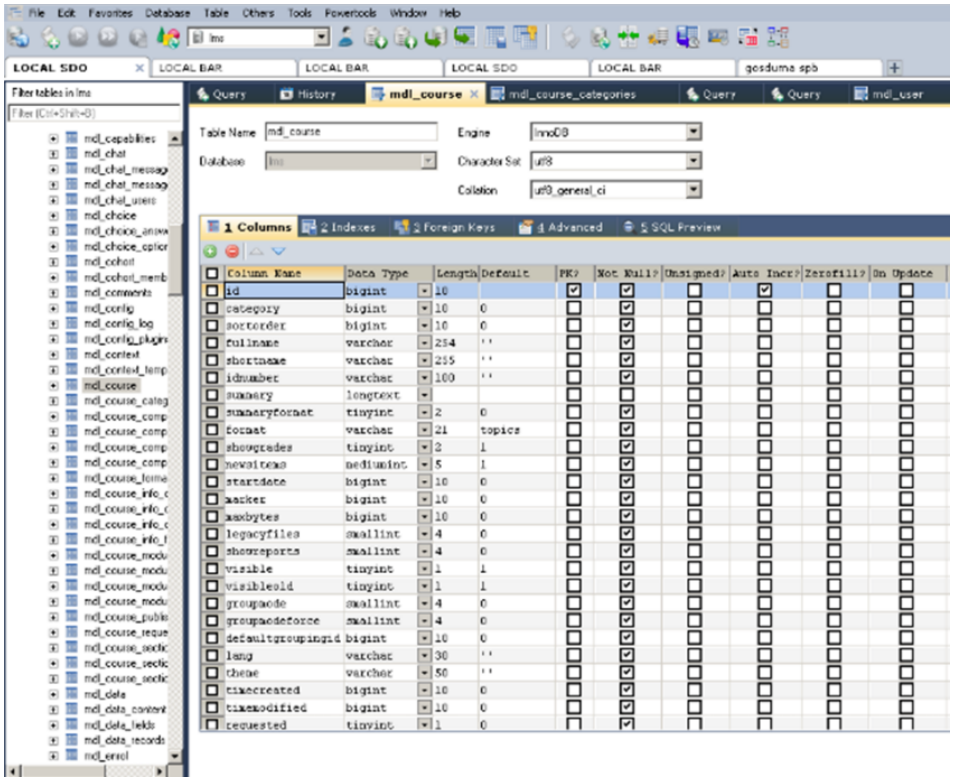

Figure 5: Courses table structure (Cources)

The developed AIS model shows the optimization of support for the organization of lifelong education, aggregating the achieved learning outcomes, forming an individual development trajectory, in terms of management processes, the possibility of consolidating statistical and analytical reports is clearly visible, which helps to increase decision-making efficiency for structures included in the educational process [19, 20, 21, 22, 23].

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