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Elaboration of Automated Systems for Development of Professional Competence

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Abstract: In this study researcher described, an approach to the construction of computer-aided instruction system for the development of professional competencies. Building such a system is an important task in connection with the introduction of a new generation of educational standards. The application of technology "client-server" is justified. Database system contains libraries of training modules, teaching materials for each module, regulations, passports competencies, fragments of semantic network, situational problems. Proposed all competences divided into knowledge, skill's and activities. This simplifies the process of learning management; system operation algorithm and the advantages of the proposed approach are described.

Key words: Automated training system, new standards knowledge competence skill's competence, activity-related competence, the database, the algorithm of work

INTRODUCTION

In connection, with the implementation of the new educational standard became the task of creating educational systems focused not on the acquisition of knowledge and skills but on the development of professional competencies.

The leading idea of modern education is expressed in an attempt to link the resulting component of education with the planned development of the individual student results. So in actual practice actualized competence approach.

Currently formed complex pedagogical approaches to the construction of educational systems (Bondarevskaya, 2004).

Many years in the Russian pedagogical theory and practice dominated knowledge's approach. Teacher formulates general principles, rules, relations, algorithms given certain external regulations. Educational procedures promote reliable fixation of the material in memory. The educational process is organized, so that students have the opportunity to reproduce their own and apply mastered the material in a variety of standard situations.

The essence of the humanistic approach to education is recognized that the main value of the student's personality, unlike the impersonal knowledge's approach. Leading the trend of the modern educational theory and practice is a student-centered approach to education. The starting point of the concept of student-centered learning is the concept of the person as the purpose of the factor of educational experience during training.

The idea of modern education is expressed in an attempt to link the resulting component of education with the planned development of the individual student results. So in actual practice actualized competence approach. Now more and more, it is suggested that the student should not be educated in general and achieve some level of competence in the methods of life in human society.

At the same time formed a set of educational methods and approaches which lies at the basis of the new approach and focused on the needs and perceptions of the students. Hat competence approach can be identified as the determining-effectively target orientation of education (Winter, 2004).

In developing the concept of building a system of continuing education in the field of Document Management (DM) is important to use and androgogichesky approach (consider features of training adults) (UNESCO, 1995). It is defined as the systematic use of the features of training adults. They already have the organizational experience, choose themselves what they teach. Adults can provide a self-learning process.

Analyses of the results of existing studies have shown that the methods of management decision-making in the field of continuing education the sphere of DM insufficiently developed (Finogeev *et al*., 2008). Only a small number of companies have their own concept of training or staff development in preschool. Program for maintain acquired skills not available also.

Decision-making in educational systems has its own characteristics. They are primarily connected with the

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processing of huge amounts of data, multiplicity of solutions and the need to multi-objective optimization (Finogeev *et al*., 2011). Therefore, the development of automated learning systems is an urgent task.

BACKGROUND

It is proposed to implement Automated Educational System (AES) training in the sphere of Document Management (DM) by technology "client-server" (Fionova, 2013). All professional competence should possess specialist to solve practical tasks required, registered in the state standard. Proposed to establish a list of competences of 3 parts: Knowledge's (KC), Skill's (SC) and Activities (AC). Each part has its own numbering (Fionova, 2009). AC will have n, KC; m_1 and SC; m_2 competencies.

KC is such competence that characterizes knowledge about the subject (concepts, terminology, models, etc.). Their study is needed to develop skills related to the acquisition, analysis, evaluation of this knowledge as well as a synthesis based on their new knowledge.

SC a competence that characterizes the practical skills (the ability to perform simple operations). Their acquisition will solve common tasks and problems.

AC a competence that characterizes the ability to solve a specific problem professional experience in DM sphere. Its development is possible only on the basis of a certain number of acquired and mastered KC and SC.

Database (DB) system is based on database MS SQL Server 2000. It includes a library of training modules each module training complex, regulations, passports competencies fragments of semantic network, situational problems.

Each training module Ymj educational program (route learning M_d) is described (Fionova, 2011) by two sets: $P_{in} = \{p_1, ... p_m\}$ and $P_{out} = \{p_1, ... p_k\}$.

Elements of P_{in} are necessary conditions for the student who wants to study this module (they include the Initial Competence (IC). The P_{out} are elements of the set Target Competences (TC) of that the student needs to master. They come in the Learning Outcomes (LO) study program as a whole.

When developing a specific module his preparations for the implementation of any educational program will need to define its purpose, describe the planned LO (TC or P_{out}) and prepare passports for all target AC's whose development is assumed after studying this module. You first need to analyze the educational standard towards training and professional competence to divide all three groups KC, SC and AC. The database consists of the following objects:

Activity; a table that stores information about all the AC: This table is linked to the tables knowledge and skill, because according to the AC passport must be known KC on the basis of which AC is formed and SC which are necessary for the development of AC.

Knowledge; a table that stores information about all the KC: This table is linked to table termins which stores information about the terms that the student should master, mastering AC and appropriate KC.

Skill; a table that stores information about all of KC: This table is linked to a table knowledge, as according to the SC passport must be specified KC on which you can master the SC and the table operations which stores information about the basic operations that make up the SC (in her decomposing model).

All tables of competences are tree like structure. They describe competence-constructed model subject sphere of document management. The data in these tables allow us to calculate the required parameters connectivity competencies and training modules.

At the educational process used graph Koenig G (X, R). It simulates the subject area. Vertices of the graph are the competence and the edges reflect their interdependence. The set of vertices of the graph X includes 3 subsets: Z, H, D. They describe KC, SC and AC, respectively:

$$X = D \cup Z \cup H;\ D \cap Z = \varnothing;\ D \cap H = \varnothing;\ Z \cap H = \varnothing \quad (1)$$

Where:

$$D = \{d_i\},\ i = \overline{1, n};\ Z = \{z_i\},\ i = \overline{1, m_1};\ H = \{h_i\},\ i = \overline{1, m_2}$$

Each ith Knowledge's (KC) or Skill's (SC) chain is a star subgraph Gi. Subset of vertices $D_i = \{d_1, d_2, ... d_k\}$ interprets a subset of activity-related competencies, development of which is based on the z_ith or h_ith competence, respectively (Fig. 1).

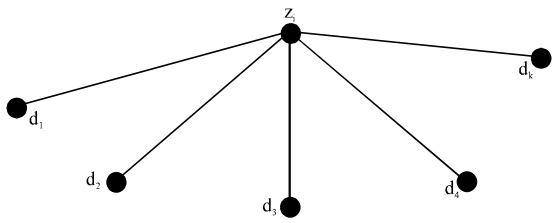

Fig. 1: Knowledge's chain in the form of stellar subgraph G_i

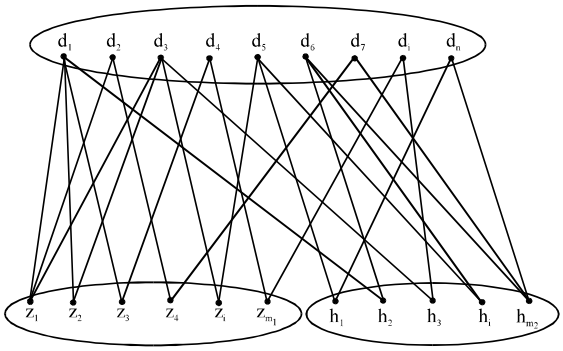

Fig. 2: Graph Koenig G (X, R) for the proposed competence model of educational space

Educational space is a set of Knowledge's (KC) and Skill's (SC) "chains" connecting AC (Fig. 2). Using this model, all communication between KC (z_i, i = 1, m_1), SC (h_j, j = 1, m_2) and AC (d_i, i = 1, n) competencies interpreted the incidence matrix of a graph G of size n×m (m = m_1+m_2): U = $||u_{ij}||_{m\times n}$. Where:

$$u_{ij} = \begin{cases} 1, \text{ if dj-competence formed based on the ith} \\ \text{knowledge's or skill's competence;} \\ 0, \text{ if } z_i \text{ or } h_i \text{ not participate in the formation} \\ \text{of djth competence} \end{cases}$$

Relations between knowledge's and skill's "chains" describes matrix of chains connectivity V = $||v_{ij}||_{m\times n}$, where:

$$v_{ij} = \begin{cases} (y) \text{ if } (y) \text{ activity-related competencies formed} \\ \text{simultaneously on the basis } z_i \text{ and } z_j \text{ or } h_i \text{ and } h_j \\ \text{or } z_i \text{ and } h_i \text{ or } z_j \text{ and } h_j; \text{ 0, if no activity-related} \\ \text{competencies that are both based on the same} \\ \text{knowledge's or skill's competencies ((chains) } z_i \\ \text{and } z_j \text{ or } h_i \text{ and } h_j \text{ or } z_i \text{ and } h_i, \text{ r } z_j \text{ and } h_j) \end{cases}$$

The matrices U and V are defined parameter connectedness "chain" (forming each KC or SC):

$$\Pi_j = \sum_{i=1}^{m} v_{ij},\ j=\overline{1,m},\ i \neq j \qquad (2)$$

and parameter of connectivity each activities d_ith competence:

$$\Phi_i = \sum_{j=1}^{m} u_{ij}\ \Pi_j,\ i=\overline{1,n} \qquad (3)$$

To implement all of the developed algorithms forming training programs and learning management formed the other tables:

- Table statutory-act which stores information about the regulations are necessary to master competencies AC
- Table level where you store the levels of education (primary, basic, professional). It contains information about what AC and what weight are primary, basic and advanced professional level on the DM
- Intermediate tables weight (they are associated with the table level) where the stored value "weight" for each competency depending on the level of training
- Table module which is also based on the principle of "Tree" which stores information about the modules of training
- Intermediate table (the table associated with the module) in the field "Source target" which stores information about whether the competence of the original (IC) for the module or whether it is the Target (TC) for the module

In addition, the database developed by AES organized storage of all the fragments of a semantic network of concepts and work spheres DM.

To describe the student (students) in the database has a table trainee which stores information about students. It is linked to a table current-condition (there also contains information on the current training completion). Table current-condition in turn linked to a table and tables module, activity, knowledge and skill.

All models and algorithms for the construction of learning adaptive control implemented directly in the database (technology-implementation on the server side) as stored procedures and user functions. Stored procedures are based on dynamic queries (dynamic queries it queries the script which is generated directly in the operation of the system, depending on the procedure for entering the parameters). All this enables a procedure in the context of a plurality of similar operations to implement and moreover, it is possible to build-up procedure without much effort.

In establishing the system uses the capabilities of the various application development tools in MS SQL Server. It provides high-speed development of all sorts of add-ins system.

Moreover, different developers due to their individual preferences can choose different development tools. The system is configured for the user on the basis of structural adjustment as a mechanism that uses dynamic SQL database stored procedures.

Thus, the server part of the system is built on a rather flexible framework. So, any time you can make changes to the existing algorithms and producing capacity of the system without much effort and cost. This is very important when going from one educational standard to

another or in the construction of corporate training programs. In this case, you need to add new competence or of training modules.

Adoption of new regulations, new terms and the development of new technologies DM all these changes simply reflected in the structure and operation of the AES. This leads to the creation of the foundations of the system of continuous education.

User interface (client side) is realized in rapid application development environment Borland Development Studio 2006 Enterprise Edition. Selecting this development environment was due to the fact that it is like no other, all the means of developing applications for MS Windows; it is the most focused on the development of database applications.

Flexible implementation of the server will reduce the burden on the "client" to a minimum. In this connection, the client part has been implemented under the web that will get rid of the installation and configuration of additional software on the user's computer such as setting up ODBC-driver for optimal performance with the database.

In DB organized storage of all components module training complex in each module, opened by user request. In the constructed AES implemented authentication system user (user role can act as a teacher and student) with certain access rights to the database for a particular IP-address or domain name to your computer by your browser (Finogeev *et al*., 2010). The system supports the most popular browsers: MS Internet Explorer, Netscape Navigator, Mozilla Firefox and Opera. Operation of the system is as follows (Fig. 3):

- The user accesses the AES (check with your password) and puts all of the requested information system (the formation of a model student)
- Indicates what Competences (IC) he owns and what Competencies (TC) would acquire, thus specifies the desired level of proficiency
- The system will offer the student to pass the test, which will specify the list of competencies which is owned by student (the analyzer initial state)
- According to the test results, the system will build the student model
- Will put the required (included in the educational program) training modules in the correct order
- Place all activity-related competence in the correct order in the study of each module
- Provide all the necessary electronic resources (manuals, regulations, assessment tasks and so on, all that is in the methodical complex) learner in the process of completing the course (or mastering each TC)

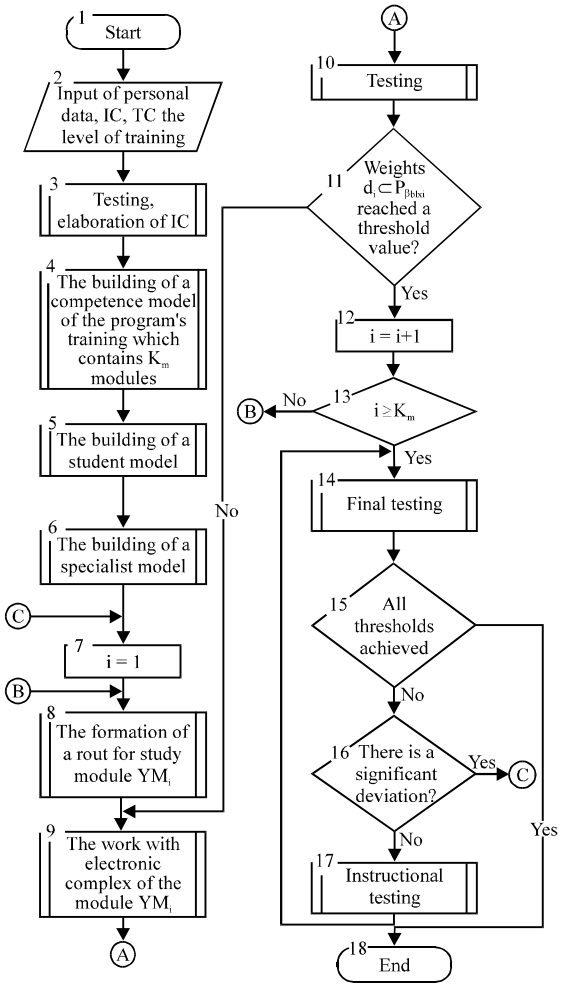

Fig. 3: Diagram of the AES work

- Upon completion of each step of training (development of competence or completion of training module) system will once again offer to be tested on each step
- Test result is stored in the previously described table current-condition as "weights" mastered competencies
- "Weights" mastered competencies compared to the values of "weights" assigned for each competency, depending on the level of training
- Depending on the result of the intermediate testing system "moves" to another student step (if the results are satisfactory). If the results are unsatisfactory, the system prompts to pass again this learning step
- At the end of training conducted a final test which helps determine how much the student has mastered those or other activity-related competencies or learned material of training module as a whole

- Depending on the result of the comparison to complete final testing system "moves" the student
  - To another level (threshold estimates achieved the completion of this phase of training)
  - At the beginning of this phase of training (at large deviation from the worse thresholds)
  - To retest on a quiz (with elements of explanations and tips) with minor deviations from the threshold criteria

In the process of learning, all the teacher can make adjustments to the model of each student. For example if the trainee learns fine material, the teacher can save him from the intermediate test after the training phase. Or on the contrary, the results of the intermediate testing add to the student model and route learning additional training modules for the successful completion of training.

CONCLUSION

In connection, with the introduction of new educational standards and the development of continuing education became the task of creating an automated training system. This system should be aimed at the development of professional competencies.

An approach to the construction of such a system for the training of specialists in the field of document management is described. At asked to provide training competencies divided into 3 groups: knowledge's, skill's and activities.

For each activity-drawn competence passport, this actually describes its model. Introduced the concept of the initial and target competence. All training modules are described by two sets of competencies P_{in} and P_{out}. Set P_{in} combines initial competencies and P_{out} is part of the learning outcomes. The proposed description of competencies and modules facilitates the learning management.

To build a system justified the use of technology "client-server". The structure of the database system is proposed. It contains a library of training modules, teaching materials for each module, regulations, passports competencies fragments of semantic network, situational problems.

In the process of learning the teacher can make adjustments to the model of each student. We can generate personalized route learning. It is now very important. The algorithm of the system is described. The system is built on an open basis. When changing training requirements can build modules. Benefits of the proposed approach is particularly important in the construction and continuous education.

RECOMMENDATIONS

The system is built on the principle of open and allows you to build modules. Further, development of the system is associated with the filling of all types of support. The first step is to develop electronic methodical complexes for all studied subjects.

Tear are task to create modules for the development of an each competence. This will facilitate the control of development. It is also necessary to develop tests to assess the development of all competencies. This will implement individual learning paths. They are especially in need of adult education.

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