MODELING OF THE APPLICATION ENVIRONMENT OF EDUCATIONAL DISCIPLINES AND THE DEVELOPMENT OF SOFTWARE SYSTEMS FOR THE CONTROL OF THE KNOWLEDGE LEVEL OF TRAINEES WITHIN FRAMES OF THE MULTIFUNCTIONAL EDUCATIONAL TECHNOLOGIC COMPLEX

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Abstract. The article considers methods of modeling of the application environment of educational disciplines within frames of the multifunctional educational technologic complex. Was offered the environment application model in the form of UML-diagrams for the creation of the block of object oriented extensible models of application environments of educational disciplines within frames of the multifunctional educational technologic complex. Described functional possibilities of software systems for the control of the knowledge level of trainees, as well as technologic peculiarities of the formation of data bases of test cases.

Keywords: control of the knowledge level of trainees, educational disciplines, application environments, modeling, UML-diagrams, multifunctional educational technologic complex.

Introduction

The modern development of the higher professional education system the special meaning is given to the modernization of methods of the control of the trainees' knowledge level. The active implementation of the informational support facilities provided for precursors for the creation and use of the special hardware and software for the control of the trainees' knowledge at all stages of the educational process. It is well-known that the best thing is the permanent control of the obtained knowledge and the definition of gaps at each trainee. This work is very labor consuming and takes plenty of both teachers' and trainees' time. In order to solve this problem automated systems for the control of the trainees' knowledge level can be used [1]. Anyway, in order not to transform the testing to the simple learning of facts, such facts can have the developed functionality, what will easily allow computer methodologists to create a lot of different types of tests.

Purpose of studies

The purpose of studies hereunder is the substantiation of modeling of the application environment of educational disciplines within frames of the multifunctional educational technologic complex at the development of program systems for the control of the level of trainees' knowledge and the formation of the data bases for test cases.

Materials and methods of studies

The multifunctional educational technologic complex (METC), developed by experts of the Autonomous Non-Profit Organization for Continuing Professional Education Institute International Standards of Accounting and Management and comprising software systems for the control of the trainees' knowledge level (SSCTKL), refers to the category of complex software systems. The experience of development of such systems, using advanced technologies of the software industry, shows the expedience of the object-oriented approach, providing for the interac-

tivity and flexibility of the development process, allowing to enhance the system functionality step by step [2, p. 19].

The object-oriented approach is based on the object decomposition, in respect to the analysis stage that means the division of the complex software system into objects and domain entities [2, p. 23]. On of the first and key stages at the creation of SSCTKL was the building of the visual model of the application environment, reflecting such functional components of the educational process, which are to be automated within METC frames. Requirements of the object-oriented approach are satisfied by the methodology, implemented on the basis of the visual modeling language UML (Unified Modeling Language) [3, p. 65]. In this juncture at the analysis stage was carried out the identification of basic notions of the application environment, which then have been represented as the application environment model. Following notions were most important: the data base of system users; the event log; the test case model; the module of cases' generation; the trainees' profile; the test specification; the test case.

The application environment model allowed to illustrate the glossary of conceptual classes with the list of attributes, which has been generated in order to reflect requirements for SSCTKL. At the creation of the application environment model conceptual classes have been considered in terms of the symbol entry and content, for what purpose were used definitions, words and images, representing certain classes of notions. The method of revealing of conceptual classes combined several strategies:

– use of the categorical list of definitions, objects and notions, referred to the control technology and to the evaluation of knowledge;

– selection of substantives as a result of the linguistic analysis of earlier created developed descriptions of precedents [4, p. 32].

Due to the need of description of several SSCTKL elements notwithstanding the existence of certain copies of such objects, as well as in the order to avoid the doubling of the information, several classes of specifications have been introduced into the application environment model, including the test specifica-

tion for the group of trainees. In the process of development of the application environment model were identified links (associations) between conceptual classes, meeting information requirements of developed scenarios, as well as ones, meeting the best understanding of the model, were highlighted [5, p. 127].

Results and discussion

The building of diagrams of the application environment allowed to obtain following results:

– function-oriented representation of the system, determining internal and external links;

– object-oriented representation of SSCTKL;

– list of software interfaces, regulating the interaction of sub-systems.

SSCTKL, included in METC, are developed on the basis of elements of new information & educational technologies. It allow to fully model the examination situation and provide all peculiarities of the traditional examination by following means:

1) with each new address the test system of the examined person generates the examination paper, comprising, on the basis of the random sampling, the given number of test cases;

2) cases, included by the test system in the examination paper from the base of test cases for each topic of the educational discipline, provide for the objectivity of the control of knowledge for all educational material;

3) time expenditures for examination of each trainee are materially reduced;

4) minutes with the examination results can be protected from forgery with the special hardware-software procedure – "facilitator's – organizer's password";

5) use of the random selection law while forming the examination paper from the base of test cases does not make sense to prepare cheat sheets;

6) the examination mode and the mode of preparation for the examination can have same computer screens what provides same psychological conditions for each trainee and reduces the stress component of the examination for them;

7) the inclusion of open test cases in the examination test allows, if necessary, to hold the additional interview, but with less time expenditures in comparison with the traditional academic form [6, p. 50].

Each SSCTKL represents an autonomous software product, implemented on standard facilities in Windows environment. The system provides for the organization of the knowledge level control of trainees in three modes:

1) self-control in any topic of the selected discipline;

2) midterm examination (credit) for a separate topic of the discipline;

3) final control (examination) in the whole learning material of the discipline.

Before the carrying out of the midterm and final control is provided the trainees' registration procedure and after the test is provided the registration of control results, which, except statistics, include texts of test cases and selected answers, provided in the examination sheet. In order to protect control results following possibilities are provided:

1) creation of the electronic copy of the protocol of control results by the key of the methodologist-organizer (examiner);

2) access to such electronic copy with printing out only with the key of the administrator of the educational process.

Each SSCTKL contains the test builder (TB), providing for the creation of the Base of test cases (BTC) for each topic of the educational discipline and allows to cover the large spectrum of types of test cases, using following 5 basic algorithms of its formation:

Type 1 – alternate test questions/cases, assuming such replies as YES or NO;

Type 2 – test questions/cases, allowing to finish the text phrase, having selected the right option from the given list (up to 9 options);

Type 3 – test questions/cases, assuming the selection of one of several options of the right reply from the offered list of replies (up to 9 options);

Type 4 – test cases, offering to fill missed words or groups of words in the test phrase, having selected such words from the offered list (up to 9 options);

Type 5 – open test, requiring the written reply with free form of presentation [3, p. 67].

First 4 types of test cases can be used both at the organization of the midterm examination or self-examination, as well as at the final control of knowledge – examination or credit. It is more expedient to use the 5-th type of test cases only for the examination.

The interface of both TB and SSCTKL is simple enough and does not require special knowledge neither skills for the program use. It allows any teacher with minimal computer knowledge to independently form BTR and to organize all kinds of control.

The processing of testing results is an enough complicated task and requires the use of the special mathematic device for the mathematic modeling (Rasch, Birnbaum models etc. [7, p. 421; 8]). For the practical use of programs of such models and for the analysis of obtained results the testing data should be placed in the data bank of test cases (DBTC), which is the important part of the whole METC information system. The data bank comprises the automated computer testing system, programs of the testing data processing by G. Rasch and the information storage system and the delivery of data processing results.

METC information system comprises the DBTC set, the software shell for the system interface, the data conversion program, the set of requests and reports for the convenient data presentation and delivery. The DBTC of METC information system are automatically created and filled (adjusted) with procedures of the automatic transformation (conversion) of data. It stores the information on the content of test cases, on extended testing results, on logits of the difficulty of tasks, as well as the other information on the data processing in G. Rasch's model [8].

The main peculiarity of DBTC information system of METC is that here the test case serves as the basis of the data structure. For each test case the information is being accumulated. Requests are also mainly oriented to the selection of the data by separate test cases. So, the main target of the information system is the step by step accumulation of test cases and the evaluation of its efficiency and difficulty. This information gives the opportunity

for the step by step creation of really effective and unbiased tests.

The software shell of the system interface is the integrated system, including the set of windows/forms for the delivery of the data and messages, the set of controlling elements and the system for the automatic verification of the integrity and consistence of the data from different related data bases. Procedures for the data conversion have been created for the automatic filling and possible correction of data bases. The data concerning test cases, testing results, results of the processing of the testing data are being selected by the user and are read from files and data bases of systems of the automated computer testing and data processing by G. Rasch's model [8]. The processing of this data, as well as the creation and filling of data bases is carried out in the semi-automatic mode, where the user can withhold and adjust the process. Conversion programs allow storing and using three kinds of test cases – text, RTF files (without related objects in separate files), HTML files.

Requests' and reports' programs are created for the convenient presentation of results of the information system work. Requests have been developed in SQL and allow to select and sort the data according to different criteria. The total number of requests is several dozens and it increases permanently as a result of creation of new requests. This system is in the process of development and is upgraded as necessary.

Opinions

The process of creation and operation of METC information system comprises the process of the accumulation of the experience in the presentation and processing of the data. The developed METC information system is being filled step by step and at the moment it contains several hundreds test cases with different disciplines and difficulty.

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МОДЕЛИРОВАНИЕ ПРЕДМЕТНОЙ ОБЛАСТИ ОБРАЗОВАТЕЛЬНЫХ ДИСЦИПЛИН И РАЗРАБОТКА ПРОГРАММНЫХ СИСТЕМ КОНТРОЛЯ УРОВНЯ ЗНАНИЙ ОБУЧАЕМЫХ В РАМКАХ МНОГОФУНКЦИОНАЛЬНОГО ОБРАЗОВАТЕЛЬНОГО ТЕХНОЛОГИЧЕСКОГО КОМПЛЕКСА

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Аннотация. В статье рассмотрена методология моделирования предметной области образовательных дисциплин в рамках многофункционального образовательного технологического комплекса. Предложена модель предметной области в виде UML-диаграмм для создания пакета объектно-ориентированных расширяемых моделей предметных областей образовательных дисциплин в рамках многофункционального образовательного технологического комплекса. Описаны функциональные возможности программных систем контроля уровня знаний обучаемых и технологические особенности формирования баз данных тестовых заданий.

Ключевые слова: контроль уровня знаний обучаемых, образовательные дисциплины, предметные области, моделирование, UML-диаграммы многофункциональный образовательный технологический комплекс.