THE CONCEPTION OF CREATION OF INTEGRATED DEVELOPMENT ENVIRONMENT FOR COMPUTER TRAINING SYSTEMS

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Abstract: *The various questions of creation of integrated development environment for computer training systems are considered in the given paper. The information technologies that can be used for creation of the integrated development environment are described. The different didactic aspects of realization of such systems are analyzed. The ways to improve the efficiency and quality of learning process with computer training systems for distance education are pointed*

Introduction

The continuous scientific and technical advance in all areas of human activity requires constantly possessing by new knowledge, and the traditional methods of the stationary learning frequently appear powerless. There has been a need for creation new technological system, which would allow transmitting to a great number of people arbitrary information content and special knowledge. One of the most perspective directions in this respect is the introduction of distance learning on the base of computer and telecommunication technologies [Bilous et al, 2000].

So, in 1984 these ideas have reduced to derivation of National Technological University (NTU) in USA, which by 1991 has been transformed to a consortium from 40 university engineering schools. Further experience NTU was investigated and was recommended as model for international electronic university. Today NTU is completely financed with fee, which is usually brought by the corporations (employers of learners). Six years later, the total income NTU was $13,5 million. Over millions students are taught on the program of distance learning. Since 1989 there has been the translation of educational courses through the System of a Public Television. Moreover the program of training and conversion training of the adults exist. It interacts with more than 1500 colleges and universities. The distance learning in Europe has developed intensively since seventieth years. Now in every European country there is a considerable group of educational institutions, in which has implemented distance learning programs.

In the simplified systems of distance learning which is not operating with principle of continuous feedback, the information necessary for giving the lectures, seminar and other sorts of class, is usually fixed on video cassettes and on video discs, and then it is forwarded to the students. Audio-records and data record on magnetic disks are used too. The materials are transferred immediately in educational institutions. Such method is applied by National center of distance learning Francium providing today distance learning more than 350000 users in 120 countries of a world. In this program, that includes 2500 learning courses take part about 5000 teachers.

Together with programs intended for large audience, set of the lectures and works, which allow to the learners after final examinations to receive the appropriate diploma or the certificate, has received a wide distribution. Examples of such direction of distance learning are the television courses of the Baltic University of Sweden, which combines more than fifty universities of the Baltic locale. Using systems of a satellite television, students

and the science officers have possibility to have scientific and educational contacts on subjects representing common interest.

However distance learning presents the new requirements to techniques of learning and testing of knowledge. First of all, these requirements concern system's representation of interdependent knowledge from different application areas [Bilous et al, 2000]. Now there is a necessity in cultivation new systems of creation and organization of active information resources. Such information system is the integrated development environment for computer training systems (IDECTS). The given paper is devoted to various aspects of development and use of it.

The role of multimedia technology in computer training systems

The modern computer training systems are developed with the help of the multimedia technology. The given technology has appeared at the butting of many branches of knowledge. Development multimedia CTS is the long-term and expensive process, therefore it is important to imagine all main stages of courses creation and possible solutions, which can be used at each stage [Shubin et al, 2006].

The courses for representation in multimedia environment are chosen at a preliminary stage. It is one of the most responsible stages of development. The choice is carried out on the basis of results of marketing researches. Already existing courses on the given problematic should be detected, must be defined the guessed expenditures and time for creation of this course and, audience, who are addressed these course and also its probable number of copies. The type of an audience allows defining the common requirements to multimedia course.

It is possible to choose groups of courses: for children of preschool age and low school age, general educational courses of a different level and courses of special derivation for beginner and experts.

The training systems for children of preschool and low school age are intended for forming basic skills and knowledge (color, the form, sound, music, speech, reading, letter, natural sciences, foreign language, the computer skills etc.) and have simple for children's perception interface, which are implemented as the fascinating game, travel and so on.

The general educational courses should take into account features of education that connected with a different level of learners schooling (estimation of learner knowledge and adaptation of the system for the optimal presentation) and with different level of computer knowledge (simple and clear the interface). It is important to provide the matching of teach subjects, that the learning of one subject didn't go to the detriment to other and didn't overtake learning of parallel subjects.

The courses of special derivation should take into account a level of knowledge, give a possibility do not repeat already known subjects, to provide the latest information in the given data domain. When course and audience are selected, the purposes of learning and degree of complexity of a material, which will be represented in a training system, should be also defined.

The methodology of creation of computer training systems

Since IDECTS is intended for design automation of CTS it is necessary to analyze the methodology of their constructing for highlighting of main development stages. The experience of using a computer in training had shown that creation of the effective program for learning process is the composite and laborious work, requiring collective operations of the experts of the different profile. Therefore modern methodologies of constructing programs for learning process need a creation a collective of the developers, which includes: the expert in an investigated subject; Methodist is the expert in a method of training, which is realized in the program; the psychologist is the expert in diagnostics of errors of learners and psychology of perception of an learning material; the artist is the expert in aesthetic designing of an learning material; the composer is the expert in musical designing of an learning material; the manager is the organizer of collective activities of programmers and experts. The structure of collective developers is similar to structure of creative group on creation of learning films with replacement operator group by the programmers.

The life cycle of CTS designing consists of the following stages:

- Decision making about program design;

- Conceptual designing;

- Detailed designing;

- Implementation that consists of programming, debugging, approbation, finishing and estimation of quality of the program;

- Implantation in the learning process and maintenance.

The analysis stage of a problem consists of exploration of learning process of some discipline, selection of fragments of this process accepting effective using of the computer, tentative estimation of expediency of using computers, decision making about a program design of CTS. A role of the CTS in the learning process here is determined.

A subject and title of the project, structure of designer's collective, age and amount of the learners, who will be trained to the given subject, ways of usage in CTS of techniques of training, methods of a data representation and knowledge, requirement to the configuration of technical means, and other items of information, that characterize CTS of particular sort, are usually defined at a stage of conceptual designing. Result of this stage is the conceptual project (the document containing basic performances of the future CTS). The conceptual project is reviewed and if it's necessary it will be corrected.

At a stage of the detailed designing a development of structure and contents of the CTS occurs. Splitting the CTS into units and functions of each unit here is defined. For each type of training system there is an individual technique of designing, which contains one or several learning scripts for programs of this type. On top levels of designing, according to selected models, there is a script of the programs consisting of a sequence of concrete subjects (purposes) and an learning material, appropriate to them, (definitions, tasks, help etc.). On lower layers of designing the algorithms of output of a learning material, analysis of learner answers and control of the learning process are specified. During designing the major notice is given to how a learning material is looked at the screen of the computer. At present time many techniques contain a lot of recommendations about external designing of the text and graphics of learning information. The main requirements that presented to CTS interface are:

1. Psychological adequacy. The ways of interaction of learner with the system should correspond to its guessed sort of activity.
2. Ergonomics is a choice of type and layouts of peripherals as well as methods of operation with them to allow optimally organizing activity of learners.
3. Aesthetically beauty intends availability of some concept (style) of representation of the information and ways of interaction with learner.
4. The minimum complexity of interaction intends that in each instant learner receives only the necessary information.
5. Harmony psychological, ergonomically and aesthetic solutions at creation of the CTS interface.

The given requirements aren't equivalent or independent. The majority of them are derived from requirements of psychological adequacy [Werner, 1987].

Result of the given stage is the project of CTS containing the thumbnails of external representation of the learning information and logical organization of the program. The project is reviewed and, if errors are found, it will be changed.

At a stage of realization the programming languages (general-purpose or authoring) and tools for creation of learning courses are chosen. At the stage the CTS coded and debugged. Here also the quality of CTS is estimated and it is approved. That is considered as necessary steps for estimation of CTS efficiency. The expert in learning technologies produces the estimation of CTS quality. The approbation consists in holding experimental training on the designed program by restricted learner's group, with the subsequent interrogation and data

processing about learning process. Result of the given stage is the full-functional CTS, the reviews of the experts about its quality and results of approbation.

For successful work of the CTS it is very important to prepare correctly the environment of its operation (create motivation and required level of learner knowledge to provide trouble-free operation of hardware, to conduct preventive measures of "computer phobia" etc.) and to train serving staff (teachers, laboratory assistants) rendering pedagogical and technical help to learners during their work with the CTS.

The structure and functioning of IDECTS

As already was noted above, the IDECTS is intended for automation of development of computer learning and testing systems of distance learning for any domain. Output data of the IDECTS is the computer training system that is oriented to concrete data domain, program environment and hardware. An input data of the system is the learning script, which help to set functionality of a training system that is creating. In other words, the adjustment of the IDECTS to particular data domain is realized with help of learning script. The learning script should have a module structure. It is obligatory the presence of following units: the unit of registration, the unit of precheck testing, the unit of the hypertext textbook, the unit of on-line learning and the unit of final testing .

The unit of registration is intended for registration of learner in the system, creation the model of learner and support of the electronic journal. The unit of precheck testing is intended for definition learner's degree of readiness for learning of the given subject and for creation and filling learner's model. The unit of the hypertext textbook is intended for presentation of large theoretical information, which consists of blocks both text's and graphic's information joining together by hyperlinks. The unit of on-line learning implements learning process by means of involving learner in active dialogue with system. The unit of final testing realizes the function of testing of the learner for checking his knowledge in material and for determining the missed units of knowledge.

The expediency of inclusion of each unit in the learning script depends on the purposes, which are put at creation of a training system by its author. Thus, the process of creation a training system in IDECTS consists of selection of necessary units, their logical coordination and appropriate set-up of their parameters. Each unit should have the set of structured elements, which represent the next level of detail of the learning script. The insert of structured element in the learning script should be done by means of dragging it with the mouse from the toolbar to a particular place in the scripts or choosing them from the appropriate menu. For the unit of registration such unit is the registration form. Registration form should allow to set biographical data, which will be interrogated from the learners and, if it is necessary to assign to them the special password for operation with the system. The creation of registration form should be made in the on-line mode with the built-in IDECTS editor of the screen forms. For the unit of precheck testing a structural unit is the test task.

After structure of learning script is created, the following stage of development of CTS in IDECTS is its filling, i.e. creation and editing of each structural element of learning script. This process should be carried out in the built-in IDECTS editor of the screen forms. The editor of the screen forms should consist from: the editor of the screen forms; the editor of properties and bar of the menu with the graphic palette of components. There should be a possibility of creation a new form with the help of special prepared templates. The additional components both decorative and interactive should be there too. The logic analyzer, which allows analyzing the formulas of logic-algebra, and blocks of the text of input fields, is an example of such components. Any training system that was created with the help of the IDECTS should include subsystems of support of the electronic journal and learning protocol.

A problem of integration of the IDECTS in management systems of the learning process is actual now. It has reduced to appearance in the market of the software a great number of tools to automation and creation Web based training courses (WBT-courses). Therefore it is necessary to have the open structure of storage of learning scripts in CTS and all related materials.

There is a problem of performance of practical operations by the learners on the computer in organization of distance learning. Most effective is possibility of access to server of an educational institution, when the learner

receives on the computer only screens, while programs are executed on the server. It considerably simplifies work with software, as it is completely allocated on server of an educational institution. Besides it is simplified the involvement of the learners in the collective projects. The learners and teachers also will have access to network resources of an educational institution (for example, to high-speed computers or expensive equipment).

In learning process the additional materials (for example, literature that is not included in the electronic library of institute) are often necessary for the learner. Then the organization of a bookshop (sending the books to the learner by post) or bridging with existing bookshops for sale this literature is necessary.

During organization of distance learning the possibility of messaging by the e-mail between the learners and teachers is important. For this purpose it is expedient to include in the IDECTS the tools for work with the e-mail. Besides, the control of the mail service is simplified. Thus the learners should have possibility to realize access to mail by means of the Web-interface (through a browser). Such manner will allow the learner do not immix mail concerning the learning process with the personal mail and will facilitate the search of necessary information. At organization of the mail service it is expedient to give to a learner the possibility to create folders for storage of different types of the messages.

One of attributes of WBT-course is the computer conference (is usually implemented as Web-forum) with participation of learners and teachers. Such conferences are usually conducted not in real-time mode. Due to that the variance in time's zones between the learners and teachers is overcame and also the necessity to be present at certain time is eliminated.

The CTS created with IDECTS should provide the learners a possibility to search in forum messages. For protection against the unfair users it is necessary to provide possibility of reviewing of forums. Thus there will be a person (moderator), who will check all messages and publishes them, only if they perform the requirements of the given forum.

In the IDECTS it is necessary to provide tools of working with the timetable-calendar within the framework of institute and within the limits of separate course. This tool should give an opportunity to publish events by both learners and teachers. It is necessary that the calendar automatically remind of coming events. The possibility for the learner to store in such calendar the events, which would be available only for him, is very useful. It is known that reading from a paper more conveniently, than from the screen monitor, therefore the learner should have possibility to receive paper variant of course. It is very important that IDECTS supported possibilities of compilation materials of courses for printing with adjustment of page setups, size and typeface of the font, and also variants of layout of the text on page.

The velocity of transmission of information grows promptly. Now if the learners have good connection to the Internet the organization of videoconferences is possible. Therefore at designing the program system like IDECTS it is necessary to provide possibility of a videoconferencing.

The materials of course should be represented with hierarchies of sections. For this purpose the appropriate tool in CTS should be included. Due to such approach, the learner permanently has the information about level of hierarchy in which he is in the present moment, and also about which sections precede the given section in hierarchy [Bloom, 1964].

The realization of search subsystem over contents of course is very important for the learners. And, the search not only text's, but also graphic's, audio- and video data may be useful. For this purpose it is necessary to provide in the CTS the advanced search engine with possibility of calling it from any place of course.

For simplification of information retrieval by the learners, the IDECTS should contain tools for organization of a glossary. Thus the titles of concepts that are covered in a glossary should automatically become the links in the text of course. Besides, it is should be realized the function of search in glossary too.

During work with materials of course learner may have need to find fast the detailed description of this or that concept. The subject index is necessary for this purpose. It is easier to make it as the list of terms with hyperlinks to section of course, where this term is described in detail.

To support lessons or conversations in real-time mode the chat tool should be included in the IDECTS. With this tool the teacher can create subject's groups for dialogue of the learners in the chat mode. The discussion of the learners with the teacher should be stored in the learning journal with the purpose of further analysis and correction materials of course on base of results of this analysis.

For simplification of creation of new courses the IDECTS should contain a set of templates of learning courses. The teacher should have possibility to select subject design from a set of templates. The presence of templates of learning courses will allow the teachers faster to study possibilities and tips of work with the system [Bilous et al, 2002].

The presence of drawing boards of share use (whiteboard), in which learners and the teachers can jointly draw in real-time mode, will allow considerably to approximate the process of discussion or interrogation to personal contact between the teacher and learners. It is used with chat or conferences during subject discussions.

It is necessary for the learners and teachers to have possibility to turn on and off the hints in CTS. Apparently, the user can't memorize all functions at once. The user should have possibility to disable the hints after certain period of using of IDECTS.

For convenience of learner work he should have possibility to add the comments for itself into sections of learning materials (the learner can add the comment, which will be stored on the learning server). Besides it is necessary to give learners the opportunity to collect together all these comments and to move through connected with them sections.

The important moment at organization of distance learning is the ensuring of information safety. Therefore teacher should have possibility to limit access of learners to all courses and to they separate parts. Using only Web-interfaces for access of learners to all parts of course (the e-mail, conference, chat etc.) simplifies ensuring of safety at a level of network and transport protocols (TCP/IP).

For realization of the learning process it is necessary to group learners into classes. According to a specialty, the certain courses and tests will be anchored to the class. It is necessary to assign one or several teachers for the class, which will have access to this class for work with the learners.

For registration of the learners the questionnaire will be rather convenient. After filling the blank the learner will enroll automatically (this way is especially convenient at enrolling on free courses). For organization of such registration system the automatic activation and termination of the learning process are necessary. In this case the following limitations are indicated:

- The date and time of a registration beginning;

- The date and time of a registration termination;

- The maximal quantity of the learners in the class.

Nevertheless, for each specialty or course it is necessary to have possibility to establish three ways of registration of the learners. The learner is registered, when he filled the questionnaire. The learner fills the questionnaire, but is registered only after confirmation of this questionnaire by the manager or teacher. The manager or teacher registers the learner without his involvement.

In the IDECTS it is necessary to provide tool of batch processing to reduce time of processing of the large amount of questionnaires, when it is need to register the group, instead of one learner.

The organization of document circulation, which is connected with registration, teaching and graduation of the learners, is imperative. From the moment of registration (from the moment of confirmation of the questionnaire) the learner should be automatically inserted in the database, in which his activities will be subsequently stored (education fee, the marks for the different tests and examinations, the amount of visiting pages with courses, participation in conferences, chats and forums etc.). And it is necessary to have possibility to limit access of the learners to these data, for example only to read.

Inside of IDECTS there should be a system for timetable formation. At distance learning it is necessary to make timetable for on-line consultations, as one teacher can teach in several classes, besides, the consultations can be conducted not only within one class, but also within course, subject of course, course project etc.

For simplification of organization of the learning process it is very convenient to keep account of the teachers and their schedule. The information about classes and degree of teacher work is stored in the system database. Thus, it is easy to adjust current schedule according to the timetable.

Among other functions of IDECTS the central place at designing belongs to the functions of storing data into knowledge base. There are all learning materials of published courses in the knowledge base. Also the dependences of learning materials from each other are reflected here. The learning material is structured so that it will be visible, in what sequence it will be presented to the learner. Thus it should be clear, what knowledge and from which sources the learner should receive before he starts learning a concrete learning material.

From all document circulation it is necessary to distinguish the information on progress of the learner. For each learner the marks for tests and examinations are stored in the CTS database. Also there should be following information: how much time learner spent on each question, date of test, how much attempt he had to receive this mark, the marks for the previous attempts. On the basis of these data it is possible easily to define progress of the learners, to build a graphics and diagrams reflecting their degree of knowledge.

It is expedient to create common database of questions. The test questions, which are created for separate course, are stored in the common database. So, different questions can be used in other courses for making total examinations at this course or at all courses, without necessity to include all question databases to developed CTS. It is the way to increase efficiency of checking learners' knowledge by using major variety of types of questions [Bondarenko et al, 2008].

Types of the test tasks, which should be supported by IDECTS during designing CTS testing subsystem, are featured below:

- The choice of one variant from several (it is necessary to provide possibility to represent variants of the answers both as text, and as graphics images);

- The choice of several variants from given;

- The short answer (one line, which can be parsed by the CTS).

- The full answer (text, which will be checked by the teacher). It works as previous, besides there should be a possibility to send files;

- The choice of accordance. Two lists will be given. It is necessary to set up a correspondence of units of the first list to the units of the second list;

- Input of the formulas with checking their correctness and comparison on equivalence;

- Indicating the coordinates of a position on the screen with the cursor;

- Dragging the particular object inside given area of the screen;

- Layout of particular texts' or graphics' units in an exact sequence. For example, on the screen the units of the computer network (workstations, servers, routers, concentrators, different types of a cable) are drawn. The learner should to arrange them in the exact order with mouse;

- Calculation of value. The set of arguments of the function is offered to learner. He should define value of the function.

Conclusion

In the given paper the theoretical generalization and new solution of the scientific task of designing the integrated development environment for computer training systems are obtained. The designing of learning course in a concrete subject is extremely laborious task. It can handle only the collective of experts (the teacher training similar course, psychologist, stylist, editor etc). But for achievement of the goal this collective of the experts of the

different profile requires the uniform tool, which would allow them cooperate effectively. Such solution is the integrated development environment of computer training systems.

The program implementation of IDECTS that is basing only on one information technology is not possible. An optimal combination is the following technologies: Macromedia Shockwave + Borland Delphi + SQL + Real Audio + Real Video. Also we shall notice that the writers developing CTS with the help of IDECTS will have problems with a relation of possibilities of hypermedia in learning course. As the practice shows, using units of hypermedia in learning considerably improves the process of obtaining knowledge and skills. For example, it is known from the theory of learning, that if at learning with usage the text information the intensity of learning is about 25 %, if the texts is supported by a sound it increases up to 50 %, and if it is used text, sound and video the intensity of learning is approximately 75 %.

Using the approach that is offered in the given paper, it is possible to develop the environment, which automates the process of creation of CTS for all three stages of learning: obtaining of knowledge, acquisition of skills and mastering skills. The application of such environment together with the technology of distance learning will allow providing high quality of learning and increase its efficiency at the expense of involving in the CTS development of team of highly skilled experts and correction of learning styles depending on level of learner knowledge and his psychological characteristics.

Bibliography

[Bilous et al, 2000] N. Bilous, I. Shubin, O. Vyrodov. The conception of interactive training system design: In journal of New Solutions in Modern Technologies, Kharkiv, Ukraine, № 79, 2000.

[Shubin et al, 2006] I. Shubin, O. Vyrodov, N. Bilous. Design of distance learning system on basis of modern information technologies: In journal of System Analysis, Control and Information Technologies, Kharkiv, Ukraine, issue №93, 2006.

[Werner, 1987] E. Werner. Artificial intelligence and tutoring systems. Computational approaches to the communication of knowledge. Los Altos: Morgan Kaufmann. 1987.

[Bloom, 1964] B. S. Bloom. Taxonomy of Educational Objectives: The Classification of Educational Goals, by committee of college and university examiners. New York: D. McKay Co. 1956-1964.

[Bilous et al, 2002] N. Bilous, I. Shubin, O. Vyrodov. Integrated environment for distance learning courses developer: In Proceedings of 5-th International conference on Internet is a New Technology Environment in Information Society, Veliko Trnovo, Bulgaria, 2002.

[Bondarenko et al, 2008] M. Bondarenko, N. Bilous, I. Shubin. The Ukrainian e-Learning Region: In Proceedings of 10-th International LLinE Conference New Partnerships and Lifelong Learning, Helsinki, Finland, 2008.

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