

# Development of Distance Learning System Based on Dialogue

Bozidar Kovacic and Zoran Skocir\*

University of Rijeka  
Faculty of Philosophy  
Omladinska 14, Rijeka  
Croatia

email: bkovacic@mapef.pefri.hr

\*University of Zagreb

Faculty of Electrical Engineering and Computing  
Unska 3, Zagreb  
Croatia

email: zoran.skocir@fer.hr

*Abstract*—Development and implementation of new technologies are very important in education. Internet computer network and distance learning enabled the transfer of vast multimedia information and the education independent of its venue and time. Student's feedback of distance learning can improve its quality. A distance learning system based on a dialogue enables the assessment of a student's knowledge. The system is based on the analysis of a student's feedback, research of the defined structure of the teaching domain and generation of the new learning contents. It follows the learning progress and improves the quality of knowledge. A distance learning system is implemented by integration database and WWW technologies.

*Index Terms*— database management system, dialogue, distance learning system, object orientation, WWW technology.

## I. INTRODUCTION

DISTANCE learning is very important in contemporary education. The development of communication technologies and especially the application of computer in communication facilitated data transfer to great distances. It was favored for development of the distance learning techniques to which the advantages of electronic media allowed fast and relatively simple distribution of the learning material to big distances. The development of telecommunication and computer networks, especially of the Internet, is a powerful base for developing distance-learning systems. Majority of the issues regarding data, information and knowledge transfer have been resolved. Now, most of the efforts are focused on the organization of distance education so as to increase its performance. Whereas an amount of multimedia information can be transferred, there is scarcity of the feedback about their adoption. A distance learning system based on a dialogue can improve the results of distance learning. This work explains the implementation of a dialogue in distance learning and development of a dialogue-

based distance learning system. The system includes all elements relevant for distance learning and those that contribute to its improvement. The latter are related to the possibility of distance learning control and include monitoring of the learning process, recording of its important characteristics and its corrections. A behavior model is based on continuous communication and exchange of information between the person learning and delivering knowledge. Permanent communication and exchange of information or a simple dialogue are necessary for monitoring and correction of a distance learning process. The main purpose of the system is to transfer knowledge, monitor the learning process and increase the effect of distance learning. The system is realized by integration of database and WWW technologies as a dynamic Web application. It can involve many students and teachers irrespective of its venue and time.

Basic principles of a distance-learning model are shown in the Section II. A formal model developed for a distance learning system is shown in the Section III. Development of a dialogue-based distance learning system is shown in the Section IV. Conclusion in the Section V is followed by the reference list.

## II. BASIC PRINCIPLES

Basic principles are explained by a distance-learning model with the following elements: knowledge base, delivery, learner, evaluation, record base and system control. The scheme of such a model is shown in Fig. 1 [1].

The system control uses a query index (defined by the specific selection criteria) to place the request to the knowledge base for data from the learning contents (the material with the information presented to the students with purpose learning student). The knowledge base sends the locator index of the requested data from knowledge base to the control system by query index. Control system controls

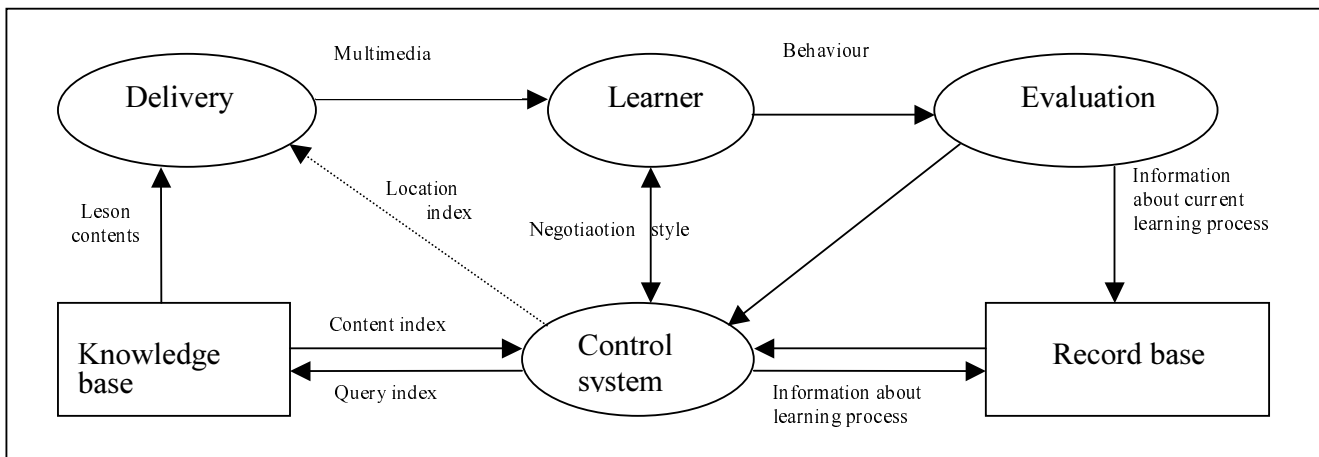


Fig. 1. The scheme of a distance learning model based on a dialogue

transfer-learning contents between knowledge base and computer for transfer data (delivery) using locator index that determines computer for transmission data to student. Multimedia learning contents is transferred to a student who generates reaction in form of behavior that is important for estimation of the result of learning process and evaluation student's knowledge. Evaluation data are sent to the system control that decides about the additional activities required for the learning process. The student's evaluation data are also sent to the record base to update the learning process data. The record base stores important data about the completed learning process that are then analyzed for the improvement of the additional learning process. The control system uses many student's evaluation data about the ongoing learning process and the record base. They are needed to define the selection criteria for the learning contents necessary for process continuation. The control system places various queries to the record base about current or previous learning processes. With its answers, the system control influences further course of learning. It changes future learning processes by upgrading the knowledge base through recognition of the completed learning processes. The control system enables direct communication with the student wanting to select the learning style (studying of a new material, refreshing knowledge, examination, etc.).

Basic advantages of the system are its capability to analyze a distance learning process and change the ongoing and future distance learning. The system must be able to record the parameters that accurately estimate the retained learning contents and stores them in the record base for the subsequent conclusions about the quality of the completed distance education. Based on these information the system control performs self-education and improves distance learning cognition. Distance learning system has the ability to expand the knowledge base with new findings, thus improving future distance learning system, it may be concluded that the quality of distance learning processes will gradually increase.

### III. FORMAL MODEL OF A DISTANCE LEARNING SYSTEM BASED ON A DIALOGUE

Implementation of such a model starts with the estimation of the learning process and definition of the ways to correct and improve it [2]. All relevant elements for estimation of the learning process [3] must be carefully analyzed. The next step is to consider of particularity that brings acceptance of technologies for distance learning. It includes storage of knowledge, its distribution to students, distance estimation and the possibility to correct the process.

The first step in designing a formal model is knowledge domain presentation. Concepts and the relations between them define knowledge domain that enable its structural organization. The experts define the concepts and every expert defines his/her relevant learning material that includes the text, pictures, audio, video and multimedia. Also, every concept is linked to the questions of three types (check up, training and examination). Checking up of the questions is aimed at defining student's acceptance of a concept through two answers: correct or false. A training question is used for student's training and checking of the acceptance level of the learning material. The examination question is aimed at final checking before the exam. A student's answer is recorded in a knowledge matrix (Fig. 2.) used for  $V_{ij}$  in a knowledge matrix. A false answer lowers the score of student's knowledge. A correct answer of a student  $U_j$  to the question about the concept  $X_i$  raises the value  $V_{ij}$ . Expert at the beginning can define value for every  $V_{ij}$  in knowledge matrix as well as during the learning process according to student's knowledge.

By using the concept's structure a student can choose a concept to learn. The learning material is presented to him/her and a question to check up every concept related to the learning concept too. If his/her answer to some check up question is false, the acceptance of the concept is unsatisfactory and he/she is instructed to learn it after what the check up questions are repeated. Every answer is recorded in the knowledge matrix by the changed value of the learned concept and it defines current adoption of the learned concepts.

	$X_1$	$X_2$	$X_3$	.	.	$X_m$
$U_1$	$V_{12}$	$V_{13}$	$V_{14}$	.	.	$V_{1m}$
$U_2$	$V_{21}$	$V_{22}$	$V_{23}$	.	.	$V_{2m}$
$U_3$	$V_{31}$	$V_{32}$	$V_{33}$	.	.	$V_{3m}$
.	.	.	.	.	.	.
.	.	.	.	.	.	.
$U_n$	$V_{n1}$	.	.	.	.	$V_{nm}$

Fig. 2. Knowledge matrix

The limit denoting satisfactory level of student's adoption of the  $X_j$  concept is defined for every value  $V_{ij}$  in the knowledge matrix. If a student reaches it a check up question is avoided every time it has to be presented for checking of the student's adoption of the  $X_j$  concept. Consequently, a student is checked only for the concepts insufficiently well adopted, so that learning of the well-known concepts is avoided as unnecessary. The achievement of every concept's characteristics relevant for estimation of student's knowledge defines student's skills because the concepts that correspond to student's skills are very well accepted. It is, therefore, possible to determine the level of student's knowledge and its structure. By comparing several students' values from the knowledge matrix we can analyze their structure and the overall quality of the learning process.

After defining the concept's structure and knowledge matrix, the algorithms for presentation of the activities during learning are created [4]. They define the steps for the avoidance of:

- defining concept's structure,
- making entries to the learning materials,
- defining concept's sequence,
- making entries to the questions,
- selection criteria for examination,
- learning process,
- repeating,
- examination, and
- analysis of the learning results.

After that the object model for a dialogue-based distance learning system is created and the UML 'use case' diagram, UML class diagram and UML state diagram used. The UML object method is used to define the object model. The UML 'use case' diagram defines the system actors and their interaction and processes for data exchange. The actors are the student, teacher, database administrator, database and external database. During learning the student and teachers use database and external database.

The UML class diagram and UML state diagram define every process between the actors in the 'use case' diagram. The UML state diagrams explain changing of the object's state during learning. The UML class diagrams define the classes and relations between them. Every class is defined by the attributes and operations.

The formal model of a distance learning system based on a dialogue comprises the following UML diagrams:

- defining relations between the concepts,
- connecting questions with concepts,
- connecting learning materials with concepts,
- defining concepts sequence,
- selecting examination criteria,
- learning process,
- repeating,
- examination,
- analysis of the learning results.

This paper presents the most important UML class diagram for performing a dialogue (Fig. 3). The UML class diagram of learning has the following classes: Student; Learning; Concept; LearningConcept; Question; ReferencedConcept; LearningConceptQuestion and Knowledge. The class attributes are presented in Fig 3, but not the class's operations because of the diagram's eligibility. One student performs one or more learning, whereas learning can be performed by one student. The concept selected for learning is presented by the class LearningConcept. The related Class Concept has the recursive binary association because every concept can be connected without or with several concepts that enable defining of the concept's structure. The question included in learning of a selected concept is presented by the class LearningConceptQuestion and connected with the LearningConcept and Question. The class ReferencedConcept presents the concepts referenced to the selected learning concept derived from the concept's structure, so that the ReferencedConcept is connected with the class LearningConcept and Concept. Every referenced concept is checked during learning, so the ReferencedConcept is connected with the class Question. The class Knowledge represents the record of the knowledge matrix (Fig. 2). It connects the students with the concepts and contains the variable  $V_{ij}$  for recording a change in the student's knowledge. The classes LearningConceptQuestion and ReferencedConcept change the value of a variable  $V_{ij}$  because their attributes contain the information about the correctness of student's answers. The presented UML class diagram defines the classes included in learning, their relations and attributes for the storage of all relevant data about learning. Analytical results of learning are obtained from the data recorded during learning in the class attributes. The UML 'use case' diagram and UML class diagrams with the UML state diagrams present a formal model of a distance learning system based on a dialogue.

#### IV. IMPLEMENTATION OF DISTANCE LEARNING SYSTEM BASED ON DIALOGUE

Further development of a dialogue-based distance learning system relies on the model shown in Fig. 1. and a formal model. A distance learning system based on a dialogue is realized as the WWW application based on integration of database and WWW technologies. The system development uses a three-tier structure shown in Fig. 4. The system connects the end user (a student or a teacher) with the data from database by the middle tier presented by the WEB server. Implementation of a distance learning system based on a dialogue is realized by:

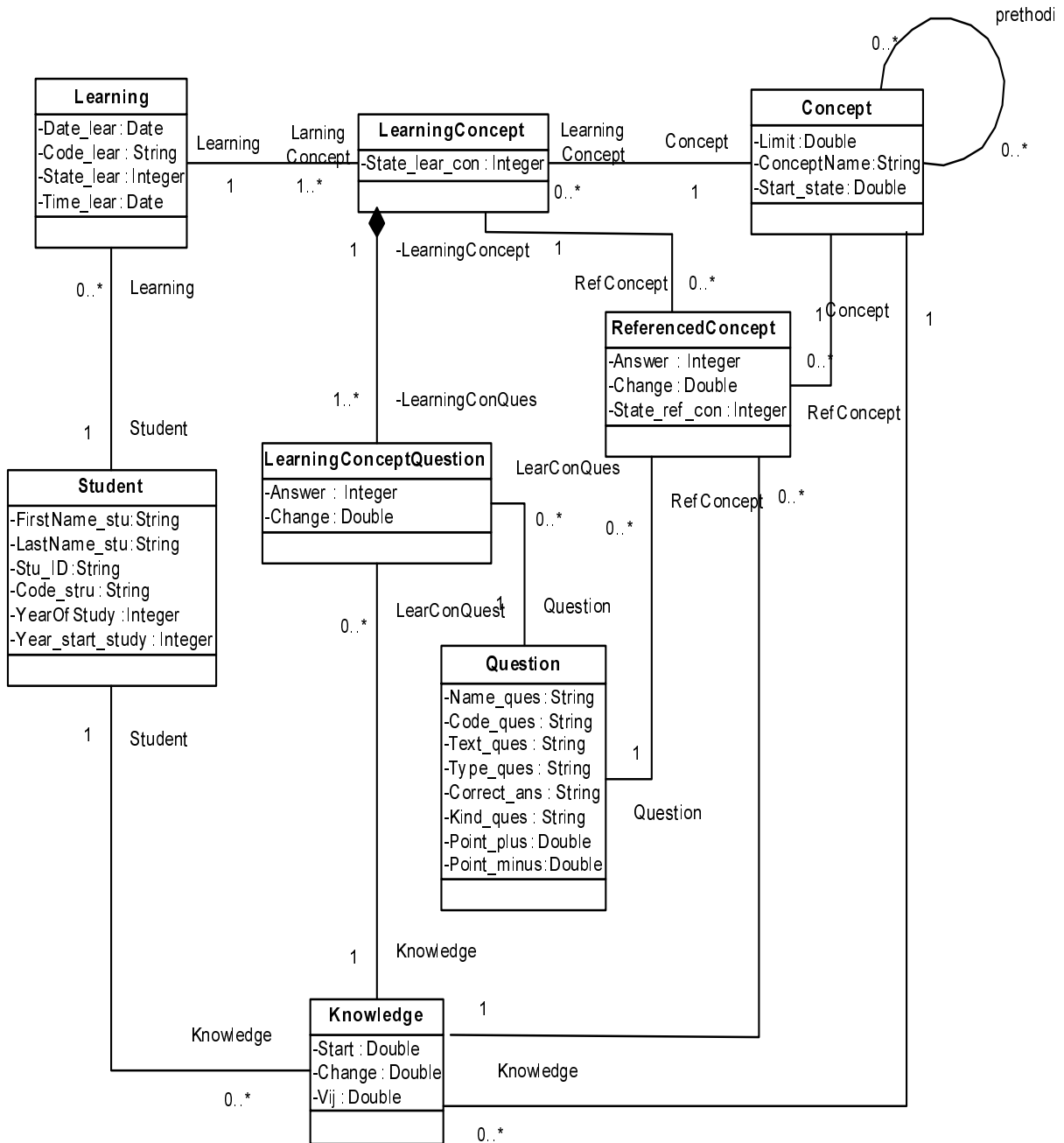


FIG. 3. THREE-TIER STRUCTURE OF A DISTANCE LEARNING SYSTEM BASED ON A DIALOGUE

- implementation of the object model data by using ORDBMS *ORACLE 8*,
- design of a dynamic Web application,
- data entry and testing of the system's behavior.

The object model is implemented by the object-relational approach using the relational model data with the object view [5 and 6]. The relevant tables are defined, then object types

and finally object view of the tables based on the object types. The design of the relevant data and object types is defined from the UML class diagram. Next step in the system implementation is the design of a dynamic WEB application [7, 8 and 9]. The JSP technologies are applied to design a dynamic WEB application. The JSP pages present the extension of HTML pages with a part of JAVA code. A user

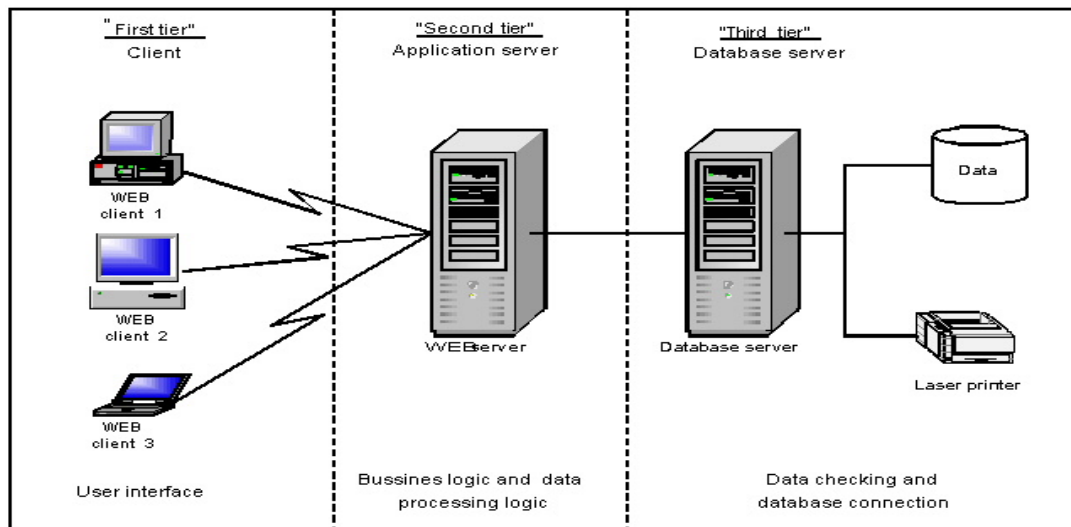


Fig. 4. Three-tier structure of Distance learning system

sends a query to the WEB server that receives and analyses inquiry and generate response in the form of the new generated JSP pages. JAVA classes are stored on the WEB server to process the data defined by the user's query and to realize them. JAVA classes, which communicate with JSP pages, receive the user's data and call procedure in other JAVA for implementation SQL query and communication with database server. Dynamic WEB application enables user's connection with database, entry into the learning materials, data selection needed to perform the processes during learning and the analysis of the learning results. Dynamic WEB application stores all relevant data about performed learning, creating the basis for evaluation of the learning quantity and quality parameter. JSP pages and JAVA classes present implementation of the algorithms showing the activities during learning. A dynamic WEB application enables many users to carry out learning independently of the venue and time. A dialogue in a distance learning system is realized by the behavior of a dynamic WEB application. WEB application performs the user's queries, analyzes the knowledge base implemented by database and extracts the data needed for continuation of learning.

#### V. CONCLUSION

This work describes the development of a distance learning system based on a dialogue. A dialogue is realized through continuous communication and exchange of information between the learner and a distance-learning system. It enables monitoring and correction of the educational process. Analysis of learner process defined actors, their interaction and parameters for estimation of learning process success. Reached comprehensions are used in development of Model for a dialogue-based distance learning system. The

presented development level of the information system determines the object-oriented approach as the most suitable for developing a dialogue-based distance learning system. A 'use case' diagram, class diagram and state diagram based on the UML notation, defines a formal model of a dialogue-based distance learning system. The information system is implemented with the use of the object-relational database ORDBMS ORACLE 8 and JSP technology for generating a dynamic Web application. The system is verified by storage of the data about the learning process and testing of the system's behavior. A dialogue-based distance learning system is a modern tool in educational process that improves the quality of distance learning.

#### REFERENCES

- [1] [http://ltsc.ieee.org/ppt/ltsa\\_overview/](http://ltsc.ieee.org/ppt/ltsa_overview/)
- [2] I. Lavrnja, "Chapters from didactics" (in Croatian), Faculty of Philosophy, Rijeka, 1998.
- [3] B. Kovacic, "Distance learning model based on dialogue", *Proceedings of the International Convention MIPRO 2000*, section CE, Rijeka, Croatia, 2000., pp. 29-32
- [4] B. Kovacic, Z. Skocir: "Formal Model for Distance Learning System Based on Dialogue", *Proceedings of the International Conference ICT2001*, Volume 1, Bukurešt, pp. 231-236, July 2001.
- [5] V. Vianu, R.Hull, S. Abiteboul, "Foundation of databases", Addison Wesley, 1995.
- [6] M. Varga, M. Pavlic, V. Strahonja, "Designing of information systems" (in Croatian), INA-INFO, Zagreb, 1991.
- [7] C. Chou, "Constructing a Computer-Assisted Testing and Evaluation system on the Wide Wide Web - The CATES Experience", *IEEE Transaction on Education*, vol. 43, no. 3, pp. 266-272., 2000.
- [8] S-C. Yang, "Information Display Interface in Hypermedia design", *IEEE Transaction on Education*, vol. 43, no. 3, pp. 293-299, 2000.
- [9] B. Kovacic, "Application of dialogue realized by distance learning system based on dialogue", *Proceedings of the International Convention MIPRO 2003*, section CE, Rijeka, Croatia, May 2003.