



# A solution of database system for interactive learning for telematics

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## ABSTRACT

The paper deals with problems of an information system solution as a support for the education system within the Department of Control and Information Systems (DICS) at the University of Žilina. The primary system is designed for education subjects from the area of intelligent transport systems with Telematics. The paper summarises and describes the existing and planned subjects in the telematic systems specialization. The main part of the paper describes the specification of teachers and students requirements related to these subjects. These specifications are the basis for a practical realization of the database part of the system with features of an interactive learning system. The specified requirements for systems include e.g. a possibility to enter the figures to the database system or to allocate the questions for subjects or selected areas. The database system was designed with a using entity – relational model. To implement the systems the MySQL v 5.0.51b SW platform was used, which is compatible with the existing database in the DICS server. The paper describes a possibility of access to systems as well as problems and solutions of realized database systems security based on cryptography tools.

**KEYWORDS: e-learning, information and communication technology, education process, PHP, MySQL, relationship data model, user interface**

## 1. Introduction

E- learning is learning process using ICT (Information and Communication Technologies) with goal to create courses, the distribution study content for the communication between students and teachers and to support the management study [6].

E-learning includes the theory and the research, as well as any educational process (with varying degrees of intentionality) which are in accordance with the ethical principles used by information and communication technologies working with data in electronic form. How to use ICT resources and availability of teaching materials depend mainly on the educational objectives and content, nature of the education environmental and opportunities for all actors in the educational process [1].

There are several operating information systems to support e-learning at the University of Žilina at the present. The cornerstone

is the system Moodle (Modular Object – Oriented Dynamic Learning Environment).

Moodle is a software package for creating web-based courses and web sites. It is provided freely as open source software. It uses a scripting language PHP (Hypertext Preprocessor) and supports the multiple types of databases, especially MySQL.

System Moodle allows to distribute the learning materials, to create tests to verify the knowledge of students.

The DCIS (Department of Control and Information Systems) guarantees the study branch Automation – study program Automation in bachelor degree, study branch Automation – study program Process Control Engineering in MSc. degree and study branch Automation – study program Process Control Engineering in PhD. degree at the Faculty of Electrical Engineering of the University of Žilina. The teachers of DCIS are preparing the new study program during branch Automation Applied Telematics with orientation to control and communication system of road transport.

The teachers of DCSIS search the new form of education within seminary and exercises [2]. They would like to continue in the begun process of education with support of e-learning. From some subjects taught at the DCIS are designed test questions that are provided to students during the semester for tuition.

Computing testing allows processing and evaluating information very fast and their visual demonstration too. This is way it necessary to use its power and new tools within education process through e-learning.

**Table 1. Subjective evaluation of attributes of examination for particular form**

Type of examination	Verbally	In writing through answers to questions	Writing test through selection of right answers
Time of examination			x
The number of examined			x
Objectivity of classification			x
Singleness of student within examination		x	
Complexity of answer presented		x	
Possibility of additional completion of answers	x		
True view of knowledge depth	x		

We know that problems of objective measuring of student's power are connected with several types of their activity. The special area of power measuring is measuring of knowledge and skills of students. During study it is necessary to require the most objective assessment of knowledge of students mainly in the process of keeping credit in the finish of semester or as result of examination.

Moodle system is not suitable for student teaching through the test which contains large number of questions. In the first, it doesn't provide immediate feedback for each question. It does not allow the student to divide the question into several independent tests. Because of these shortcomings was created an information system that is intended to teach students by going through test questions [5].

Testing of students' knowledge we can realize by using several forms: verbally (individually), argumentation on certain theme, by writing through working out answers to questions, by writing test and by practical examinations. Each form of examination has positive and negative aspects. In the Table 1 shows the attributes of the examination with the subjective evaluation of the most suitable form for each attribute [3].

## 2. Analysis of requirements specifications to information system for establishment of knowledge

The aim of analysis of requirements to realized information system was determine the demands of user to information system. The requirements are necessary to specify during all time of system development. The testing system has to contain information about questions; range of questions and about justified users.

The base of system creates the following data related to particular questions:

- reading of question,
- one correct answer,
- information about inserted pictures connected to questions and answers,
- information about included questions to range.

Authors approach to realization of information system so that several users can access to system. We divided the users to three groups: students, teachers and administrator. The student has possibility to access to system and does not have possibility execute modification. Administrator has the possibility to add and modify data to others users.

The requirements to function of testing system for administration are the following:

- authentication of access of teachers and students,
- to extend and to update the database,
- to set and to limit the assess of users (login, password).

The created system must allow to teachers the access to system and basic operation with concrete test.

The requirements to function of testing system for teachers are the following:

- log in to system(verification of access to system via login and password),
- creating the test and setting of its features:
  - selection of range of questions from subject or its part,
  - number of questions,
  - selection of the number of log in for one student to certain test,
  - the setting of maximal time duration of test,
  - the setting of time validity of test
  - form of results valuation,
- creating and editing on of questions for selected test,
- statistical illustration of test successful,
- presentation of answers of concrete student for concrete test.

The realized testing system must provide for access of students to testing of their knowledge on the base of selected test parameters.

The requirements to function of testing system for students are the following:

- log in to system(verification of access to system via login and password),

- selection of test (interval of questions) for testing students' knowledge,
- to answer to randomly selected questions according to selected type of test,
- execution of changes in answers during test processing,
- illustration of results about test successful (percentage or time form),
- possibility to define the number of repeated running of test during which time the correct answers are drop.

With using presented form of repetition of knowledge within education process the student can learn very quickly right to answer numbers of answers.

The requirements to realized infrastructure are the following:

- Information system must be allocated to server with connection to internet.
- The possibility to use testing system as local application.
- The possibility of connection with existing system of e-learning (minimally with help of hypertext reference or directly as embedded application to windows of Moodle).

### 3. Analysis and specifications of requirements for an information system designed for improving knowledge

The main goal requirements analysis was to identify user requirements for information system. The requirements are specified and added throughout the system development.

The system must contain information about queries, areas of queries and about Access privileges of users.

The basis of the system is the data for individual issues:

- the text of the question,
- one correct answer,
- information about added associated images with question or answers,
- information about the assignment each question to area of created queries.

Into the system accesses more types of users. We divided them into three groups: students, teachers and administrator. The student is not able to log into the system and to make changes.

The administrator manages the database of questions and be able to add and edit information about other users.

Requirements to system functionality for the administrator:

- authenticate the access to teachers and students,
- to expand and update the database,
- to set a restricted user access (login, password).

Requirements to system functionality for the teacher:

The system should allow the teacher to access the system and basic operation of the specific test. The system should allow:

- log into the system (access authentication by login and password),
- creating test and set its properties:
  - select range of issues subject or a part thereof,

- number of questions,
- set the number of logged per student for the test,
- set the maximum duration of the test,
- set the validity period the test,
- method of assessing results,
- creation and editing of selected test questions,
- statistics show the success of the test or tests
- show the responses of a particular student on a particular test.

Requirements to system functionality for the student:

The system should provide access to test student's knowledge of the selected test parameters that define teacher. It should enable the student:

- log into the system (check access),
- selection of the test (range of questions), which the student will test your knowledge,
- respond to questions selected randomly according to the selected type of test,
- make any change answers during the test process,
- show the results of successful tests (as a percentage or time),
- allowing the definition of re-running the test, in which are omitted correctly answered questions. Such form, the student can repeat in quick time to learn the correct answer many questions [5].

Infrastructure requirements:

- information system should be placed on the server with an Internet connection,
- the possibility of using the system as a local application,
- enabling the interconnection with the existing e-learning systems at least through a hyperlink or through embedded directly into applications like Moodle window.

### 4. Design of the database part of the system

Because a described database information system is of a small or medium-scale, we chose to design a database of relational data model. Using the model to address three basic issues of database:

- data structure,
- data manipulation,
- integrity constraints.

In term of the structure of data is necessary to ensure identification of all objects and their properties, including a description of structures which to express relationships between objects. The problem with data manipulation includes the design permitted operation over a relevant volume of data.

For each object, its properties and relations between objects is necessary to define a set of integrity constraints, defining the essential characteristics of data objects [4]. The subject matter proposal is to create a specific model of reality which should the most reflect the essential features of reality. The final relational data model is shown in Fig. 1.

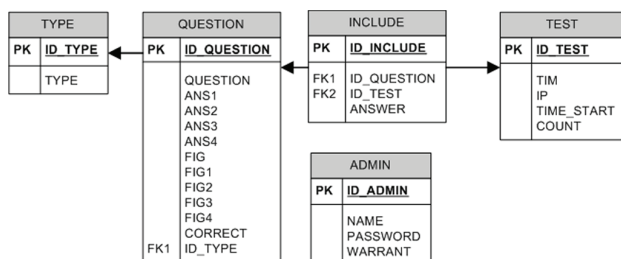


Fig. 1. Relational data model

The relational data model contains two independent RD models. The first model describes the database of questions and tests. It contains four data structures, and three sessions. The base model is the data structure QUESTION. It contains information on question such as wording of the question, the wording of possible answers, addresses and filenames of images, marking of which variant of answers is correct and the type questions. Indication of the correct answer could be omitted. In this case, a correct answer would be deposited in the database first in order. It would although save space in the database of the system, but would increase the demands on the functional part of the system. System would have for each question randomly mixed the answers. Therefore, we decided for the first option. If in the future the system will contain a large amount of data and we will have to available for use the powerful server, system can be modified.

Data structure TYPE contains the name of the type of questions. Between the structures and TYPE and QUESTION is relation with cardinality 1: N, because each question can be only one type but several queries may have the same type. Because we are an indication of the type of question have created a separate data structure for each question do not store information about the type name in the form of a character string, but only the identification number in decimal form. We save the data space using the primary key and we can clearly identify the type of questions, which can be used, for example in compiling the tests.

Data about generated test can we found in the data structure TEST. The structure contains a primary key which is needed to identify the test. Also information about the IP address of computer in order to uniquely identify the user. This identification prevents conflicts when multiple users are testing the same time. The structure keeps information about the total time duration, about time to run test and about the total number of questions. One question can be used in multiple tests and in one test can contained more questions. Therefore between the data structures QUESTION and TEST is the cardinality N: M. T It is built by using data structures INCLUDE. It contains only foreign keys of structures and

TEST and QUESTION and own primary key INCLUDE.

For the purposes of registration information system users and definition their user rights serves data structure ADMIN. It contains information such the login names and passwords of users. For new user registration could do not be used more times the same username. The structure also contains information about user rights [4].

## 5. Specification of applied platforms

For the production of the system were used languages PHP, SQL, and HTML with extension CSS. Pages are created by using PHP scripting language commands. After processing on the server is returns the page for user which is formed by the markup language commands (HTML) that the browser appears as a static page. The system communicates with the MySQL database using SQL commands query language. These technologies have been used for ease of portability to most server systems for small and medium scale. The communication server technology can be seen in Fig. 2.

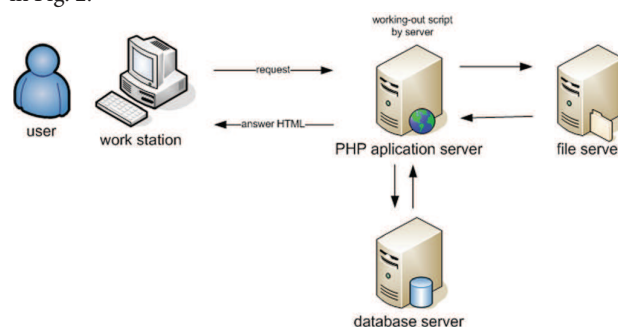


Fig. 2. Communication of server technology

For the creating and testing system were used the following server components:

- Microsoft Windows XP 2002, SP3,
- Apache web server 2.2.8,
- PHP 5.2.6 PHP server,
- Database system MySQL 5.0.51b.

The system was installed on the server of the Faculty of Mechanical Engineering, University of Žilina. Currently is under trial operation during which there has been no finding communication problems or problems with the functional part of the system.

The information system will be installed on the servers of the Department of Control and Information Systems Faculty of Electrical Engineering, where it will serve in the first run to teach subjects from the field of telematics systems (control systems, communication security, intelligent transportation systems and secure communication system). It is possible to extend the range of taught subjects without the need for internal changes to the system in the future.

For the creation of code there are numerous specialized programs to facilitate its creation. In creating the program we used PSPad 4.5.3. Supports all types of codes used (HTML, CSS, PHP, SQL).

## 6. Options for the distribution of data

One of the basic requirements was the distribution of data through the Internet. For this reason, the information system was not created primarily as a local application. The servers will be placed on the server of department, which already contains all necessary components. The server parameters also verify the requirements for such use. The distribution system can be seen on the Fig.3.

The system can be configured that users can use the system only on a local network, for example department or university, or make the system available across the Internet. Territorial definition of the users we can protect stored data from unauthorized reading, for example for the author's rights. Protection by the filing datas requires administration of user accounts. Practically, definition of IP addresses used in a large number of unknown users that is territorial in one place.

## 7. Practical implementation

In general, an information management system database can be vertically divided into a data part, which is the database itself, and the functional part, serving to database management. Both parts must communicate with each other using appropriate language. For purposes of our database information system we were divided the system into three parts:

- Data part.
- Functional part.
- User's part.

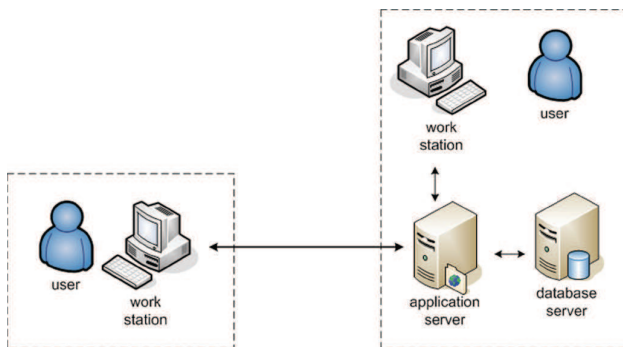


Fig. 3. Data distribution system

We devoted to data part of the system at length in Chapter 3.

The role of the functional parts of the system is to modify the user portion of the data into a form suitable for storage of data and through language SQL inserted them into the database in the data portion of the system. Using the data of the data part it also converted them into a form suitable for display of the user. In this section it is also implemented control of the user rights. It consists of functional blocks occurred in an external library, which we have created.

User part – the user interface consists of web pages through which a user communicates with the information system. To created them, we take into account the ergonomic aspects of GUI (graphical user

interface) namely simplicity, transparency, resistance against the fault for data input, a logical connection between the pages, color and control elements. PHP language used in the creation of the user part, made it possible to dynamically change content and layout of pages depending on user rights of the client.

The screenshot shows a web form titled 'Vložte novú otázku' (Add a new question). At the top, there is a dropdown menu labeled 'Typ:' with the value 'teoretické' selected. Below this is a large text area labeled 'Znenie otázky:' for entering the question text. To the right of the text area is a 'Prehľadávať...' button. Below the text area are four rows, each with a label 'a)', 'b)', 'c)', and 'd)' and a corresponding 'Prehľadávať...' button. At the bottom, there is a section for 'Správna odpoveď:' (Correct answer) with radio buttons for options 'a)', 'b)', 'c)', and 'd)', and a 'Vložiť' (Save) button. A 'Naspäť' (Back) button is located at the very bottom center.

Fig. 4. Demonstration of graphical user interface

The user interface is only part of the information system with which it comes into contact with ordinary user. Therefore, the asked for it are different that only non-functional requirements, especially ergonomic and individual requirements.

We accentuated on simplicity and transparency of the user having to spend a minimum of effort (minimum number of steps) to obtain the required information.

For the creating a user interface we focused on the following characteristics: color, brightness, contrast, the elements used for the screen, size and style of the used symbols, the structure of pages, number of operations necessary to achieve the desired result. Demonstration can be seen in Fig. 4.

Form in Fig.4 is used to insert new questions into the database. The form is properly located in the center of the screen. Includes selection drop-down menus SELECT to provide users limited number of options. To enter text questions used multiline text box TEXTAREA. It was used because it is assumed that the wording of questions will be more than one line. For the setting various options, we used the elements of a text field TEXT. To determine the correct answers are elements RADIO switches, which also do not indicate more than one option. To insert images servers elements FILE. In the case of inserting an image file is stored on the server using PHP script into a dedicated folder. Name and address of the image file path is entered into the database data structure question.

During the trial operation it has been verify the correctness of the function of all parts of the information system. Testing was carried out in the following steps:

- Filling a database - the database is filled with a representative sample of questions and verify the correctness of data structures.
- Verification of the functions – a process during which the system functions were verified by the selected data to test their proper conduct, cooperation, information exchange and compatibility with the database.

Testing Output - used to test the graphical user interface pages. It has been tested grammaticall, the layout of the components on the screen and transparent.

During the process of testing there were discovered some errors, that have been removed. It is possible that some errors are only detected during the next operation, seeing that it is early stage of life information system.

## 8. Conclusion

In the paper the authors described the alternative form to existed e-learning education system Moodle, which is uses in University of Žilina and has several disadvantages. The authors described the realized testing information system which serves to interactive education of subjects from area of telematics mainly with orientation to intelligent transport and communication system. According to our opinion designed system will remove the disadvantages of existing Moodle system in the direction of possibility to testing the students with large number of questions. Created information system is functional and is in the field of testing and in the near future is possible to use it in normal operation. System will be installed into server of Department of Control and Information Systems. The system can be used in the future for others subjects of specialization too according to loaded database by required data depend on selected subject. Without functional aspect of created system we are planning to test the system for possibility of usage. For successful testing we will need feedback reaction of the large numbers of users. Seeing that within realization of system was used principles of object orientated programing, as e.g. modularity, the system is possible to modify very easy in the future.

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## Bibliography

- [1] ZOUNEK J.: E -learning – one form of education in modern society. In: Czech. Masaryk University, Brno, Czech Republic. 2009, p. 37-38
- [2] BUBENÍKOVÁ E., FRANEKOVÁ M., HOLEČKO P.: Innovation of method of education with support of MATLAB WEB SERVER. In: Slovak. Technical Computing Prague, 2006. Prague, Czech Republic. 26. 10. 2006, ISBN 80-7080-616-8, p. 24-25
- [3] KOPECKÝ K.: E-learning not only for theachers. In: Czech. Olomouc, Czech republic. Hanex, 2006. ISBN 80-85783-50-9
- [4] BUBENÍK P., BUBENÍKOVÁ E., KORBEL P., NAGY P.: Information technologies for bussiness practise, EDIS Žilina 2004, ISBN. 80-8070-288-9
- [5] BUBENÍKOVÁ E.: Electronic testing system as part of e-learning. In: Slovak. Conference E-learning in university education. Zlín, Czech Republic. 4 - 5. 6. 2003, p. 23-27
- [6] BUBENÍKOVÁ E., HUDEC R.: Analysis of author's systems for creation of multimedia application for e-learning. In: In: Slovak. Conference: Pedagogical software 2004. 9.-10. 6. 2004, České Budějovice, Czech Republic. Scientific Pedagogical Publishing, 2004. - ISBN 80-85645-49-1. - p. 423- 426