DEVELOPMENT OF A RELATIONAL DATABASE FOR LEARNING MANAGEMENT SYSTEMS

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ABSTRACT
In today's world, Web-Based Distance Education Systems have a great importance. Web-based Distance Education Systems are usually known as Learning Management Systems (LMS). In this article, a database design, which was developed to create an educational institution as a Learning Management System, is described. In this sense, developed Learning Management System consists of basis of Virtual Education Institutions. In this study, a fully relational database design has been realized in compliance with SCORM standards and got ready to be used as Virtual Education Institutions. This system can be used for any required education institute and it can be run within the same interface. In LMS that will be generated, a faculty or institute can be defined and academic and all administrative processes of the defined institute can be managed with the designed system. Proposed database design has been used in a LMS of Afyon Kocatepe University. In this system, many processes like indexing, uploading, downloading, production and editing of web based learning materials can also be performed easily and safely.
Keywords: Distance Education, E-learning, Web-Based Distance Learning Systems, SCORM, Relational Database Design.

INTRODUCTION

In today's modern age, changes are observed people's life style. Development of mobile communication systems and mobility of the people play the most important role about this issue. People's daily activity programs are divided into many different type activities. The main concern in education is that how classical education institutions will establish education environment of increasing active population. The purpose of mobile education is to move today's stable education environment to a virtual, flexible education environment of the future (Yuen and Wang, 2004).

Today, there is a growing interest in online learning all over the world (Elango, 2008). Electronic learning plays important role not only in academic institutions but also in small and medium-sized enterprises, which have the will to renew knowledge and experience of their staff. E-learning provides practical solutions to the students, who did not participate in the past education processes (Roy and Raymund, 2008). At this point, scientists have emphasized on customization, interaction and control (Piccoli, 2001). An e-learning program should be especially prepared for all students with the integration of different objects, past experiences and also these students should increase their own activities (Collins, 2005; Collins, 2006; Hodges, 2004).

E-learning trusts in current information and communication technologies for distribution of learning contents. Learning process or its ambiance is organized according to either synchronous or asynchronous method. E-learning, which has been developed as a learning solution, represents the distance education with the flexibility of educational software and process covering synthesis of different technologies (Yapicioglu, 2001).

Increasing internet using rate and developments in the infrastructure of today's internet have caused many improvements in web-based software and services. As a result of these improvements, education activities have begun to be performed by using the internet and network technology. Many technological tools like electronic books, electronic mails and conference environments have also taken active parts in these kinds of education activities. Due to increasing rate in using these tools and related education methods, a special education system has appeared. The whole education system is called as "Web-based Distance Education System" (WBDES). Today, distance education systems are established in many universities and education-teaching activities are performed via these systems. One of the big reasons in increasing using rate of Web-based Distance Education is requirements to these kinds of systems in parallel with developments in the information technology.

One of the most important advantages of WBDES is being able to provide asynchronous education within a virtual education environment. In a WBDES, students can easily access to the educational contents, which was transferred by educators to the system and take advantage of these sources by using different educational tools. Because of its advantages on costs, WBDES is also preferred to be used rather than other models or systems (Carswell and Venkatesh, 2002). Today, the most important reason in increasing the number of WBDES and to be accepted by students is their independent working mechanism from time and location (Bullen, 2006). It has

been an important preference reason for the people who suffer shortage of time and can not take active part in the location where education activities are performed. Generally, Web-based Distance Education Systems are called as Learning Management Systems (LMS). Factors and methods, which are considered in designing LMS, have been examined in the literature from various perspectives (French, 1999; Harris, 1999; Joliffe, 2001). When they are evaluated in terms of cost, it is seen that the cost of WBDES is approximately half of a typical traditional and formal education cost. On the other hand, interactive education feature of WBDES and up-to-date content presenting function should also be considered (Balbieris and Reklaitis, 2003).

In this study, a database model, which was designed and developed to be used for Learning Management Systems, is described. The database model was developed in a relational structure and designed to be suitable for LMS, which are in compliance with SCORM standards. Additionally, the developed model has a portable, easily accessible and easy-to-manage structure and can be used in long-term studies. With this database model, a virtual education institute can be established and published via required interface structures. In the related Learning Management System, a faculty or institute can be defined and all academic and administrative processes of these institutes can be managed with the help of developed database model.

SCORM Standards

SCORM is a Content Management System Standard and can be defined as "Shareable Content Object Reference Model". SCORM includes a framework for running lesson contents. SCORM standards are interested in publishing rather than teachable features of the lesson content (Su, 2006; Him, 2005).

While explaining the content management aspects of distance education systems, SCORM standards must also be examined in every respect. While applying SCORM standards, some factors, which belong to SCOM standards, must be stated. These factors are;

1. *Interoperability:* Merging contents from different sources for interaction and to be able to run in different systems and communicate with other systems.
2. *Re-usability:* The situation that defines re-usability for information and objects, which consist of e-learning content (script, graphic, sound, animation, video, code…etc.) and turning into a different education object, which includes all of these objects.
3. *Manageability:* Monitoring the information, which belongs to the user or content management system.
4. *Accessibility:* To be able to access a learning object at any time.
5. *Durability:* A technological development, which describes generating new versions for the tools requiring re-design and coding.
6. *Scalability:* Being able to change according to quantity of users, number of the technology, number of courses or content.

If SCORM standards are taken into consideration, the developed system or model can be used for a long time and updated easily. System or model contents can also be accessed easily from any location.

Relational Database Model for a Learning Management System

Database design is a detailed study, which must be overviewed plenty of times in the period of analyzing performance. Tables and properties of these tables must be examined in any module structure during the analyzing and designing process. Because of some processes like information filtering or information access, the database model should have an integrated structure. In every phase of the analyzing process, features and functions of a typical relational database must also be considered. Moreover, handicaps appeared by relation scenarios can jeopardize information integrity and also information security. So, these factors must also be considered.

Database structure of a typical distance education system presents a relational and complex structure. Different user types, authorization features and behavior rules also requires a relational database model. For instance, if a new user is added to the system, the necessary space, which this new user will need should be arranged automatically according to the user type. Different information depend on a user is kept in different tables like exams, personal information and course lessons in the distance education system. A relational model is also required to ensure a flexible model, which provides needed spaces for each new user added to the database. Congruently, the model can also remove related information and records automatically when a specific user is removed from the database.

MS SQL Server – Database Management System has been used in designing the LMS database structure.

Before designing the database structure, an analyzing performance has been performed and structure of the education system has also been adjusted. At this point, the features, which will be needed in the LMS, are considered. Designed LMS system consists of 38 main modules and 153 tables. Each module includes an integrated sub table structure.

While realizing the association process, a semantic scenario among database tables has been generated and according to this scenario, 14 different associated groups were created.

These groups are:

1. Application
2. Users
3. Financial Services
4. Workshop
5. Test
6. Menu
7. Academic Information
8. Chat
9. Group
10. Forum
11. Other Applications
12. Course
13. Demo
14. Survey

Each module in the system is an integral structure within itself. Additionally, a module is also an integral relation scenario at the same time. So, there is only one module in a provided relation scenario.

Tables and Relation Scenarios

The first module of the developed model is named as the Application module. Users who want to benefit from the system (administrators, students or lecturers) take part in the database structure of this module. The Application module tables and relation scenarios are presented in Figure 1.

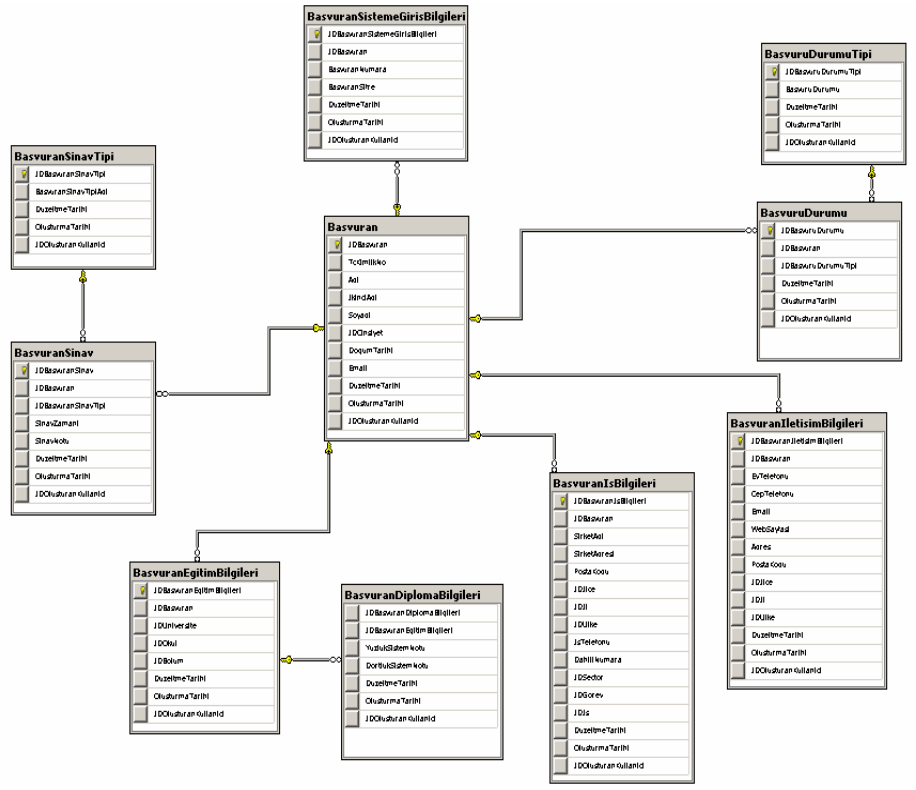

Figure 1. Application module tables and relation scenarios.

User tables relation scenarios are given in Figure 2. The user module is one of the most important modules of the LMS module. All necessary information about system users (from administrators to course students and lecturers) is stored in this module.
Financial transactions scenario and its LMS module are shown in Figure 3. In this module, students' registration fees, incomes from additional courses and basic expenses like financial transactions are tracked.

Workshop module was developed to be used for course activities, which can be performed by visitor users. With this module, special education sessions like training seminars can be performed easily. For instance, a general "Photoshop" training can be organized with the help of this module. Users, who participate in this module, are evaluated in similar conditions with other course students. Workshop module and relation scenarios are presented in Figure 4.

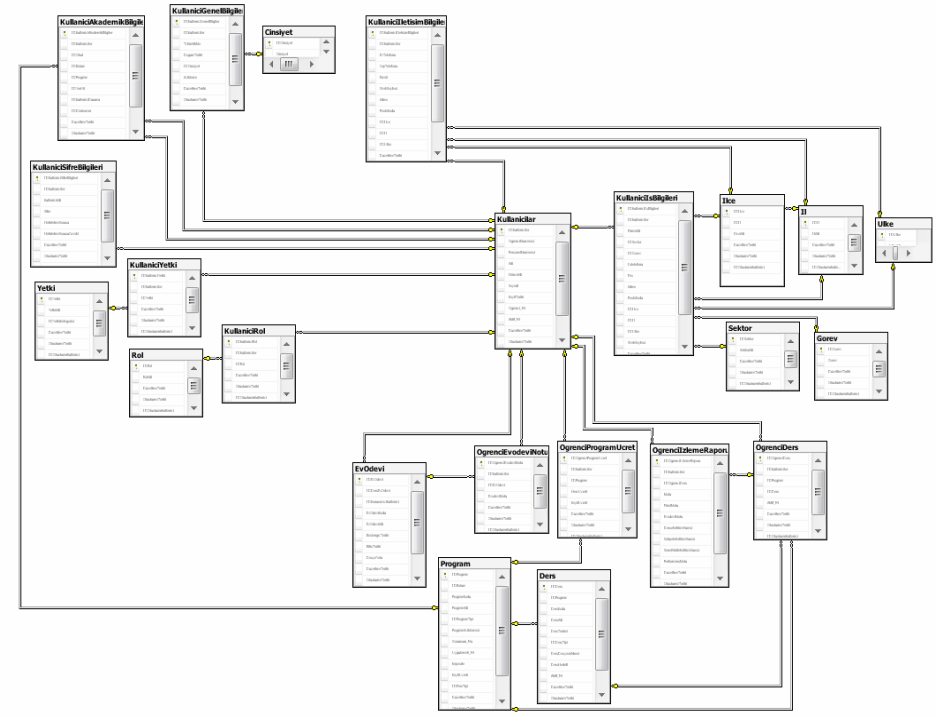

Figure 2. Users module tables and relation scenarios.

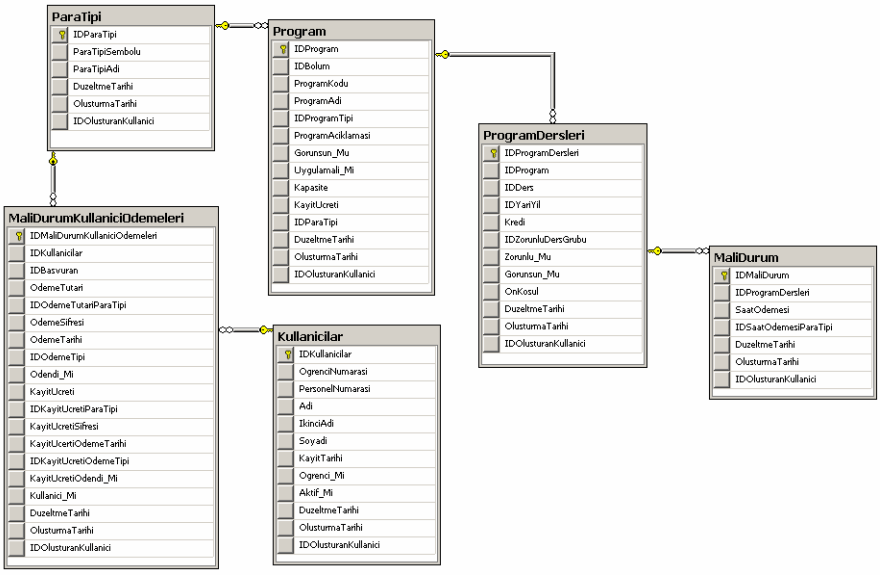

Figure 3. Financial services tables and relation scenarios.

Exam module and relation scenarios are shown in Figure 5. The developed module is suitable to be used for special exams like visa and final examinations. As it can be seen from the table structure, various information like examination branch or class, examination type, examination date, examination starting and ending time, examination questions and examinations results can be stored in the database.

Menu structures, which can be seen by administrators, students and lecturers, are organized by using the Menu module and its database features. At this point, features of provided menu interfaces are changed according to the user type as “student” or “lecturer”. These menus are organized according to user roles and privileges. Menu tables and relation scenarios are presented in Figure 6.

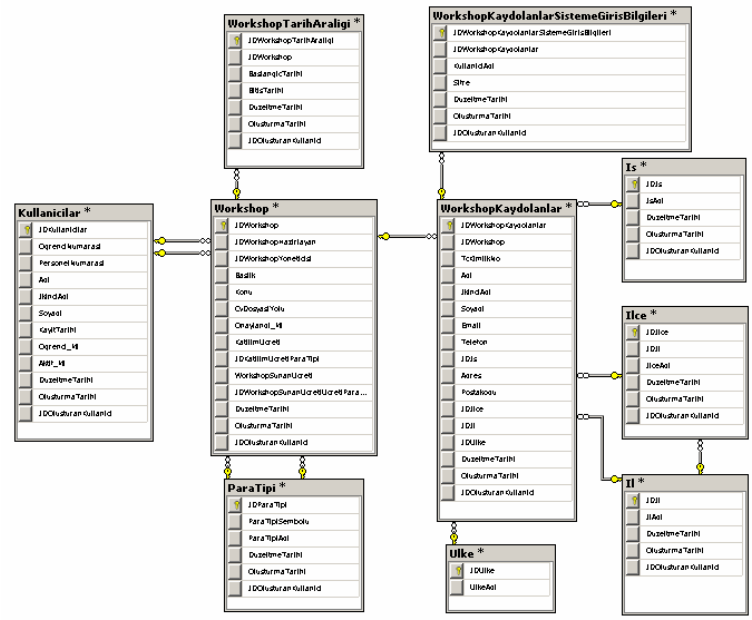

Figure 4. Workshop module tables and relation scenarios.

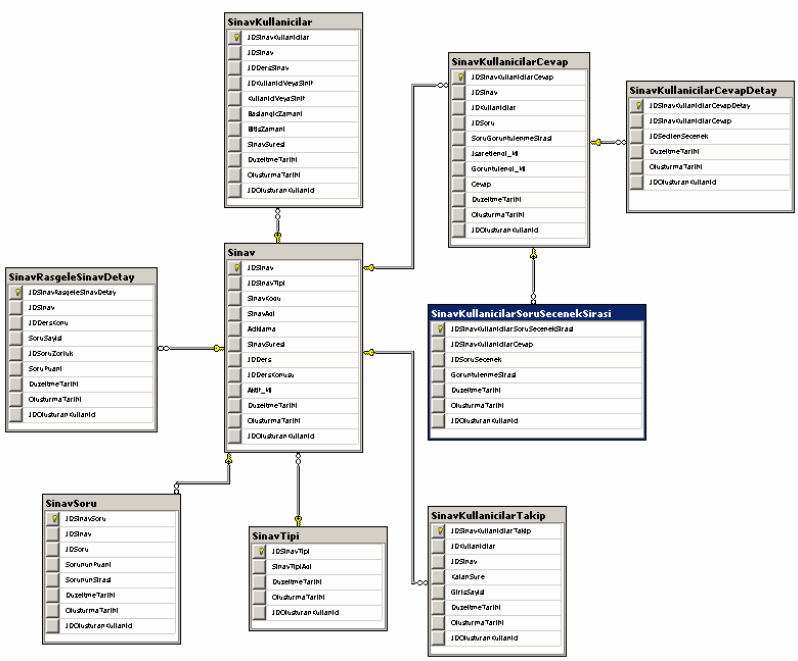

Figure 5. Test module tables relation scenarios.

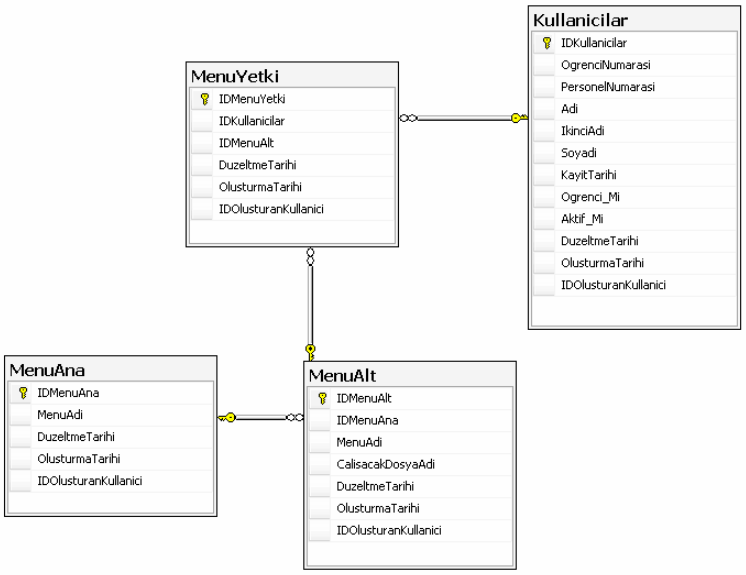

Figure 6. Menu tables and relation scenarios.

In Academic Information module, a structure, which can be used by each education institute to fulfill its academic functioning, has been formed. With this module, different information like students' personal information, registration details, system sections, branches, courses and payment information can be kept in a relational structure and many different actions associated with the mentioned information can be defined easily. Academic Information tables and relation scenarios are presented in Figure 7.

Chat module has been developed to ensure text-based and auditory conversation sessions among students and lecturers on specific dates and times.

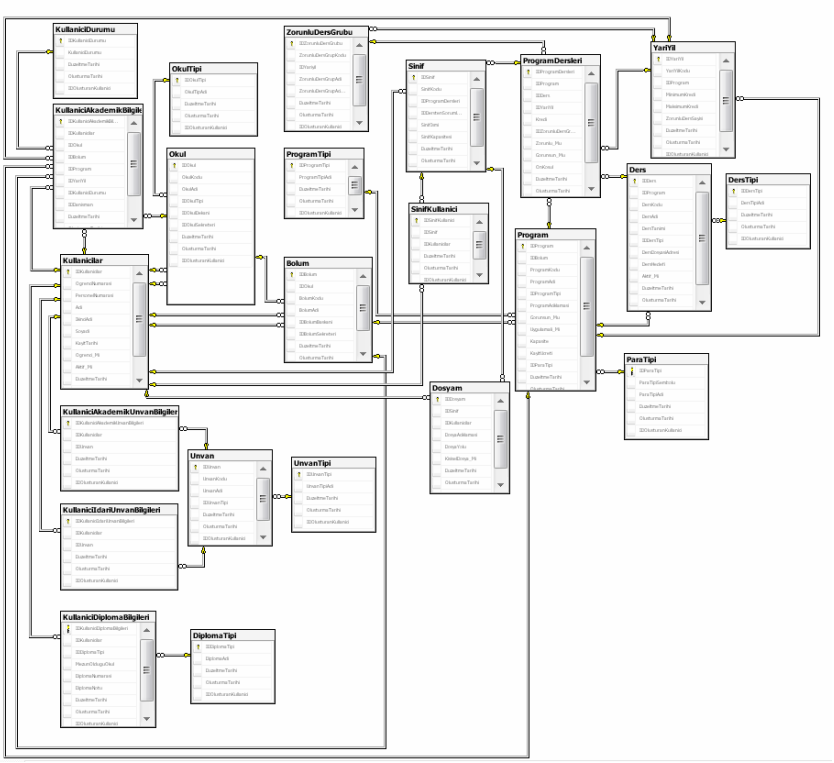

Figure 7. Academic Information tables and relation scenarios.

As it can be seen from Figure 8, only lecturers and students can perform chatting activities mutually.

In Group module, authorization descriptions and related functions are adjusted for the registered users. In this aim, new role or authority descriptions can be added to the system and authorization or role assignments can be performed easily for each registered user. It is also possible to define new user groups, which are allowed to access specific areas. Group module tables and relation scenarios are shown in Figure 9.

A discussion forum has been consisted in to ensure information sharing among lecturers and students. This module is associated with the user login system and so each user can participate in information sharing activities at the same time. Forum module tables and relation scenarios are shown in Figure 10.

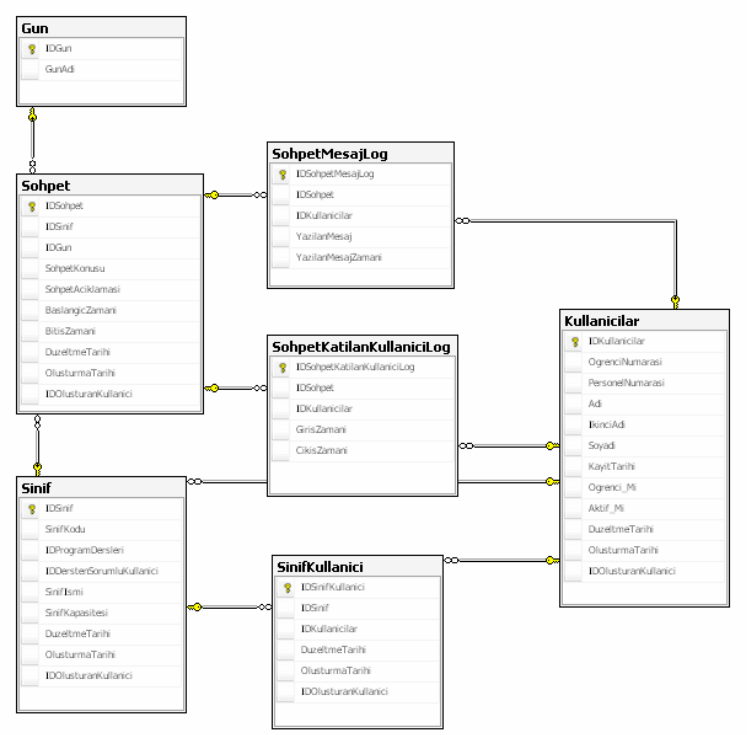

Figure 8. Chat module tables and relation scenarios.

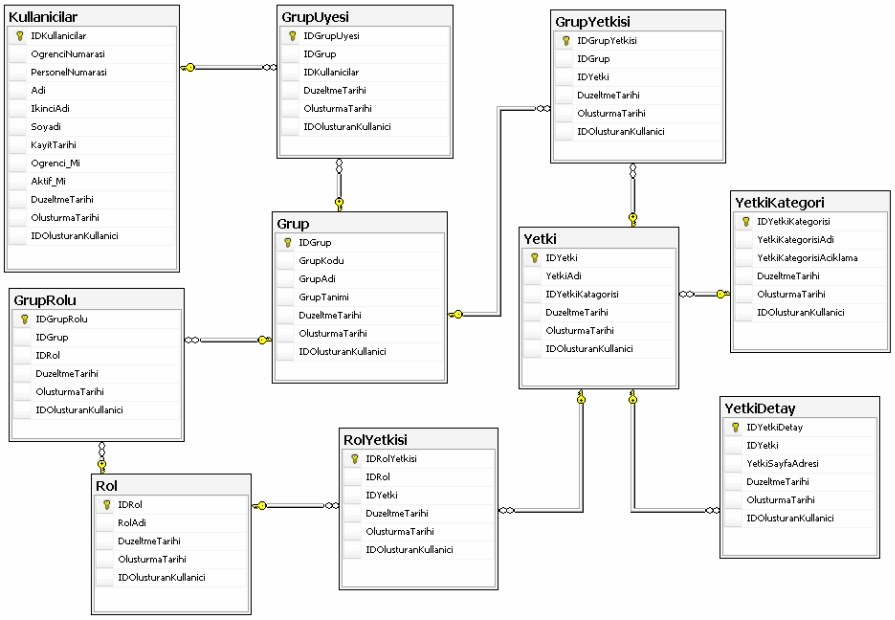

Figure 9. Group module tables and relation scenarios.

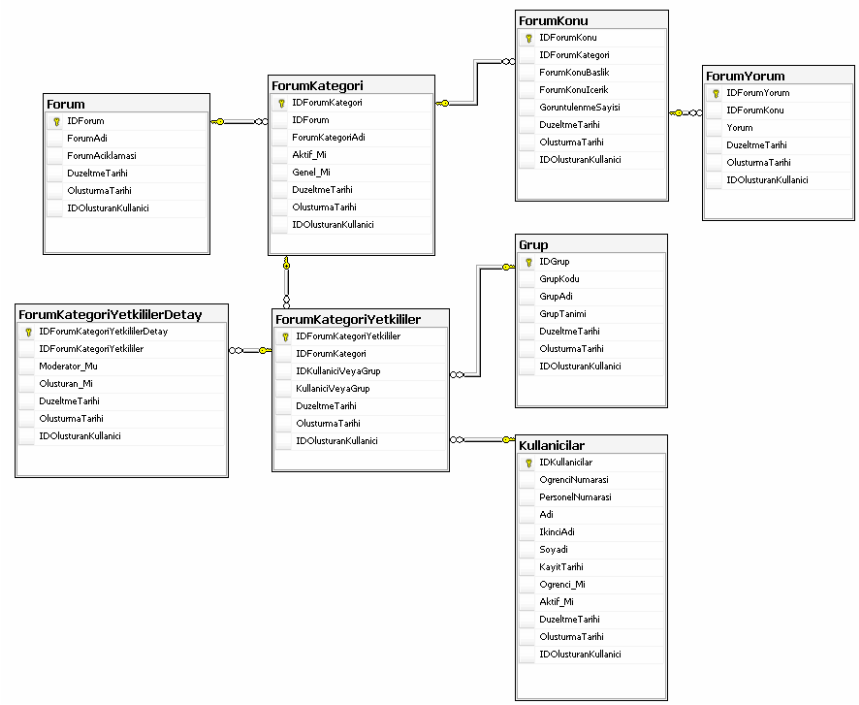

Figure 10. Forum module tables and relation scenarios.

LMS functions are not limited to only modules explained before. Many different modules are also combined under “Other Applications” tables and relation scenarios. Some of the related modules are: Personal Calendar, Academic Calendar, Transcript, Performance Tracking, News, Personal Notes, Dictionary, Virtual Classroom, FAQ, Private Message and Meeting modules. Other Applications tables and relation scenarios are presented in Figure 11.

Courses module is used for defining the courses, which will be provided in the system. In this module, some information about prepared courses (related course codes, descriptions for courses, course lesson contents…etc.) are defined easily. By using the Courses module, it is also possible to create different types of courses and define different features (course assignments, course examinations, descriptions for added course lesson contents…etc.) for the stored courses. Course module tables and relation scenarios are presented in Figure 12.

Demo module was developed to be used for showing system features and functions to the people who are not fully registered and want to review the whole system. With this module, user can only examine using features and can not make any changes in the system. Demo module tables and relation scenarios are shown in Figure 13.

Survey module was developed to be used for performing survey activities in the system. With this module, it is possible to define survey questions and show them to user via system interface. Added surveys can also be removed automatically at specific times. Additionally, statistical information about added surveys can also be shown to users or just kept as confidential. Survey module tables and relation scenarios are shown in Figure 14.

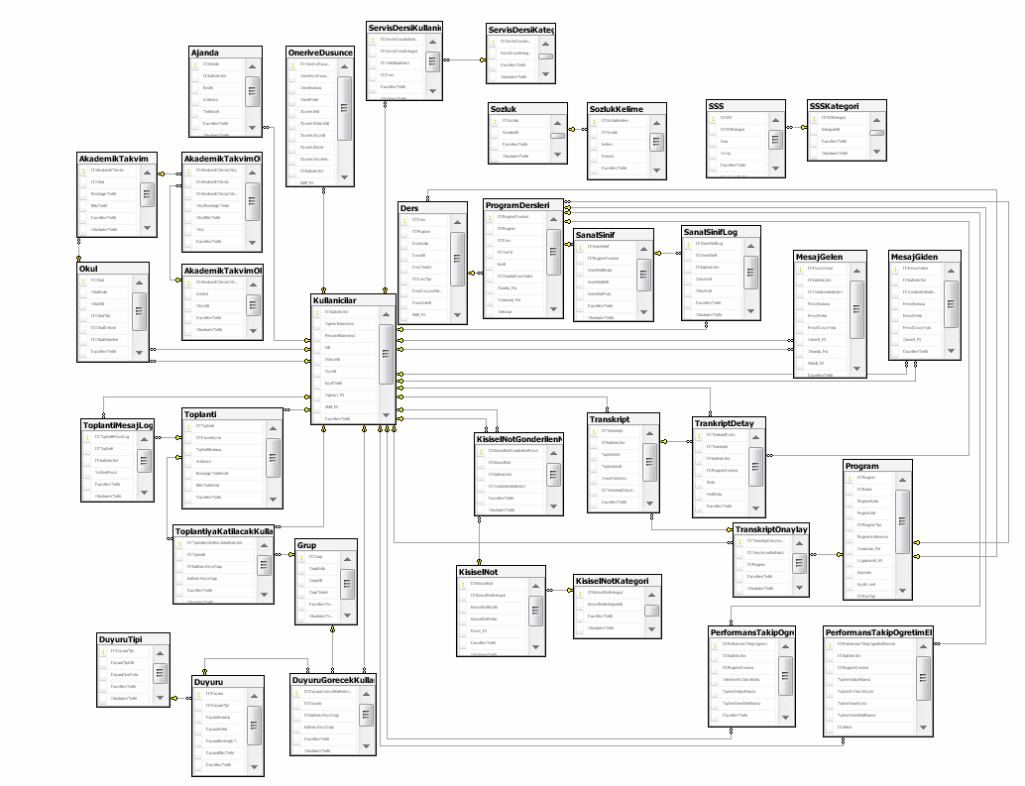

Figure 11. “Other Applications” tables and relation scenarios.

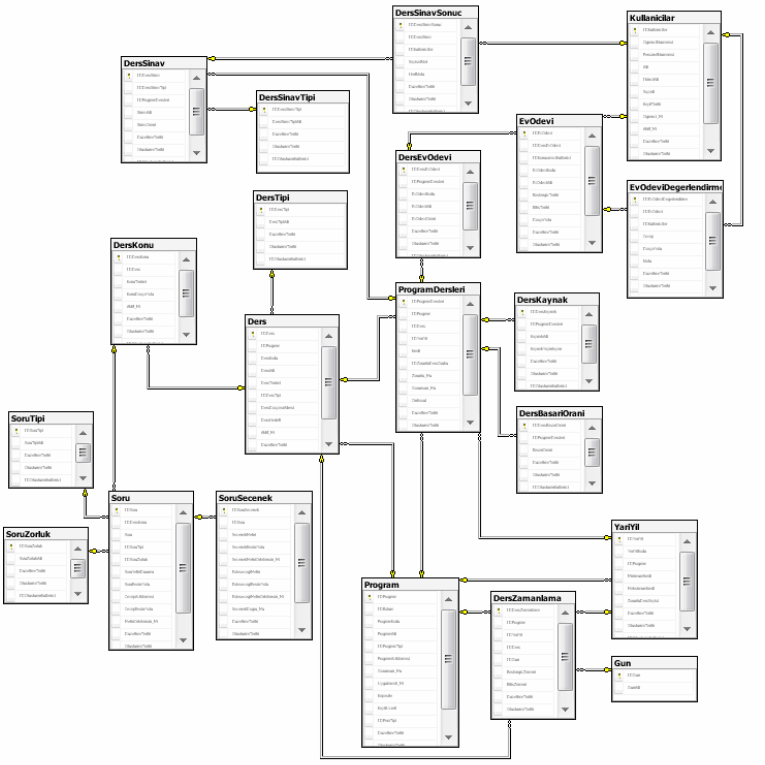

Figure 12. Course module tables and relation scenarios.

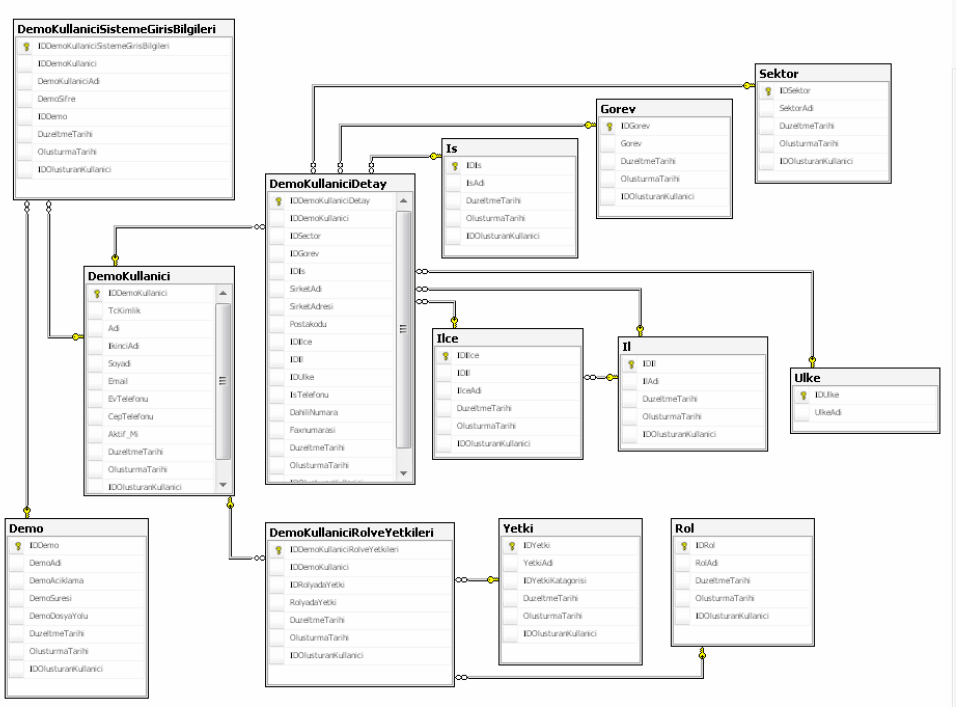

Figure 13. Demo module tables and relation scenarios

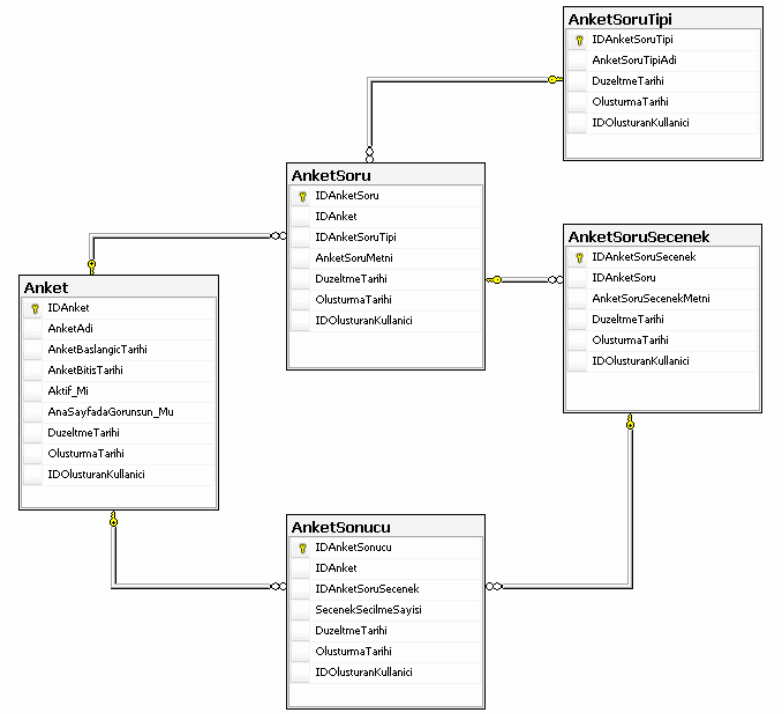

Figure 14. Survey module tables and relation scenarios.

The LMS Application

Designed database is currently used in a LMS developed at Afyon Kocatepe University. The LMS is named as Afyon Kocatepe University Distance Education Center (@KU-DEC). It runs efficiently on the web address: www.uzem.aku.edu.tr. It is not possible to explain the whole system features and functions here. So, it will be explained briefly.

Developed LMS has all the features that a typical LMS must employ. The system allows creating a virtual campus easily and provides different activity environments for administrators, students and lecturers. It has a modular structure and so system modules can be added, removed or updated by using the provided tools. Figure 15 shows the login page of the developed LMS. Each user has a username and user password to login to the system via login page. After logging in to the system, users can view Frequently Asked Questions (FAQ) section, explanations for using the LMS and an academic calendar provided on the homepage.

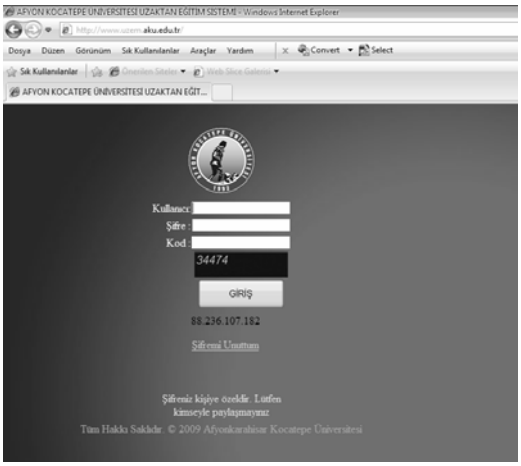

Figure 15. Login page for the LSM

Administrators have some authorities like creating entity, department or course and tracking both lecturers' and students' activities on the system. They also have authority to examine lecturers' and students' activity performances. Finally, administrators can also communicate with other users at any time as individually or collectively.

Lecturers can prepare weekly lesson contents and add new weeks by using the content preparation module provided in the system. Additionally, they can communicate with students via synchronous and asynchronous communication modules, which can be used as text based, verbal and visual. They can also prepare surveys with the present survey module to take students' opinions about lessons. By creating question banks over the system, assessments like quiz and homework can be prepared and provided to students as online. Figure 16 shows a screenshot from the lecturer homepage.

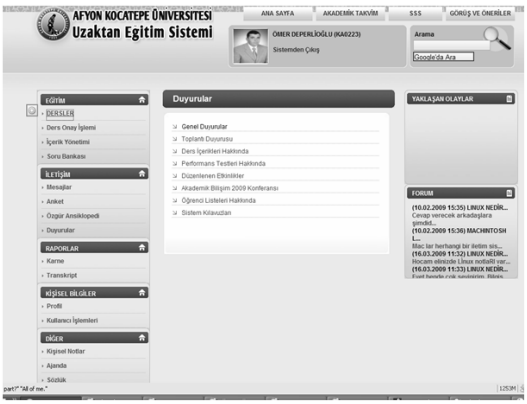

Figure 16. Homepage for lecturers

In the system, students can join a course lesson, track both synchronous and asynchronous lessons and perform all kinds of activities based on office operations (transcript, school report, student certificate or identity card request…etc.). They can also communicate with administrators, lecturers or other students by using e-mail, forum and petition functions. Figure 17 shows a screenshot from the student homepage.

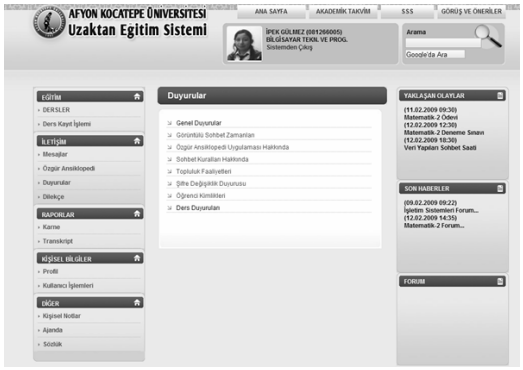

Figure 17. Homepage for students

CONCLUSIONS AND SUGGESTIONS

In this study, a relational database model, which can be used within web-based distance education systems, is described. The developed model provides fully relational design, data integrity and security for large-scale Learning Management Systems. Relation scenarios was arranged to be suitable for a Learning Management System and got ready for a management system interface. The system has also been prepared in compliance with SCORM standards. Prepared database model is used in a LMS, which was developed to be used as distance education infrastructure of Afyon Kocatepe University (@KU-DEC). The developed system has been tested since at the beginning of 2009. Up to now, no disruption has been observed in both system and the database. Any educational institution, which uses this database design, can be integrated to the developed system easily. This function is helpful for especially researchers who try to develop a new LMS. In this way, wasting time on database analysis and creating education scenarios can also be prevented.

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