

Development of a database of higher education process management information system based on the relational model

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Abstract— Current research is devoted to the process of creating a database of higher education process management information systems, creating tables regarding the activities of teacher, student, and curriculum. These are the main tables of the database, and developing relational connections between tables, and creating a data structure.

Keywords — *database, tables, attribute, data structure, relational, curriculum, student, teacher*

I. INTRODUCTION

Today, information systems are rapidly entering the entire industry. In particular, information systems created for the organization and management of higher education processes contribute to the development of the domain and ensure transparency. Demand for such information systems is growing, especially in the context of a COVID-19 pandemic.

With the Resolution of the President of the Republic of Uzbekistan dated October 5, 2020, numbered PF-6079 "On approval of the Strategy" Digital Uzbekistan - 2030" and measures for its effective implementation" priorities include the gradual digitization of processes, the formation of an "electronic database of students of higher, secondary special and vocational education", an information system "Digital University" is introduced, which will allow digitizing the number of documents, such as students' rating notes, group journal and student ID.

The education management information system is a system for collecting, consolidating, processing, storing and disseminating data to support the analysis and formulation,

planning, monitoring and management of decision-making policies at all levels of the education system. It provides a system of users, technologies, models, methods, processes, procedures and rules that work together to provide a comprehensive set of relevant, reliable, accurate and timely information for education managers, decision-makers and managers at all levels [1].

The complexity of the learning process poses several challenges in creating an education management information system database. This is because of the complexity in the data hierarchy, in the organization of a system database, creating tables, and generating queries.

II. STATE OF THE ART

World experience shows that today the automation of the higher education system and the introduction of management information systems in the educational process serves to improve the quality of education. Various research on the introduction of information systems and databases in the educational process has been done by the following scientist: Yu.Alashkevich, M.Krasilnikova, V.Kryukov, V.Miklushevsky, I.Robert, G.Selevko, N.Talyzina, O.Efremov, P.Belyaev, N.Fedyakova, K.Sastry Musti, R.Aloev, D.Mukhamadieva, H.Zaynidinov, M.Rakhmatullaev, U.Khamdamov, S.Kuznetsovym, V.Novikovim, B.Wolfengagenym, Zykinym, Michael Stonebraker, David DeWitt, Patrick Valduriez [5].

Currently, the world's leading universities successfully implementing and using information systems for the effective management of educational processes, such as: "Galactic

Management", "1S: University", "GS-Vedomosti", "Axiom", "Tandem University", "University's WS", "SIMS.net Capita Education", "IBS: Personnel Management", "BlackBoard", "SunGard" [5].

One of the phenomena that have a significant impact on the field of data processing technology is the emergence of the Big Data concept. Analyst firm IDC predicts that the amount of data in the world will double every two years. The proliferation of data causes problems in its storage and processing.

III. DATA STRUCTURES AND RELATIONAL CONNECTIONS

The education management information system provides operational planning and management of educational and scientific processes of higher education institutions, automation of administrative activities, providing information in decision-making in all major areas of activity, rapid reporting, easy access to information for students and teachers. Through the introduction of management information systems in the educational process of higher education institutions, it is possible to cover all the tasks related to the educational and scientific processes.

With the introduction of the information system, it will be possible to establish an electronic exchange of educational information and resource between higher education institutions of the Republic of Uzbekistan and the Ministry of Higher and Secondary Special Education [2].

Of course, in creating such large-scale information systems, it is necessary to emphasize the importance of the database. The more correctly the database of the information system is organized, the higher the efficiency of the created information system.

The HEMIS (Higher Education Management Information System) information system database consists of a total of 161 tables and includes the following special symbols:

- e - entity: main tables that contains registration data;
- h - helper: tables containing data from education classifiers;
- r - report: tables containing data for generating reports;
- s - system: tables containing data for system management.

Current work refers to some parts of the HEMIS information system database, which consists of basic, additional, and auxiliary tables. The main tables are as follows:

- Teachers
- Students
- Curriculum

Additional tables of the teacher's schedule include: *HEI_Dept, Projects, Books, Publications, Int_property*.

The auxiliary tables of the teacher's table consist of the following (Table 1): *HEI_inf, HEI_faculty, Work_form, Work_rate, Position, Acad_degree, Acad_title, Project_type, Project_currency, Members, Project_fund, Book_type, Paper_type, Int_property_type*.

The additional tables of the student table are as follows (Table 2): *Acad_record, Stipend_payment, Performance, Diploma, Employment, Attendance, Contract, Payment, Invoice, Stipend_cost, Acad_potok, Acad_group, Acad_subgroup, Student_meta*.

The auxiliary tables of the student table consist of the following: *Districts, Provinces, Countries, Nations, Tuition_fee, Accommod, Nations*.

Additional tables of the curriculum table include: *Courses, Curr_semesters, Course_schedule, Exam_schedule*

The auxiliary tables of the curriculum table are as follows: *Edu_Spec, Grades, TuitionFee_cost, Edu_type, Edu_form, Curr_sections, Academ_yaer, Course_types, Course_details, Exam_type*.

The tables listed above are the most necessary tables of the information system for the learning process. These tables cover the information of the student and the teacher related to the learning process.

Each table in an information system has a data structure. The data structure of the following tables is given.

TABLE I. DATA STRUCTURE TEACHER TABLE

Field	Type	Note
ID	INTEGER	ID teacher ID
ID_dept	INTEGER	ID department
Name	VARCHAR(100)	Name teacher
BirthDate	DATETIME	Teacher date of birth
Gender	INTEGER	Teacher gender
Passport_ser	VARCHAR(2)	Teacher passport Series
Passport_num	VARCHAR(10)	Teacher passport number
Passport_pnfl	VARCHAR(14)	Teacher pnfl
ID_Position	INTEGER	ID position
ID_Acad_degree	INTEGER	ID academic degree
ID_Acad_title	INTEGER	ID academic title
ID_Work_form	INTEGER	ID work form
ID_Work_rate	INTEGER	ID work rate
Photo	VARCHAR(255)	Teacher photo

TABLE II. DATA STRUCTURE OF STUDENT SCHEDULE

Field	Type	Note
ID	INTEGER	ID student
Name	VARCHAR(100)	Student Name
Birth_date	DATETIME	Student date of birth
Gender	INTEGER	Student gender
ID_Citizenship	INTEGER	Citizenship ID
ID_Nationality	INTEGER	Nationality ID
Passport_ser	VARCHAR(2)	Student passport Series
Passport_num	VARCHAR(10)	Student passport number
Passport_pnfl	VARCHAR(14)	Student pnfl
ID_country	INTEGER	country ID
ID_Province	INTEGER	Province ID
ID_District	INTEGER	District ID
Home_address	VARCHAR(100)	Student address
Curr_address	VARCHAR(100)	Student address university
Year_of_enter	DATETIME	Student year of admission
ID_Tuition_fee	INTEGER	Type of training with a payment ID
ID_Accom_type	INTEGER	Type of accommodation ID
Photo	VARCHAR(255)	Student Photo

Figure 1 shows a relational connection diagram of the teacher's

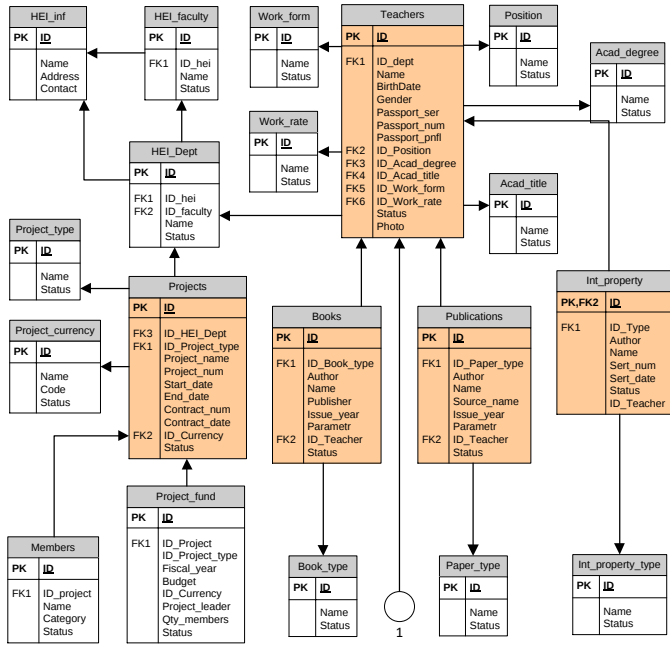


Fig. 1. Relational connection diagram of the teacher's table

Figure 2 shows relational connection diagram of the curriculum

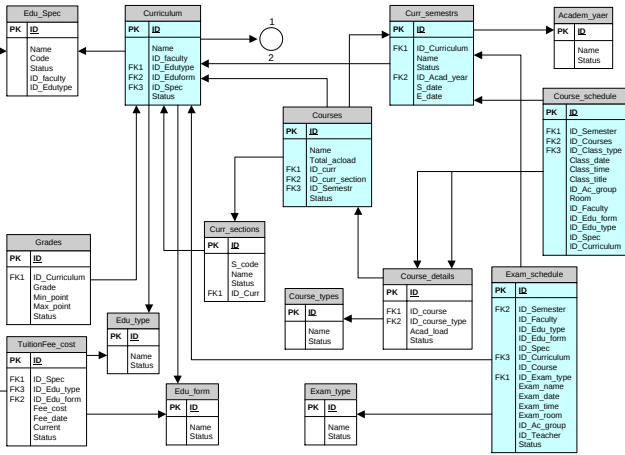


Fig. 2. Relational connection diagram of the curriculum table

Figure 3 shows relational connection diagram of the curriculum

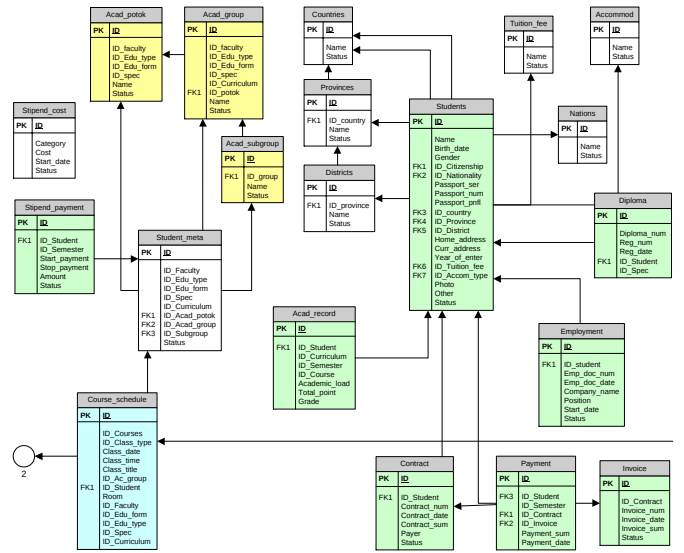


Fig. 3. Relational connection diagram of the student's table

Tables in the Higher Education Process Management Information System are defined as $\{R_1, R_2, \dots, R_n\}$. Each relationship consists of at least one tuple and attributes. They are described as follows:

X_i – attributes, $r_i[x_i]$ – X_i tuples of the R_i relationship corresponding to the attribute. The formation of tables in a relational database is described as follows:

$$R_i[X_i] = \{ r_i[x_1] | r_i \in R_i \} \quad i=1, \dots, n; \quad (1)$$

A total of more than 200 approaches have been developed in the higher education process management information system. In this research, we focus on some of the key relationships.

Teachers – R_1 includes teachers' personal information
Position – R_2 contains information relevant to the position
Acad_degree – R_3 contains information related to the academic degree;

Acad_title – R_4 contains information related to the academic title;

Work_form – R_5 The Employment form contains the relevant information

Work rate – R_6 contains information on the work rate

HEI_Dep – R_7 contains information about the department

Teacher's table R_1 has the following description:

$$R_1[x_1, \dots, x_{15}] = \{ r_1[x_1], \dots, r_1[x_{15}] | r_1 \in R_1 \} \quad (2)$$

where:

$r_1[x_1]$ – teacher ID

$r_1[x_2]$ – department ID, it takes the value from the field

$r_7[x_1]$

$r_1[x_3]$ – full name of the teacher

$r_1[x_4]$ – teacher date of birth

$r_1[x_5]$ – teacher gender

$r_1[x_6], \dots, r_1[x_8]$ – passport data

$r_1[x_9]$ – ID position, it takes the value from the field $r_2[x_1]$
 $r_1[x_{10}]$ – ID academic degree, it takes the value from the field $r_2[x_1]$
 $r_1[x_{11}]$ – ID academic rank, it takes the value from the field $r_4[x_1]$
 $r_1[x_{12}]$ – ID work form, it takes the value from the field $r_5[x_1]$
 $r_1[x_{13}]$ – ID work rate, it takes the value from the field $r_6[x_1]$
 $r_1[x_{14}]$ – Photo
 $r_1[x_{15}]$ – Status

In the next step, we look at the relationship of the student table. Students will interact with the following tables

Student – R_8 contains students' personal information
 Countries – R_9 contains information about the states
 Nation – R_{10} contains information about the nations
 Provinces – R_{11} contains information about the regions
 District – R_{12} contains information about the regions
 Tuition_fee – R_{13} includes tuition-based tuition information

Accommodate – R_{14} includes information on the address of residence

R_8 – the student table is expressed as follows:

$$R_8[x_1, \dots, x_{19}] = \{r_8[x_1], \dots, r_8[x_{19}] \mid r_8 \in R_8\} \quad (3)$$

This is:

$r_8[x_1]$ – student ID
 $r_8[x_2]$ – full name of the teacher student
 $r_8[x_3]$ – student's date of birth
 $r_8[x_4]$ – gender student
 $r_8[x_5]$ – citizenship ID, it takes the value from the field $r_9[x_1]$
 $r_8[x_6]$ – nationalities ID, it takes the value from the field $r_{10}[x_1]$
 $r_8[x_7], \dots, r_8[x_9]$ – passport data
 $r_8[x_{10}]$ – country ID, it takes the value from the field $r_9[x_1]$
 $r_8[x_{11}]$ – Province ID, it takes the value from the field $r_{11}[x_1]$
 $r_8[x_{12}]$ – District ID, it takes the value from the field $r_{12}[x_1]$
 $r_8[x_{13}]$ – Home address
 $r_8[x_{14}]$ – University address
 $r_8[x_{15}]$ – Year of admission
 $r_8[x_{16}]$ – Type of training with payment ID, it takes the value from the field $r_{13}[x_1]$
 $r_8[x_{17}]$ – Type of accommodation ID, it takes the value from the field $r_{14}[x_1]$
 $r_8[x_{18}]$ – Photo
 $r_8[x_{19}]$ – Status

As a result, we can see that the tables are relational to each other. These links play an important role in performing queries in tables and in performing search and filtering operations.

IV. CONCLUSION

In summary, this paper discusses the development of a database of higher education process management information systems based on a relational model. The basis of any information system is a database. Therefore, the correct organization of the database of the information system affects the quality of information exchange in the system. There is a total of 161 tables in the database of the Higher Education Process Management Information System. The information system is located in the servers of each higher education institution and is designed to store important information such as personal data, mastering results, attendance statistics and diploma information of all students of the institution. In addition, the results of educational, scientific and methodological work of professors and teachers, which are reflected in this system.

REFERENCE

- [1] Sajjad Ahmad Bhatti, Awais Adnan. Challenges in education management information system in developing countries//2010 International Conference on Information and Emerging Technologies. <https://www.researchgate.net/publication/235686569>
- [2] Utkir Khamdamov, Alisher Abdullayev, Jamshid Elov, Djamshid Sultanov. Conceptual Model of the Education Management Information System for Higher Education Institutions//International Journal of Advanced Trends in Computer Science and Engineering//Volume 9, No.5, September - October 2020
- [3] Abdullaev A., Khamdamov U. The concept of development of information systems and services in the system of higher education of the Republic of Uzbekistan. // EU-01-002070 "Asian Intellectual Property" LLC, 2018. Available at: <https://interoco.com/all-materials/literary-work/2364-2018-11-30-10-41-59.html>
- [4] Ivanova Elena Vladimirovna. Methods for parallel processing of super-large databases using distributed columnar indices // Dissertation for the degree of candidate of physical and mathematical sciences // Chelyabinsk – 2015
- [5] N.N. Fedyakova. Improvement of information systems of university management // Integration of education. Vol. 20, no. 2.2016
- [6] J.B. Elov, U.R. Khamdamov, O.Q. Makhmanov. The data structure and information model for the information system of monitoring the educational process in the medical field // International Conference of Information science and communications technologies applications, trends and opportunities ICISCT 2019. 4-6 November, 2019. Tashkent, Uzbekistan, 4p.
- [7] J.B. Elov, U.R. Khamdamov, Dj.B. Sultanov, O.Q. Makhmanov. Organizing functional processes of information system for the advanced training of medical personnel on the basis of IDEF methodology // International Journal of Advanced Research in Science, Engineering and Technology. Vol. 6, Issue 12, December 2019. India. –p. 12085-12090.

[8] J.B. Elov, U.R. Khamdamov, Dj.B. Sultanov, O.Q. Makhmanov. Structure of functional processes and information model of e-referral module of the system for medical personnel retraining // International journal of scientific & technology research Volume 9. Issue 05, may 2020. France/India. -p. 207-211.