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ORIGINAL ARTICLE

Design databases to be use in the Sistemas de Información en Salud department, Havana 2021

Diseño de base de datos para el departamento de Sistemas de Información en Salud, La Habana 2021

Projeto de banco de dados para o departamento de Sistemas de Información en Salud, Havana 2021

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ABSTRACT

Introduction: the Facultad de Tecnología de la Salud has a database in use for gathering information concerning enrolled students; however, this database does not meet the needs of the department of Sistemas de Información en Salud, it is very important for professors to have a properly information management system helps them for performing the organizational strategies required. **Objective:** to design a database to be use in the department of Sistemas de Información en Salud for a better information management. **Method:** an applied research in technological innovation was conducted at the Facultad de Tecnología de la Salud, La Habana, in the period November 2020 - February 2021. A relational database was designed for practical usage. Theoretical and empirical methods were used, including the use of the interview methods focused on obtaining a better description of the department's needs, designing properly through logical and conceptual models the proposed databases. Microsoft Access database engine 2019 was used to build and implemented the databases. **Results:** the database was developed using the Entity-Relationship model. The entity-relationship diagram and a relational database schema were obtained. By using the Microsoft Access software were built different tables with their respective links, queries, forms and reports. **Conclusions:** it was designed and implemented a database that satisfies the functional requirements with which the department of Sistemas de Información en Salud will be able to manage its data, in a centralized and efficient manner. The designing and implementation processes of the database were described.

Keywords: database; relational database; entity-relationship model; information management; health information systems

RESUMEN

Introducción: la Facultad de Tecnología de la Salud dispone de una base de datos para el tratamiento de la información concerniente a los estudiantes matriculados, sin embargo, esta base de datos no cubre las necesidades propias del departamento de Sistemas de Información en Salud. Se necesita para la elaboración de estrategias organizativas por parte del departamento un sistema de gestión de información ajustado a las características del colectivo docente. **Objetivo:** diseñar una base de datos para el departamento de Sistema de Información en Salud en aras de una mejor gestión de la información departamental. **Método:** se realizó una investigación aplicada de innovación tecnológica en el período noviembre de 2020 – febrero de 2021, en la Facultad de Tecnología de la Salud, La Habana, en la que diseñó una base de datos relacional. Se emplearon métodos a nivel teórico y empíricos; entre ellos la entrevista para obtener una descripción detallada de las necesidades del departamento, y la modelación para representar a través de modelos lógicos y conceptuales del universo de discurso. Se empleó el Microsoft Access 2019 para la implementación de la base de datos diseñada. **Resultados:** la base de datos se diseñó mediante el modelo Entidad-Relación. Se obtuvieron el diagrama de entidad-relación y el esquema relacional de la base de datos. A través de Microsoft Access se crearon las tablas con sus respectivas relaciones, las consultas, los formularios e informes de la base de datos. **Conclusiones:** quedó descrito todo el proceso de diseño e implementación de la base de datos que satisface los requisitos funcionales con la cual el departamento de Sistema de Información en Salud podrá gestionar sus datos de una manera centralizada y eficaz.

Palabras claves: base de datos; base de datos relacional; modelo entidad-relación; gestión de información; sistemas de información en salud

RESUMO

Introdução: a Facultad de Tecnología de la Salud possui um banco de dados para o tratamento das informações dos alunos matriculados, porém esse banco de dados não atende às necessidades do Departamento de Sistemas de Información en Salud. Para o desenvolvimento de estratégias organizacionais por parte do departamento, é necessário um sistema de gestão da informação ajustado às características do grupo docente. **Objetivo:** projetar um banco de dados para o departamento de Sistemas de Información en Salud para melhor gerenciar as informações do departamento. **Método:** foi realizada uma pesquisa aplicada sobre inovação tecnológica no período de novembro de 2020 a fevereiro de 2021, na Facultad de Tecnología de la Salud, Havana, na qual foi projetada uma base de dados relacional. Foram utilizados métodos teóricos e empíricos; entre eles a entrevista para obter uma descrição detalhada das necessidades do departamento, e a modelagem para representar por meio de modelos lógicos e conceituais o universo do discurso. O Microsoft Access 2019 foi utilizado para a implementação do banco de dados projetado. **Resultados:** o banco de dados foi desenhado usando o modelo entidade-relacionamento. Obteve-se o diagrama entidade-relacionamento e o esquema relacional do banco de dados. Através do Microsoft Access, foram criadas as tabelas com seus respectivos relacionamentos, as consultas, os formulários e relatórios do banco de dados. **Conclusões:** foi descrito todo o processo de desenho e implementação da base de dados que satisfaça os requisitos funcionais com os quais o departamento do Sistemas de Información en Salud poderá gerir os seus dados de forma centralizada e eficiente.

Palavras-chave: banco de dados; banco de dados relacional; modelo entidade-relacionamento; gestão da informação; sistema de informação em saúde

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INTRODUCTION

Information, in its different types, media and forms of transfer, is at the heart of the transformations of the productive system, as well as being an essential resource for economic, political and social development. Adequate and up-to-date access to information is essential for economic and social development, especially to support decision-making processes in planning, policy formulation and implementation, or to support professional development and practice.

For an effective development in the activities of the institutions it is essential to have adequate and timely information as a fundamental tool that, due to the enormous flow in circulation, must be organized and systematized in a way that enables its effective use.[1]

Proper management of institutional information represents a challenge due to the boom reached by technologies. At the same time, it is a powerful tool for the generation, modification, dissemination, accessibility, timeliness and durability of information, provided that the conditions and knowledge for its implementation exist.

In Cuba, actions are being developed that contribute to information management. The national information policy establishes the bases for the management of institutional information, a fundamental requirement for efficient decision-making.[2]

The electronic format of the information is now commonplace in all the country's institutions, hence, the process of computerization of society is necessary to streamline processes in the catch, modification and processing of the volumes of information essential to manage resources.[2]

Among the contributions of the development of the fields of informatics and electronics is the concept of databases (DB) with electronic formats, which contribute to the planning and organization of a company, organization or institution. Quintana-Rondón[3] states that the purpose of databases is to group all relevant information that, because of its significance, must be stored and preserved, since it will support the institutional activity, in a single place.

Databases are "a set of data stored in external memory that are organized by means of a data structure" that can be accessed quickly and their design responds to the need to "satisfy the information requirements of a company or other type of organization". The DBs are developed through Database Management Systems (DBMS), understood as an application that allows users to define, create and maintain the DB, in addition to providing controlled access to it, and it is precisely the tool selected for this study.[4]

The Facultad de Tecnología de la Salud of Havana has a database for the processing of information on students enrolled in the faculty, with which the department of Secretaría Docente works regularly. However, this database does not meet the specific needs of the career departments, including the department of Sistemas de Información en Salud (SIS), for which this work is oriented. For the development of organizational strategies, the department needs its own computer system adjusted to the characteristics of the teaching staff.

This work aims to contribute to a better management of departmental information, so the present study proposes to design a database for the department of Sistemas de Información en Salud of the Facultad de Tecnología de la Salud, Havana.

METHOD

An applied research of technological innovation was carried out in the period November 2020 - February 2021, at the Facultad de Tecnología de la Salud, Havana.

Empirical and theoretical methods were used:

At the empirical level, documentary analysis was used for the review of the different bibliographies found that are related to the topic in question and the most relevant ideas of these sources of information were taken in a summarized form. An interview was conducted with MSc. García-Savón, head of the Sistemas de Información en Salud, to obtain a detailed description of the universe of discourse on which the database is based.

At the theoretical level, modeling (theoretical representation of a system of real-life objects and phenomena) was used. The conceptual model of the data and the logical modeling of the DB were elaborated. As a result, the entity-interrelationship diagram and the relational schema of the DB were obtained, where the information to be stored was described in an abstract way.

The analytical-synthetic method was used in the in-depth analysis of the most relevant materials that made it possible to have an orderly and synthesized knowledge for the elaboration of the research.

There was a study of the historical background in the application of DBMS for a better understanding of its current and future logical behavior (historical-logical method).

Microsoft Access software, from the Microsoft Office 2019 package, was used as a manager to program the DB.

RESULTS

In the interview with García-Savón, head of the SIS department, it was possible to obtain a detailed description of the universe of discourse on which the database was implemented. The interviewee referred to the need for a database that would make it possible to control the data corresponding to the students in the course, the subjects they take, the professors who teach these subjects, and the grades students receive in these subjects.

The future DB was given the name Sistemas de Información en Salud, since it was intended for the work of the department of the same name. A relational database was designed because of its advantages in the manipulation of information.

The DB was designed from the entity-interrelationship model approach. By means of this methodology, three fundamental stages were applied in the design and conception of the DB: conceptual design, logical design and physical design, which will be referred to below.

Conceptual design

This stage was based on the study of the detailed description of the universe of discourse proposed by García-Savón in the interview conducted to prepare the entity-relationship diagram of the DB (Figure 1). Finally, the following were determined as regular entities: Students, Professors and Subjects.

The corresponding relationships were established between them according to the literal description and, in this way, a relationship was established between Students and Subjects, and between Subjects and Professors. The cardinality correspondence between the entities Subjects and Teachers was of the "one to many (1:N)" type and between the entities Students and Subjects was of the "many to many (N:M)" type. Attributes were determined for each of the entities and relationships, which represent the characteristics or properties they possess.

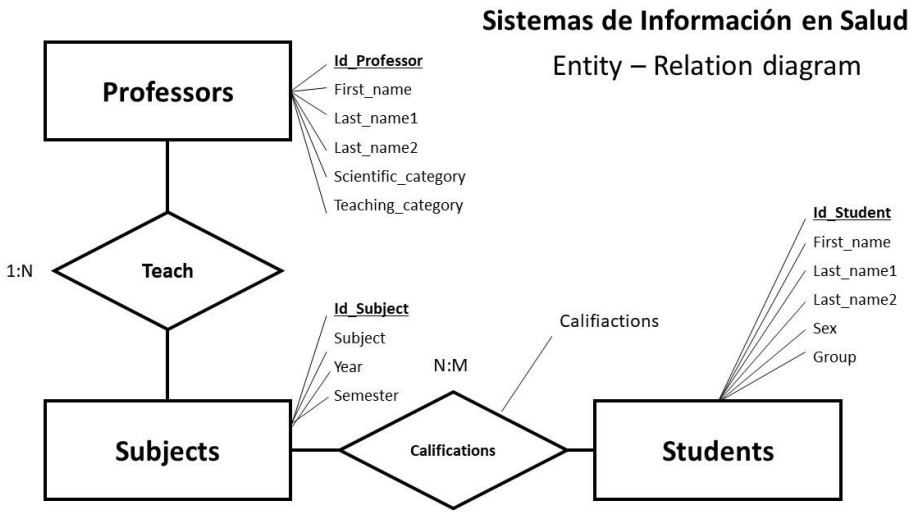

Fig. 1. Entity-relationship diagram of the Sistemas de Información en Salud database.

Logical design

With the logical design of the DB, the entity-relationship diagram obtained in the previous stage was transformed into the relational schema, which was adapted to the DBMS data model. (Figure 2) With this model it was possible to carry out the programming of the DB in the available manager.

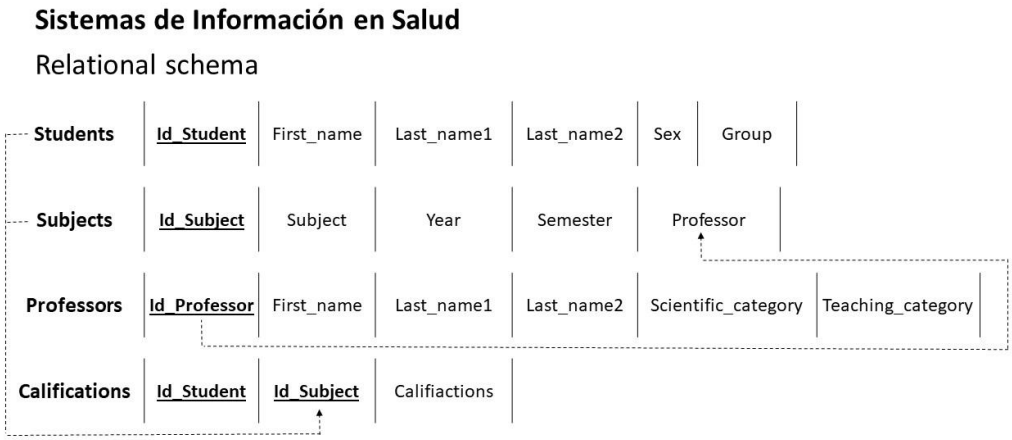

Fig. 2. Relational schema of the Sistemas de Información en Salud database.

Physical design

The Microsoft Access program from the Microsoft Office automation package was used as the database manager. It was possible to execute the implementation of the DB by taking the relational schema as a reference. The resulting structure was:

a) Tables: 4
b) Forms: 19
  - Table forms: 4
  - Query forms: 5
  - Start forms: 1
  - Navigation forms: 1
c) Queries: 5
d) Reports: 5

Four tables were programmed, corresponding to each of the entities. The tables were related according to the entity-relationship scheme, and the referential integrity for data entry was established (Figure 3).

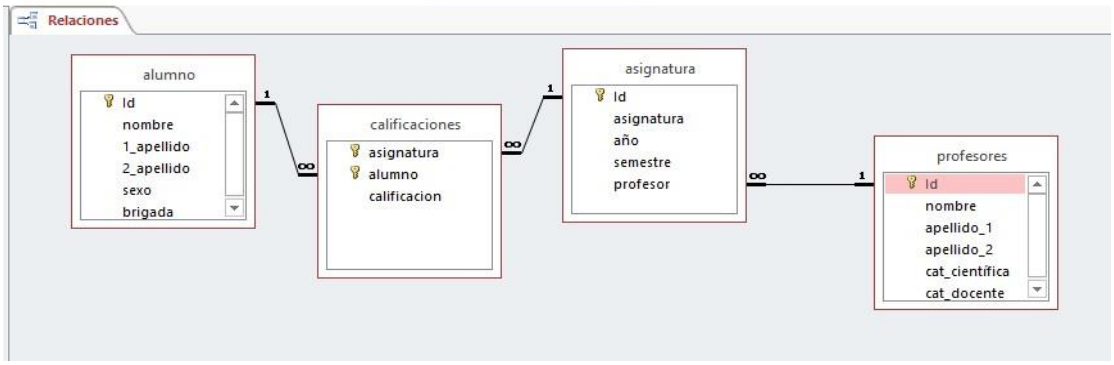

Fig. 3. Relationships of the Sistemas de Información en Salud database programmed in Microsoft Access.

Forms were created for tables, for the introduction and visualization of information in the database, and query forms were created to present the data to the user (Figure 4).

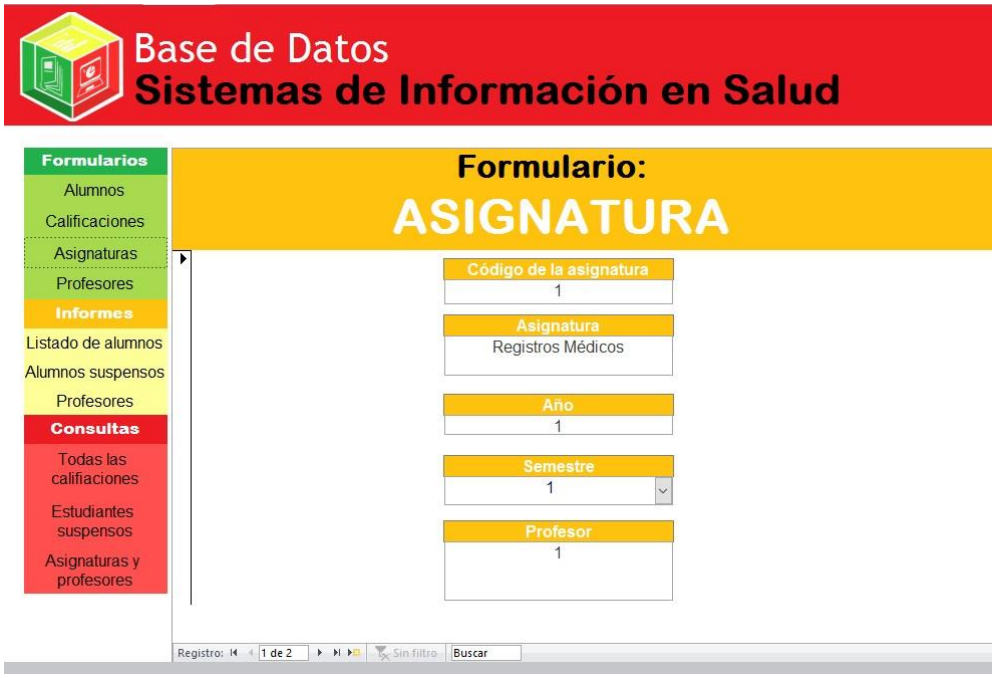

Fig. 4. View of the navigation form with the Subject subform.

In the table forms, text type fields were used, in general, to enter the information. For the attributes teaching category and scientific category in the Teachers table, semester in the Subjects table, gender in the Students table and grade in the Grades table, list type fields were used.

The query forms made it possible to visualize the results of the selection made by the corresponding query. A startup form was created, which opens automatically by means of macros when the database is executed. This start form gives access to a navigation form from which one can access the table forms, query forms and reports in subform.

Five queries were programmed to select the records that meet certain conditions in order to display them and to be able to operate with the records. The following selection queries were created and are shown in Table 1.

Table 1. Health Information Systems Database Queries

Query	Description
calificaciones	Displays the name and surname of all students, the brigade to which they belong and the grade received in the subjects.
suspensos	Displays the name and surname, as well as the brigade to which the students who failed subjects belong, as well as the subject they failed.
asig profe	Displays the name of the subjects, the academic year and semester in which they are taught, and the name and surname of the professor who teaches the subject.
grado cient	Displays for each scientific grade the names of the professors with their respective teaching category. The query has a parameter to reduce the selection to a specific scientific grade.
asignatura	Displays for each academic year, the subjects, the semester to which they correspond and the professor who teaches them. The query has a parameter to reduce the selection to a specific academic year.

Source: own elaboration.

A report was created for each query, which included a header with the institution and department data. The levels of access to the system will be determined by the system administrator, in this case, this function will be performed by the head of the department. Her function will be to establish the permissions to the information that is pertinent to the professors. The person in charge of editing, designing and modifying the elements of the DB will be the technician designated by the department head. It is recommended that the main author of this article be assigned to this function because of his mastery of the specifics of the system.

The person who works directly with this information will be the only one who will be able to view the information contained in the DB due to ethical implications. This person will be selected by the head of the department. The principle of least privilege was applied, so that the end users of the DB will have access only to the part of the information that concerns them.

DISCUSSION

The use of the BD Sistemas de Información en Salud is intended to contribute in an assertive way to the solution of some issues such as the lack of security and coherence in the handling of information. Also to the greater reliability of statistical results, due to the automation of some processes that allow obtaining processed, detailed and summarized information, with less delay in the response time. This whole process will bring about a considerable reduction in the consumption of office material and will favor the savings policy.

Many of these advantages will arise from the use of the relational model for the design of the DB. This model is a data modeling tool that makes it possible to represent the relevant entities of an information system, as well as their interrelationships and properties.

According to Valverde[5], relational databases provide tools that avoid duplicity of records and ensure referential integrity, thus, when eliminating a record, it eliminates all the related dependent records, and favors standardization because it is more understandable and applicable.

Santana-Espinosa[2] states that the relational design of the DB avoids redundant information, allowing the data collected in the tables to be displayed in drop-down lists without the need to enter them repeatedly. An advantage of using this model is the simplicity of its logical structure and that it is based on the mathematical concept of relationship, which is represented by a table.

One of the most popular DBMSs is undoubtedly Access, or Microsoft Access, a software that allows to manage a DB.[6] According to Domínguez Alconchel[8], Access has the ability to collect data from other utilities (such as Excel, SharePoint, etc.) and manage them by means of queries and reports.

Also, Santana-Espinosa, *et al*. [2] report that queries to the database allow database managers to have filtered data about their professors and students more quickly. DB queries allow information users to make summaries on the faculty and to be aware of the dates of teacher ratification, when it is their turn to propose an award, and to continuously update the information.[6,7,8]

Forms are a form of presentation in which the data involved and their position on the screen are defined. They are considered the main interface between the user and the application.[6] Their function is to retrieve information from the database, just like queries, but in a format that facilitates their presentation and printing on paper.

According to Roche-Madrigal[7], as well as other authors[8,9,10], reports and queries generally complement each other since reports are usually built from stored queries and not from tables.

The use of database security techniques is an important phase in ensuring the security of stored data and thus mitigating damage to threats to the integrity of the information.[1]

The implementation of passwords in the databases guarantees greater confidentiality of the information managed therein and limits access only to authorized users, which contributes to the ethical component.[2,11]

Other institutions have implemented database systems in data automation, from the loading process to handling and processing to replace manual tasks. In addition, it saves time, money, improves efficiency, helps reduce errors through data validation and ensures that the data loaded is structured.[12,13,14]

CONCLUSIONS

At the conclusion of this article, all the aspects of the design and implementation process of the database with which the department of Sistemas de Información en Salud will be able to manage its data in a centralized and efficient manner are described; in addition, the proposed design satisfies the functional requirements and solves the shortcomings that motivated its creation.

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Conflict of interest
The authors declare that there are no conflicts of interest with respect to this study.

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