E-R Method Applied to Design the Teacher Information Management System's Database Model

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Abstract

The development and application of management information system must be supported by the database. Data model is the database of data organization form. One of the core problems of database design is to have a good data model, storing the data effectively, meeting the application requirements of various users. E-R method is widely used in database model design. This article focuses on E-R method applied to design the teacher information management system's database model.

Key words: *E-R method; Teachers information management system(TIMS); database model*

1. Introduction

E-R method is the short for Entity - Relationship Approach, be translated as entities - contact method. Through the E-R diagram to represent entities and their contacts is widely used in database model design. The database model design is an extremely important link in the design of management information system, is the basis of the application. The database model design is good or bad directly affects the success or failure of the whole system. A good database model design can make the application system high efficiency, maintenance simple, and use easy. It also can improve the application performance and life cycle. But it was often ignored in actual development of system. In here, we emphatically discuss the database model design combined with our school's teacher management system.

2. Teacher Information Management System (TIMS) Overview

A. TIMS Development Necessity

High quality education requires efficient management. Establishing efficient practical information management system of modern can make the masses of teachers and teaching staff freed from tedious work, and improve the work efficiency and the teaching high quality. It can also provide practical information of decision analysis for school leaders better, and lay a solid foundation for achieving the first-class teaching.

Teaching work is the core of school work. The teacher is the key to judge the teaching work. Teacher information management system is an important part of the school management information system construction. It is the key to improve the quality of teaching management. Teacher information processing of computerized and networked is also an important content to realize school management modernization and informatization.

In the school system, Human Resources is mainly refers to the staff teaching teachers as

the main body. Human Resources information not only refers to the personnel data, also include the work information of staff in teaching, scientific research, management and so on. The informatization of Human Resource is very important. Only using the Human Resource (the teacher resource) reasonably, having orderly circulation in all aspects of school work, sharing resources reasonably, and playing the staff's potential fully, that can constantly improve the quality and the level of education. So it is very necessary to develop our school's teacher information management system.

B. TIMS Function Description

Through the communication and discuss with teaching staffs, determine the system contains the following four items:

- the teachers basic information
- the teaching workload
- the advanced study
- the teaching and scientific research

For each item, user with different identities has different operations permissions. Ordinary teachers have only the rights to query their private information; Head of the teaching and research group (TTRG) can query the teachers' information in this group; Head of the teaching and research department (TTRD)can query the teachers' information in this department; School leaders can query all teachers' information; teaching staff and HR staff can input, modify and delete information; and they can also statistics all kinds of information about the personal teacher, the teaching and research group, the teaching and research department and all the staff of the school by semester and academic year two situations. All the query and statistics support the report printed.

All users will log in this system through the password verification. The system adopts the Browser/Server structure, with SQL as the backstage database. It convenient user use all kinds of information resources in the TIMS (teacher information management system) by network

3. TIMS' Database Model Design

The development and application of information management system must be supported by the underlying database. Database is the foundation of all data processing. The work of building database in the whole system construction is a foundation link of high technical requirement and difficulty. A good database design and database construction can guarantee the rationality and validity of the data.

One of the core problems of database design is to have a good data model. That is to construct relatively optimal data model for a given application environment, so it can store data efficiently, and meet the application requirements of various users.

A. What is a Data Model

Data model is the data organization form of database. It is a model representation of database how to organize, the frame of the database, and the basis of database definition. Database represent not only what information is stored, the most important thing is to represent the connection between various data by a certain data structure, can reflect the associated information leaded from a kind of information. Data model should not only reflect the information, but also reflect the relationship between information. So its data structure is complicated. The focus of data model is on the construction of data structure.

B. Data Model Structural Approach - Entity-Relationship Approach (E-R method)

The basic element of E-R model is: entity, property, and relationship.

- Entity: it is a data object, refers to the objective existence thing can be distinguished in applications, such as person, department, etc.
- Properties: the feature of entity, such as age, gender, *etc*.
- Relationship: it means the link between entities. The relationship between different entities is divided into three kinds, 1:1 relationship, 1: N relationship, M: N relationship.
  - 1:1 relationship: an entity in either side corresponds to only one another entity at most in the other side.
  - 1: N relationship: an entity in either side corresponds to multiple entities in the other side.
  - M: N relationship: any entity in either side corresponds to multiple entities in another side.

C. The System's E-R diagram Design

E - R diagram design should follow the principle as follows:

- Determine the entity and the relationship between entities and properties, and design local E-R diagram.

The key to design E - R diagram is to determine the entity and the relationship between entities and properties. Because the teaching management people do not understand the system design and only can provide related reports and "what I have now, and what data I want to have in the end." We should know exactly what the users need before the design, and consider how to make the software to meet users needs in the long run. After understanding the needs of users, turn them into effective database design. First of the design is to clarify the relationship between the various data, and then determine the entities and properties of each entity according to the requirements.

In teaching and scientific research, for example, the original form provided of management people includes information of subject name, application date, approval date, result forms, expected completion time, building basis, research scheme, and information of the host teacher and participate teacher. Actually, this form contains data of two different themes, the project basic situation and the teacher situation engaged in. If take this form as an entity, the properties include all information above, then the relationship constructed in this way not only contains a large number of redundant data, but also has problems when modified. One teacher may engage in multiple subjects, if one of the fields of his changed, the subjects he had engaged in should have to change, and this is not what we want to see. So use two entities express the table data, and then determine the relationship between the two entities.

Through the analysis of original data, finally determine the entities of this system include: the teacher, the teaching and research group (TTRG), the teaching and research department (TTRD), course, research subject, advanced study. The property of each entity is as follows (the underlined means primary key):

Teacher: (teacher id, teacher name, operation permission, password, sex, date of birth, nationality, native place and other private information)

The teaching and research group (TTRG): (The teaching and research group code (TTRG code), name of the teaching and research group (name of TTRG), head of the teaching and research group (head of TTRD)).

The teaching and research department (TTRD): (The teaching and research department code (TTRD code), name of the teaching and research department (name of TTRD),

establishing time, number of male teachers, number of female teachers, head of the teaching and research department (head of TTRD)).

Course: (course code, course name, major)

Research subject: (subject id, subject name, application date, approval date, result form, expected completion time, building basis, *etc*.)

Advanced study (study code, study name, content, note)

The relationship between the various entities is as follows:

- One teacher only belongs to one TTRG, and one TTRG can contain a lot of teachers;
- One teacher only belongs to one TTRD, and one TTRD can contain a lot of teachers;
- One TTRG belongs to one TTRD, and one TTRD can contain a lot of TTRGs;
- One teacher can teach a lot of courses, and one course can be taught by a lot of teachers;
- One teacher can guide a lot of practice courses, and one practice course can be guided by a lot of teachers;
- One teacher can engage in a lot of research subjects, and one research subject also can have more than one teacher to attend;
- One teacher can engage in a lot of advanced studies, and one advanced study also can have more than one teacher to attend.

There are three 1: N relationships, and four M: N relationships. Property of the relation is as follows:

Teaching: (semester, class, number of theory class, number of practice class)

Internship: (semester, class, number of week, number of class)

Engaging in advanced study: (time, place)

Engaging in research subject: (member category)

Based on the above analysis, the local E-R diagram of this system is shown in Figure 1.

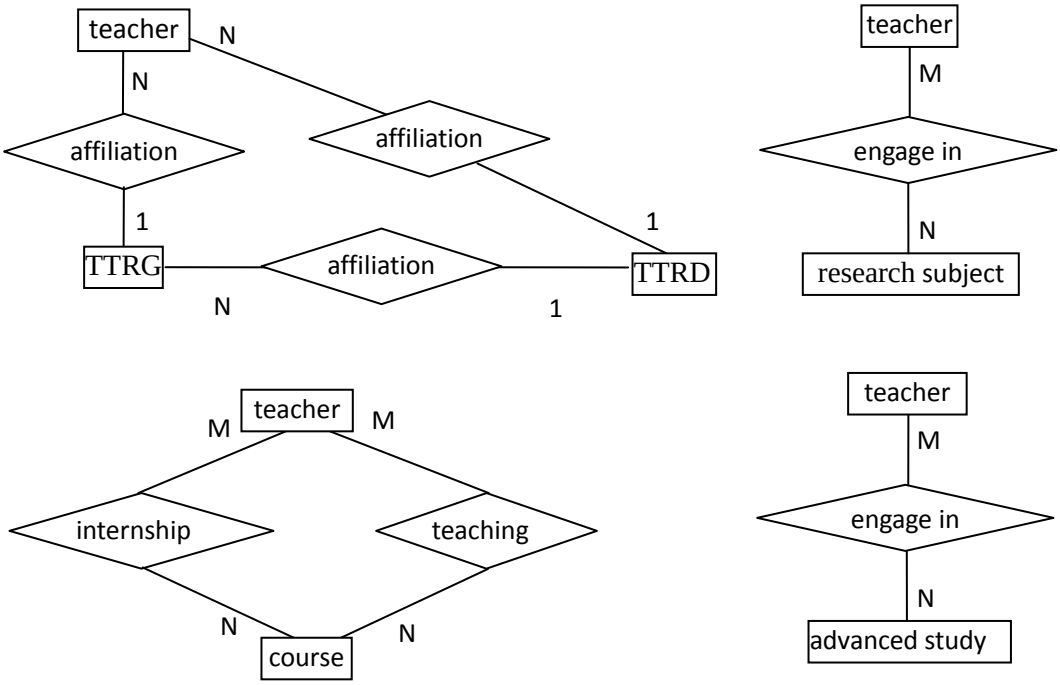

Figure 1. The Local E-R Diagram of this System

- Integrating each local E-R diagram, produce the overall diagram reflecting data as a whole concept. When integrated, each entity can only appear once in order to eliminate redundancy. In addition, seen from the Figure 1, 1：N relationship exists in between entities of the three entities, the teacher, the teaching and research group (TTRG), and the teaching and research department (TTRD). Relationship between the teachers and the teaching and research department (TTRD) is redundant and should be removed, because it can be derived both from the relationship of the teachers and the teaching and research group (TTRG) and the relationship of the teaching and research group (TTRG) and the teaching and research department (TTRD). The overall E-R diagram of this system is shown in Figure 2.

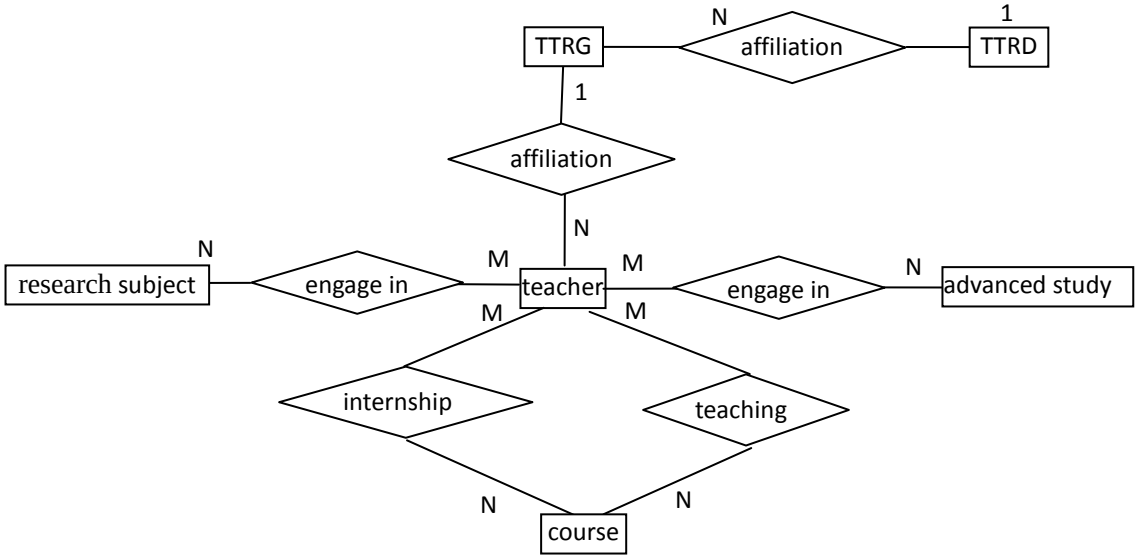

Figure 2. The Overall E-R Diagram of this System

D. Transformation from the E-R diagram to Relation Model

The main ingredients of E-R diagram are entity and relationship. The transformation rules is how to convert the entity and the relationship into a relational model, the specific rules are as follows:

- The entity's transformation: each entity in the E-R diagram is converted into a corresponding relationship, including all the properties of the entity.
- Transformation of relationship:
  - 1:1 relationship: In this relationship model, adding the key (as a foreign key) of one relational model and the relationship type property into another relational mode.
  - 1: N relationship: adding the key and the relationship property of the entity of side 1 into the relational model converted from the entity of side N.
  - M: N relationship: converting the relationship into relational model. The properties are the entity's primary key and the relationship type property of both sides. The key is the combination of the entity's key on both sides.

There are 6 entities in E-R diagram: the teacher, the teaching and research group (TTRG), the teaching and research department (TTRD), course, research subject and advanced study. According to the transformation rules, the 6 entities can be converted into 6 relational models, these are: the teacher table, the teaching and research group table, the teaching and research department table, the course table, the research subject table and the advanced study table.

Because the relationship between entity "the teacher" and entity "the teaching and research department (TTRG)" is 1: N relationship. Entity "the teacher" is on side N, the property "TTRG code" is added into “the teacher table” converted from the entity "the teacher"; Because the relationship between entity "the teaching and research group (TTRG)" and entity "the teaching and research department (TTRD)" is 1: N relationship, and entity "the teaching and research department (TTRG)" is on side N, the property " TTRD code" is added into “the teaching and research group table”.

Because the relationship between entity "teacher" and entity "research subject" is M: N relationship, when converting it into relational model, the model contains the property

"members category" of itself and two entity keys "teacher id" and " research subject id". Other 3 M: N relationships will also be converted into relation model.

According to above analysis, there are 10 relation models at all, as follows:

The teacher: (teacher id, teacher name, operation permission, password, TTRG code, sex, date of birth, nationality, native place and other personal information)

The teaching and research group (TTRG): (TTRG code, TTRD code, name of the teaching and research group (name of TTRG), head of the teaching and research group (head of TTRD))

The teaching and research department (TTRD): (TTRD code, name of the teaching and research department (name of TTRD), establishing time, number of male teachers, number of female teachers, head of the teaching and research department (head of TTRD))

Course: (course code, course name, major)

Research Subject: (subject id, subject name, application date, approval date, result form, expected completion time, building basis, *etc.*)

Advanced study (study code, study name, content, note)

Teaching: (teacher id, course code, semester, class, number of theory class, number of practice class)

Internship: (teacher id, course code, semester, class, number of week, number of class)

Engaging in advanced study (teacher id, course code, time, place)

Engaging in research subject: (teacher id, course code, category)

E. Relationships between Tables

The relationship between tables is shown in Figure 3:

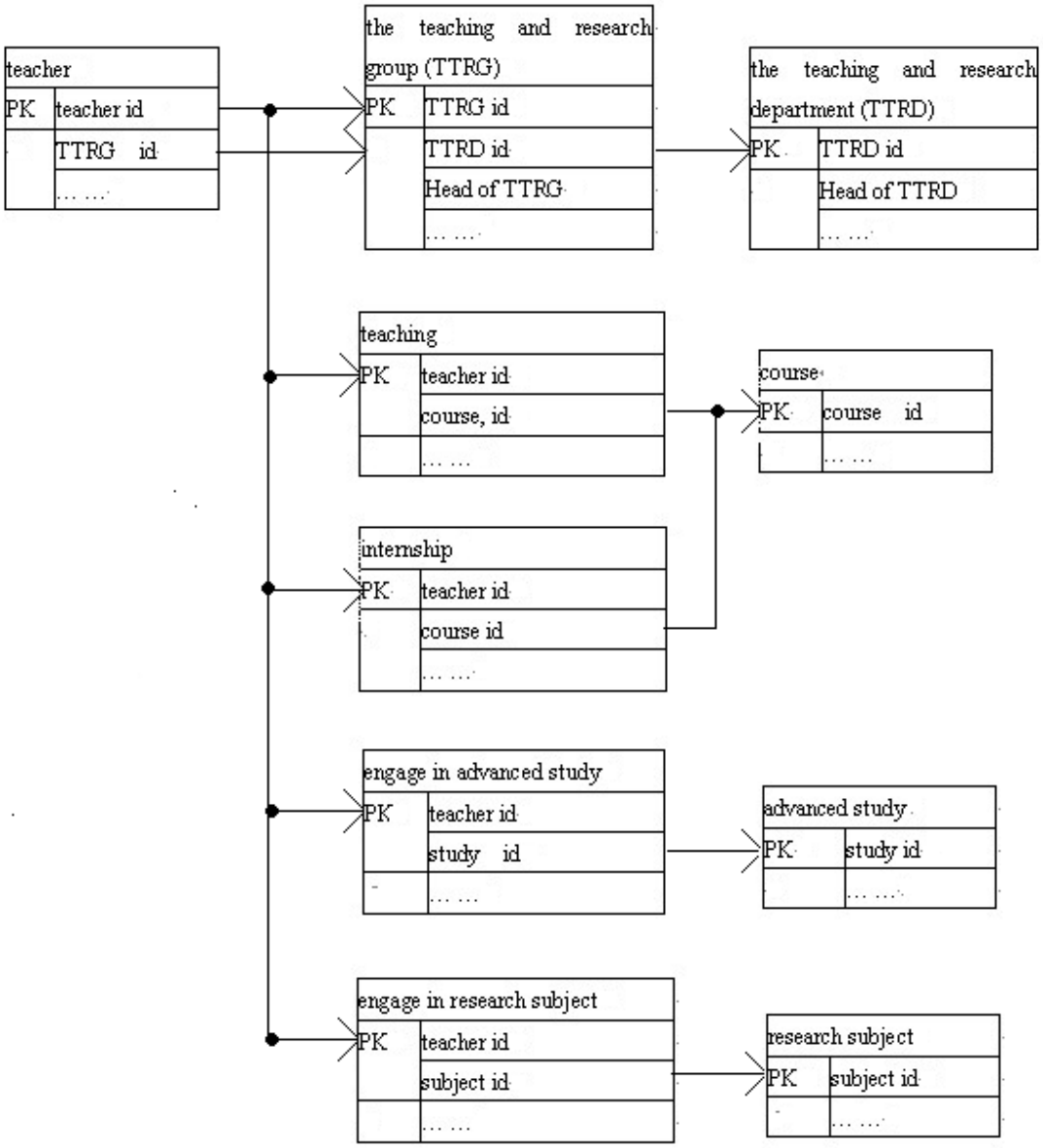

Figure 3. The Relationship between Tables

4. Conclusion

Above is the design of the teacher information management system's database model by E-R method. It better reflects the all data and all relationship in this system, meeting the needs of users. The database model designed by E-R method can remove redundant, greatly reduce the storage amount of data in the database, better guarantee the data integrity and consistency, but it will make some data need to be derived and calculated, and the derivation process will take CPU time. If the system's application is focuses on the query, and rarely involves the operations such as insert, update, delete, we can allow a certain amount of data redundancy to get a good response rate. If the information expressed by the relationship is too simple, querying data will need connection operation, and it is a big consumption of CPU. So, when designing database relational model, must combine with the actual system.

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