Teaching Case

Front-End and Back-End Database Design and Development: Scholar's Academy Case Study

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Abstract

This case study consists of a real database project for a charter school – Scholar's Academy – and provides background information on the school and its cafeteria processing system. Also included are functional requirements and some illustrative data. Students are tasked with the design and development of a database for the purpose of improving the current process of keeping track of students' meals. Skills to be learned include logical database modeling and design, physical design and implementation using both ACCESS (front end) and SQL Server (back end) Databases. Queries, forms and reports are to be developed in ACCESS while the tables will be created in SQL Server. This Case study targets students with no prior programming or database experience. However, more advanced students can further explore the intricacies of an enterprise level database management system (e.g., SQL Server).

Keywords: Teaching Case, Database Design and Development, SQL Server, ACCESS.

1. CASE SUMMARY

Scholar's Academy is a public charter school that emphasizes a Math and Science focus. Within the last five years, enrollment has increased from 400 students to 800 students and lunch service has grown from 100 to 300 students. The nutrition director and the school principal would like to collect students' meal information in a computerized database in order to have timely and accurate information on all types of students (paid, reduced and free meals). Currently, Scholar's Academy relies on a manual process to track students' meals supplemental by an Excel spreadsheet. Due to the increase in enrollment, it has become an inefficient and cumbersome system. Moreover, to be compliant with privacy policies, cafeteria staff cannot discuss account balances with students as they pass through the lunch line, therefore allowing some students to continue getting meals while having an unpaid balance. This concern is clearly stated by the nutrition director:

"There are so many rules that make it hard to collect in the lunch line. I can't highlight the students that owe money because other students may see or hear me. Our system is set up as paid students are charged $3.00 per meal. Reduced students are charged $.40 and then our free students. If I say to a student in the lunch line that he owes $2.40, then I just identified that student is on reduced lunch and breached confidentiality."

As a result of this current process, Scholar's Academy was forced to write off over $7,000 last year in unpaid lunches.

Current Process Description:
Scholar's Academy's current cafeteria processing system consists of the following: 1) a daily paper printouts of students' list, 2) manual check mark next to the student's name and type of meal at the actual cafeteria line as the students go through the line, 3) data entry in Excel Spreadsheet, 4) manual end-of-day production of daily reports, and 5) manual end-of-day production of emails and/or printed letters to parent/guardian regarding student meal balances.

In an interview with the nutrition director, she emphasized the above steps:

"A typical day for me is to print off the entire school roster which wastes paper as only half of the students eat lunch, take the list to the cafeteria and check off the students' name as they get their lunch tray. Later that day I will enter the checked names into the information in the computer in Excel. I look up student names, select their meal (breakfast, or lunch), and make sure I have today's date. If I am behind, I have to enter yesterday's date."

Due to additional duties and the complexity of the different types of meals applied to individual student, it has become more difficult for the Director to monitor the student's lunch balances.

Problems with Current System:
Scholar's Academy's current cafeteria processing system is hindered by the following problems:

o The current system relies heavily on the use of paper printouts and manual data entry, which is extremely time-consuming and causes a slow movement of students through the meal line. This reduces the amount of time that students have to complete their meal before returning to class.

o The current system does not have an efficient mechanism in place that allows for full compliance with the federal law that prohibits schools from overtly identifying students receiving free and reduced price meals.

o The current system does not have an electronic mechanism that ensures that a "free" student obtains a "full meal", rather than simply getting limited individual items. Scholar's Academy is required by the USDA to prove that all "free" students get a "full meal"; otherwise Scholar's Academy's funding will be jeopardized.

o The current system does not have an electronic mechanism that ensures that a particular customer is only allowed to go through the meal line only once per meal session.

o The current system does not have an efficient mean of verifying that the actual student in the meal line matches the student name on the roster list.

o The current system does not have an efficient electronic mechanism to ensure that information for each and every instance of a customer transaction is captured, which causes inaccuracies in recordkeeping and reporting.

2. FUNCTIONAL REQUIREMENTS

The nutrition director, along with the school principal, wants a more efficient cafeteria processing system that will keep track of students' meals and balances. The nutrition director needs access to a computerized form at the cafeteria to allow staff to either check students at the lunch line. Daily internal reports are needed to accurately capture total transactions to the school administration while external reports are sent the State for reimbursement for free and reduced meals.

Database Design Requirements
Each student has a unique six-digit ID number, a photo and fingerprint scan. Students must be linked to at least one parent/guardian (for payment purposes). The contact will have a unique six-digit ID number along with name, address, phone number, and email recorded. The unique identifier for meals will be a five-digit ID number and a description of the meal will also be included.

A student may purchase several meals but each transaction is associated only one student. A transaction is made for only one meal. Transactions have a unique seven-digit number as an identifier and date, time, and transaction amounts are recorded as well.

A payment can be made by the student through cash, check or credit card (unless it is free then, there is no payment). An instance of payment is associated with only one customer. Payment will

be uniquely identified by a six-digit number, and amount, date, payment method and processor.

Parents/guardians are associated with students for the sole purpose of receiving monthly meal statements and for notification when balances are unpaid.

Queries Requirements
The nutrition director needs several different queries to obtain the information needed to become more efficient and cut down on losses.
1. **Student List:** List all students' first name, last name, and grade. Sort by grade first and last name second.

2. **Students and their Meal Status:** List all students' first name, last name, meal status (free, reduced, or paid). Order by meal status first and last name second.

3. **Daily Transactions:** Calculate the total number of meals served and the sum of meal cost per day.

4. **Total Free Meals:** Calculate the total number of meals served to students with a status of free meal and the cost of the meals.

5. **Total Reduced Meals:** Calculate the total number of meals served to students with a status of free meal and the cost of the meals

6. **Payments by Students:** List all payments made by students.

7. **Student Balances:** List the name of students, their current charges and payments

8. **Unpaid Balances:** List students' names and any payments that are less than total charges.

Forms Requirements
The nutrition director requested several data entry forms to either enter new data or view existing records for the following tables: Student, Menu, Payment, and Parents. Other forms are also needed and require linking two or more forms:

1. **Transaction Form:** This form will be used at the cafeteria line to display a student name and photo as soon as he/she places a thumb on the biometric device attached to the computer, and allow the staff to select the menu item that the student is consuming during a transaction.

2. **Payment History Form:** This form will hold all information on the meals consumed by a student as well as payments made. A drop down list allow users to select a student name.

3. **Main form:** Scholar's academy would like a simple main form that allows easy access to either reports or other forms.

Report Requirements
Scholar's Academy will need several reports to ensure accurate internal reports, external reports free meals to the State, and external reports to the parents.

Internal Reports
1. **Student Lunch Count:** Sub-total by free, reduced, or full paid lunches including total charges (in dollars).

2. **Monthly Total Lunches:** Sub-total by free, reduced, or full paid lunches including total charges (in dollars).

3. **Total Lunches per Grade:** Sub-total by free, reduced, or full paid lunches per grade.

4. **Total Meal Charges versus Payments:** Sub-total of meal charged; Sub-total of payments received.

5. **Daily Reports to the Teachers:** Daily list of students with zero or negative balance. This will prevent students from being told in the lunch line that they have no funds.

External Reports
1. **State Funding Report:** Total amount of free and reduced lunches reported to ensure those students receiving free lunch receive a "full meal" and not jeopardize school funding.

2. **Reports to Parents:** Individual report per student showing unpaid balances. The report should show the meal charged and the payments received.

3. DELIVERABLES

Deliverable One
Identify entities and attributes and develop an entity-relationship diagram (ERD). Mark cardinalities and modalities, and solve any

many-to-many relationships (i.e. associative entities). Document any assumptions.

Deliverable Two
Revise the previous ERD (if necessary). Convert assumptions into business rules. Create data structures normalized to 3NF. Complete an attribute description table including: field name, data type, and comments.

Deliverable Three
SQL will be used as the back end to create the tables and Access as the front end for the forms and reports. Students will have to set up an ODBC connection.

1. Create the tables and populate them with made up student data. Students can use the appendix to populate the meal table.

2. Run the queries and reports mentioned.

3. **CONCLUSION**

Before ending the interview with Scholar's Academy nutrition director concerning their requirements, she noted:

"There must be several ways to handle the cafeteria processing system better than what I currently am doing. What options are available to me to become more efficient and how do I start to find more information about them?"

Clearly, Scholar's Academy needs your assistance. As the school enrollment grew from 400 to 800 students, the current process presents several shortcomings. The daily print out of the entire school roster, the manual check off at the cafeteria line, and the end of day data entry into Excel is preventing Scholar's Academy from accurately and effectively processing students' meal information. To prevent another year of writing off unpaid balances and wasting staff time, Scholar's Academy needs your assistance with developing a database to better track its data. Help Scholar's Academy get rid of its current practices and become more efficient.

Appendix

Breakfast is a 2 week cycle menu. The regular paying student price is $1.50, reduced student is $.30. If a student does not get the full meal, they will pay more for individual items regardless of their meal status. The breakfast entrée will cost $2.00, fruit $1.00, and milk and juice will cost $.75 each.

Lunch is a 3 week cycle menu. The regular paying student price is $3.00, reduced students is $.40. If a student does not get the full meal, they will pay more for individual items regardless of their meal status. The lunch entrée will cost $3.50, fruit and vegetables are $1.00 each and milk is $.75.

Calendar		
Menu	**Description**	**Schedule Day**
BREAKFAST: WAFFLES, SYRUP, FRUIT, JUICE, MILK…….LUNCH: SALISBURY STEAK, MASHED POTATOES, GREEN BEANS, PEARS, MILK		
BREAKFAST: COLD CEREAL, SUPER BUN, FRUIT, JUICE, MILK……..LUNCH: CHICKEN QUESADILLA, BAKED BEANS, MANDARIN ORANGES, MILK		
BREAKFAST: WW BLUEBERRY MUFFIN, FRUIT, JUICE, MILK……..LUNCH: HAMBURGER ON WHEAT BUN, FRIES, BANANA, MILK		
BREAKFAST: CEREAL BAR, YOGURT, FRUIT, JUICE, MILK………LUNCH: BREADED CHICKEN SANDWICH, CORN, CARROTS, PEACHES, MILK		
BREAKFAST: EGG PATTY, BISCUIT, FRUIT, JUICE, MILK………LUNCH: BAKED ZITI PASTA, BROCCOLI, WHEAT BREAD, PINEAPPLE, MILK		
BREAKFAST: FRENCH TOAST, SYRUP, FRUIT, MILK, JUICE…………LUNCH: CORN DOG BAKED BEANS, PEACHES, MILK		
BREAKFAST: BLUEBERRY MUFFIN, FRUIT, JUICE, MILK……………LUNCH: CHICKEN NUGGETS, GREEN BEANS, WHEAT BREAD, BANANA, MILK		
BREAKFAST: CEREAL BAR, YOGURT, FRUIT, JUICE, MILK…………..LUNCH: CHICKEN PASTA, CARROTS, WHEAT BREAD, PEARS, MILK		
BREAKFAST: CHEESE MUFFIN, FRUIT, JUICE, MILK………LUNCH: BEEF & BEAN BURRITO, GREEN SALAD, FAT FREE RANCH DRESSING, PINEAPPLE, MILK		
BREAKFAST: TURKEY SASAGE, BISCUIT, FRUIT, JUICE, MILK………..LUNCH: GRILLED CHICKEN SANDWICH, FRIES, MANDARIN ORANGES, MILK		
BREAKFAST: WAFFLES, SYRUP, FRUIT, JUICE, MILK…………LUNCH: CHICKEN NUGGETS, SWEET POTATO FRIES, PEACHES, WHEAT BREAD, MILK		
BREAKFAST: COLD CEREAL, SUPER BUN, FRUIT, JUICE, MILK…LUNCH: COUNTRY STEAK, MASHED POTATOE, GREEN BEANS, ORANGES, WW BREAD, MILK		
BREAKFAST: BLUEBERRY MUFFIN, FRUIT, JUICE, MILK………..LUNCH: SPAGHETTI, BROCCOLI, APPLE, WW BREAD, MILK		
BREAKFAST: CEREAL BAR, YOGURT, FRUIT, JUICE, MILK………LUNCH:CHEESE BURGER MACARONI, RANCH BEANS, PINEAPPLE, W BREAD, MILK		
BREAKFAST: EGG PATTY, BSCUIT, FRUIT, JUICE, MILK………LUNCH: PIZZA POCKET, GREEN SALAD, FF RANCH DRESSING, PEARS, MILK		
BREAKFAST: FRENCH TOAST, SYRUP, FRUIT, JUICE, MILK………LUNCH: SALISBURY STEAK, MASHED POTATOES, GREEN BEANS, PEARS, MILK		
BREAKFAST: BLUEBERRY MUFFIN, FRUIT, JUICE, MILK………LUNCH: CHICKEN QUESADEILLA, BAKED BEANS, MANDARIN ORANGES, BANANA, MILK		
BREAKFAST: WAFFLES, SYRUP, FRUIT, JUICE, MILK…………LUNCH: CORN DOG, BAKED BEANS, PEACHES, MILK		

Calendar		
Menu	**Description**	**Schedule Day**
BREAKFAST: COLD CEREAL, SUPER BUN, FRUIT, JUICE, MILK..........LUNCH: CHICKEN NUGGETS, GREEN BEANS, WHEAT BREAD, BANANA, MILK		
BREAKFAST: BLUEBERRY MUFFIN, FRUIT, JUICE, MILK..........LUCNH: CHICKEN PASTA, CARROTS, WHEAT BREAD, PEARS, MILK		
BREAKFAST: CEREAL BAR, YOGURT, FRUIT, JUICE, MILK..........LUNCH: BEAN & BEEF BURRITO, GREEN SALAD, FF RANCH DRESSING, PINEAPPLE, MILK		
BREAKFAST: EGG PATTY, BISCUIT, FRUIT, JUICE, MILK..........LUNCH: GRILLED CHICKEN SANDWHICH, FRIES, MANDARIN ORANGES, MILK		