Automated School Management System – Recipe for Viable Educational System in Developing Countries

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ABSTRACT
Automated School Management System is an information system primarily developed to computerise, integrate and control all the activities involved in the collation and processing of student data mostly the academic records. The system not only makes student results collation fast but also easy and error free. It also makes the pool of data possible and information readily available and decision making fast. The system provides solution to the problems encountered in school management. There are numerous challenges and difficulties faced by school managers in making sure they come up with vital decisions and quality services to her valued students and customers. These things cannot be achieved through manual operations. Though, the use of paper works in school administration cannot be completely written off, the Automated School Management System is developed to enhance and boast the general school administration. The System is implemented to specifications using Microsoft Visual Basic 6.0 at the front end and Microsoft SQL Server-2005 database at the back end. Symmetric data encryption model is used to ensure maximum security, since the validity and integrity of information depends on who had an access to it. Automated School Management System is able to generate academic results, transcripts, timetable, registration of students, matters regarding welfare of students among other things.

KEYWORDS: symmetric data, EMIS, server-side, thin-client, thick-client, encryption model, HLM

INTRODUCTORY BACKGROUND
The revolution in information technology has exploded into the new knowledge economy and new information technologies are changing the ground rules for information flow in societies. The importance of using new technologies to provide information access is of great significance in the global economy. In other words, information technology is the focal point of electronics, data processing and telecommunication. This convergence has two aspects thus: The elimination of distances through providing linkage among separate computers in the world-wide web and the computerization of systems which result in new capacities to transfer sounds and images. This mutual convergence provided experts with a new tool to collect, store, and process, organize, transfer and represent information. Information technology has numerous applications ranging from tax collection to bank organization, from oil excavation to creating energy systems, from document management to the analysis of complex scientific problems etc. Education system forms the backbone of every nation – hence, it is important to provide a strong educational foundation to the young generation to ensure the development of open-minded global citizens securing the future for everyone. Advanced technology available today can play a crucial role in streamlining education-related processes to promote solidarity among students, teachers, parents and the school staff.

PERTINENT REVIEWS
There is probably no single best information system solution that can meet the needs of all public schools, school districts, private schools, and numerous education agencies in states and outlying areas. However, there are certain steps that could help all education organizations to determine the best solution for their particular situations. This booklet can lead education organization decision-makers through the process of making the best and most cost-effective decisions about information management systems devoted to individual student records. Tom Cassidy (2005) says that Information and Communication Technology (ICT) is widely believed to be important potential levers to introduce and sustain education reform efforts. Despite evidence of increasingly widespread use of IT in education initiatives around the world, yet there is little guidance available for policy makers and donor staff specifically targeted at countries contemplating using IT to meet the education-related Millennium Development Goals. Jain and Jain (2004) states that once an automatic computer has been provided with data and instructed through a program, it can process the data without further human intervention. He further highlighted the computing pattern that divides processing work for transaction application that runs among diverse system types which he describes as cooperative processing. More than fifty World Bank education projects over the years have had components related to the development of education management information system (EMIS), but little is known about best
practices and lessons learned from such investments. Wako (2003) defines Educational Management Information Systems (EMIS) as a data collection, storage, retrieval, processing and dissemination system specifically designed for use by decision makers and administrators to plan and administer education systems more efficiently and effectively.

Educational Policy Standards
The use of standard data element definitions across education organizations helps to ensure that data will be comparable and, thus, more useful. The Student Data Handbook for Elementary, Secondary, and Early Childhood Education was developed by the National Center for Education Statistics (NCES) specifically to promote the use of standard terminology and data elements. It contains a comprehensive listing of data elements that might be used in a student record system. In addition to definitions, there are related entities listed, code tables for some of the data elements, and recommendations for computer formatting. Another detailed effort to identify what data elements should be included in a student record is the SPEEDE/ExPRESS electronic transcript format. SPEEDE/ExPRESS contains a standard set of data elements and formats. The SPEEDE/ExPRESS data elements and formats are consistent with the data elements included in the Student Data Handbook for Elementary, Secondary and Early Childhood Education, although not always identical. This standard transcript format could be used as a suggested set of data elements to be included in a student record system.

As more national standards are developed, maintaining a match between local records and those standards will allow schools to take advantage of automated exchange methods. With the emergence of national standards and definitions, student record systems within separate education agencies will become part of a larger system of student records. This does not mean there cannot be local flexibility in the selection or structuring of data. It simply means that for data elements that will be shared, it is best to use consistent definitions, preferably in common use. This will help to ensure that information will be accurately interpreted when it is shared or analyzed.

Vital Review Observations
From the review carried out, the following gaps have been observed and need to be addressed:

- do not facilitate attendance record keeping by the teachers.
- do not keep electronic tracks of library materials.
- do not allow detection of debtors and proper communication thereof.
- do not allow general overview of the students performance at a glance.

This system is provided to fill the gap by automating the various activities at schools. It tends to satisfy customers need and simplify the works of administrators, record officer and teachers. With an automated school management system parents can easily interact with the school community to follow up their children’s achievement and play their role in the school development processes.

Information Engineering and Evaluation
Lucey (1991) stated that timely and accurate information is essential resource to maintain operations and be competitive. The common functions of a student records system are to support the maintenance of personal and study information relating to: handle inquiries from prospective students, the admission process/enrolling new students and storing teaching option choices, handle examinations/assessments and award marks/grades, monitor academic progression, maintaining records of absences and attendance, handle the award of credit or qualifications, graduation, and post-graduation contact with alumni.

In larger enterprise such as school having student data at their core, further functions in finance, human resources, and more may be catered for by the software. Where national or government systems exist for student finance or statistical return purposes, student records system often provide functionality that caters for this, by way of modules or core elements that handle the production of required files, or deal with the formatted transfer of information.

Availability: When information from a student record is requested, it is usually needed promptly. A principal making placement decisions about a new student needs the previous school’s records immediately to assign the student to the appropriate programs and services. A counselor with a student in crisis needs immediate access to records to help intervention specialists effectively deliver their services. A school board making a policy change to a “no-pass/no-play” rule needs analyze to support its decision. A well-designed student record system allows for timely retrieval of needed information in these, or similar, situations. Just when you thought computing couldn’t get any more complex, it has.
Performance and Capacity Planning: Ensuring optimal performance of e-management applications is critical to customer satisfaction. To be proactive, devise a means to both measure performance and plan for robust computing infrastructure that meets society demands per time. Succinctly, effective performance and capacity planning depends upon the ability to understand these factors:

- The e-management activity in terms of number of orders received and processing time,
- The business activity trend and cycles which helps to anticipate and plan for increased computing workloads.

Service Support: Quick response to customer requests is critical to her satisfaction. Haag, et al (2000) states that servicing the needs of customers extend beyond just providing products and services—it includes providing perfect service to the customer, which occurs at the customer’s moment of value. Customer moment of value he said is providing service when, where and how it is wanted and to the satisfaction of the customer.

Security Measures: Security involves both policies and mechanism to protect data and ensure that it is not accessed, altered or deleted without proper authorization. It is a critical component of automated device that must be incorporated safeguard all layers of system architecture – network, servers, operating systems, databases, middle-ware and applications. End-to-end security is a must, since a single loophole in the firewalls could cause a security breach that costs millions of dollars. According to Adewumi and Garba (2006), the increasing use of electronic means for data transfer, coupled with the growth in networking and internet communication has extended the need to protect vital information.

MATERIALS AND PROCEDURE
The system has two different applications using the same database. These are the Windows application (thick-client) and Web application (thin-client). As windows based application, these tools are most suitable and are accordingly deplored: Ms-VB6.0 at the front end for EXE files, ActiveX controls, Components Object Model (COM) facilitates server-side processing or add-in modules, DLL files, and Ms-SQL Server-2005 at the back end. Also, Data flow diagram DFD and Entity Relationship ER diagram are relevant tools used to express data movement at various levels of operation.

Naming Convention: Simple and easy-to-recall convention was used in most parts of the design. The table below shows the affixes used for the controls/object names.

<table>
<thead>
<tr>
<th>Objects/Controls</th>
<th>Naming Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Frm</td>
</tr>
<tr>
<td>Textbox</td>
<td>Txt</td>
</tr>
<tr>
<td>Command Button</td>
<td>cmd or btn</td>
</tr>
<tr>
<td>Option button</td>
<td>Opt</td>
</tr>
<tr>
<td>Check Box</td>
<td>Chk</td>
</tr>
<tr>
<td>Combo Box</td>
<td>Cbo</td>
</tr>
<tr>
<td>Picture Control</td>
<td>Pic</td>
</tr>
<tr>
<td>Image Control</td>
<td>Img</td>
</tr>
<tr>
<td>Listview</td>
<td>Lst or Listview</td>
</tr>
<tr>
<td>Datepicker</td>
<td>Dtp</td>
</tr>
</tbody>
</table>

Architectural Analysis
The proposed system is expected to replace the existing manual system by an automated system in all facets. It is mainly based on the system Analysis document. The architecture used for the system is a 3 tier Client/Server Architecture where a client can use Internet browsers to access the online report provided by the system within the local area network of the school or any where using the Internet. The data tier maintains the applications data such as student data, teacher data, timetable data etc. It stores these data in a relational database management system (RDBMS). The middle tier (web/application server) implements the business logic, controller logic and presentation logic to control the interaction between the application’s clients and data. The controller logic processes client requests such as requests to view student’s result, to record attendance or to retrieve data from the database. Business rules enforced by the business logic dictate how clients can and cannot access application data and how applications processes data.

Analysis Procedure
A number of steps are necessarily adopted in realizing depth knowledge of what is to done and how it would be done. The Data Flow Diagrams (DFDs) and Entity Relationship(ER) diagram are has been deplored to ensure proper analysis. At this phase, relevant diagrams such as DFDs are used to show clearly the movement of data traffic within the system.

Two levels of DFDs are been considered: Level 0-Context Analysis Diagram (CAD), Level 1-School Management Process and also used Entity Relationship Diagram (ERD) in analyzing the system.
Fig. 1: DFD level 0 (Context Analysis Diagram)

![Diagram](image-url)

- **Student or Applicant**
  - Admission
  - Fee Deposit
  - Book Request
  - Reports

**School Management System**

**ADMINISTRATOR**
Fig. 2: DFD Level 1 - School Management Process
DEVELOPMENT PROCEDURES
Software development involves the use of successive phases that helps to manage complexity (Pressman, 1999). He defines it as a complicated process that requires careful planning and execution to meet the goals. From the requirement phase to deployment must be well articulated and enforced. In current practice, UML is the standard modeling language for requirements specification (as well as for system design). Requirements are specified in graphical models as well as in textual descriptions.

System Design: Is a sort of construction phase. Sommerville (2001) states that a software design is a description of the structure of the software to be implemented, the data which is part of the system, the interface between system components and, sometimes, the algorithms used. Implementation: designs are been transformed into codes and is usually an error-prone activity. Kalicharam (1998) highlighted that the implementation process runs from the point where the system design is completed and is ready to be used. This is more of programming based on re-using pre-existing components. Thereafter, the various sub-systems are been integrated to function as whole. Ghezzi et al., (2003) says that software integration signifies the movement from the ‘programming in the small’ to the ‘programming in the large’

HLM Description and Decomposition
The school management process is made of different modules with each performing a separate function. Sub-systems holds related classes/objects and are decomposed to reduce complexity of the system.
The High Level Model (HLM) for SMS has major subsystems identified thus: “StudentRegistration”, “Login”, “Attendance”, “ReportCard”, “Transcript”, “Timetable” and “Report” subsystem. The “Login” subsystem authenticates a user to grant access based on the role of the user. The “StudentRegistration” subsystem registers a student offline. It allows recording the detail information of the student including parental and emergency person. “Transcript” and “ReportCard” subsystems are used to generate transcript and report card respectively. The “Timetable” subsystem generates a timetable, which involves allocating a time slot to a subject teacher for a class of students. The “Attendance” subsystem facilitates recording absent students on the school daily. It aids homeroom teacher in controlling absenteeism and reports to parents or administrator necessary corrective measures. The “Report” subsystem generates reports to parents, officials from kebeles and kifle-ketema and teachers in order to facilitate viewing students’ status and course achievement online.

(a) **Student Record:** It handles details of student along with the photograph by entering admission number.

(b) **School Fee:** Shows the fee structure of every class and the fee for student whether the student has paid fee or not. Also, payment outside prescribed period attracts extra amount as penalty.

(c) **School Profile:** It displays teacher detail and general information about the school.

(d) **Time Table:** It searches out the teacher and subject due a class at a particular time.

(e) **Examination Result:** It checks the performance of students for various subjects within a particular year. On passing the particular class, student record and student TC is updated.

(f) **Library Management:** Library management process updates the library database. It gives information about a particular book when issued to the student and when it is taken back.

**DISCUSSIONS**

The SMS Prototype; here the implemented system is described. How the user interacts with the system and some of the results of interaction with the system along with the screen shots are described. Once valid user id and password is entered on login window, the main menu window automatically displays as shown in Figure5. The main window displays menus and sub menus based on the role of the user. Moreover, web application is deployed on the central server in the schools intranet and the clients in the intranet with any browser can access the (home page) school’s site. The user logs in by providing his/her user Id and password, then the system displays information based on the role of the logged in user. The roles are homeroom teacher to record attendance, parent and officials to see the status of students and view reports.

**Input Design Windows**

The roles for the Windows application are to accept records from the users, the Record Officer, System Administrator and Principal. If the record officer has logged in then the main window displays menus and sub menus to register student along with parental information. The system also displays menus and sub menus to record marks, generate report cards and Transcripts.
After a student is registered via figure 6 above, the system launches another window to further register the student’s parent and emergency persons. Note that parental and emergency person’s information is highly required by the school for handling the student in his/her stay at the school, for example in taking disciplinary action when the student commits a crime. Therefore, such information as the name, address of the parent or emergency person can be easily retrieved. A user wanting to generate report cards or transcripts will select the corresponding sub menu from the “Reports” menu and a form is displayed to facilitate generation of the reports.

If the user has logged in as the principal, may be to produce timetable, then a form as shown in figure 7 below is displayed for use. When the user clicks on “Process” button the scheduler selects a subject-teacher from the database, retrieves all the classes assigned to the teacher, calculates the load of the teacher which cannot be greater than the maximum load and selects one of the days randomly based on the number of lessons of the subject, searches a free appropriate time slot and assigns the slot to the lesson. The scheduler repeats the process until the load of the teacher becomes zero and all the teachers in the database are visited. The system produces a feasible timetable satisfying all the constraints.
RESULTS/OUTPUT
In a typical operation, the system processed the inputs from a user and displays the following results for decision making and documentations.

### Table 2: Subject Score Sheet

<table>
<thead>
<tr>
<th>Student</th>
<th>Final Score</th>
<th>Project</th>
<th>Theory</th>
<th>Lab</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>87</td>
<td>90</td>
<td>95</td>
<td>92</td>
<td>364</td>
</tr>
<tr>
<td>S2</td>
<td>78</td>
<td>85</td>
<td>90</td>
<td>85</td>
<td>348</td>
</tr>
<tr>
<td>S3</td>
<td>82</td>
<td>88</td>
<td>92</td>
<td>87</td>
<td>359</td>
</tr>
<tr>
<td>S4</td>
<td>90</td>
<td>95</td>
<td>98</td>
<td>92</td>
<td>375</td>
</tr>
</tbody>
</table>

**Economic Viability**
School Management System (SMS) undertakes numerous tasks such as registering students, attendance record keeping to control absentees, producing report cards, producing official transcript, preparing timetable, keeping digital library, keeping proper financial records, harmonizing students in hostels or houses and producing different reports for teachers, parents, officials, and other stakeholders.

Automation is the utilization of technology to replace human with a machine that can perform more quickly and more continuously. By automating SMS, documents that took up many large storage rooms can be stored on few disks. Transcript images can be
announced. It reduces the time to retrieve old transcripts from hours to seconds. However, the school system in Nigeria government schools today is not automated and the record officers generate transcripts and reports manually. School administrators are constrained to use their experienced knowledge of miss and hit approaches to prepare complicated timetables full of errors – hence the inevitability of this system.

Comprehensive Strategic Achievements
- Anywhere availability – Intranet with automatic synchronization
- Scalable, customizable and supports multiple languages
- Centralized data repository for trouble-free data access
- Authenticated profile-dependent access to data
- Centrally stored information with zero redundancy
- Resource optimization and low cost of ownership
- Auto-generation of timetables with dynamic substitute management

CONCLUSION
With proper planning and management, student record system can be a valuable resource to many people, ranging from parents and local school officials to researchers and policy-makers. While many of the decisions concerning design and implementation are made only once, it is important to note that some aspects of planning and management are recurring and must be reviewed regularly to ensure long-term effectiveness. Whenever data are entered into the system, care must be taken to promote data integrity. Similarly, procedures for security and providing access must be continuously updated and monitored to ensure the confidentiality of student records. The needs of users will change over time. Thus, you will need to review users on a periodic basis to be sure that the system is meeting the needs of the users. Automated school management system is meant to help those who are school leaders and managers to automate student record system, to make the best decisions and maximize usefulness while protecting confidential information. Our solution of the timetabling problem is very simple. Data structures are used to implement the timetable designed. Interestingly, the prototype has been tested with data from St.Teresa’s College Nsukka to ascertain proper functionality. It shows from table 2 above that the system effectively registers students by assigning

This system is a powerful offline and online school management software with such potential to provide several strategic advantages to various schools. It plays vital roles in gaining competitive advantages for businesses using networks that tie them electronically to their customers (Vivek and Ramaswamy, 2005). Most of these benefits include:
- Total operational automation and cost-effective one point solution for total school management

admission number automatically, stores parental information, easily retrieves information about a student and generates the required reports such as transcript, report card and timetable. In addition to generating a feasible master timetable it produces a timetable for each teacher. Moreover, it has been shown that the web application of the system helps attendance recording by the form teacher and parents can view the status of their children using the Internet or Intranet of the school.

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