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Design and Evaluation of an Integrated Smart School Management System

Sunday Agholor[1]

[1]Department of Computer Science, Federal College of Education, Abeokuta, Nigeria

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Abstract

Due to the inefficiency of the manual and paper-based documentation system, most primary and secondary Schools administrators in South-West Nigeria have introduced partial automated systems. Thus, in Schools where results are automated, it is partial computerization as they are not comprehensive enough to handle all issues of result processing. In some other Schools, only the School website can be found showcasing the School to the world with no provision for result processing and other routine tasks. Thus, there exists a fragmentation of systems: either result processing system or a website system but certainly not both. It is against this background that an integrated smart School management system, in this study referred to as eSchool Manager was developed. The eSchool Manager integrates a School website and a School portal, offering a unified digital solution for managing School operations, communications, and resources. The website, which is open to the public, does not require login details. On the other hand, the portal is the engine room of the eSchool Manager with privacy control mechanisms. It handles the marking of the class attendance, result processing, other students' data, AI-enabled teaching and other tasks such as library operations, financial operations, equipment and inventory operations, School bus tracking, hostel allocation, etc. The eSchool Manager was thoroughly tested and deployed for use by the sampled Schools. Thereafter, the users' satisfaction were measured alongside with the systems being used by the sampled Schools. The results showed that the eSchool Manager has an excellent user acceptance level with an average score of 82%. Furthermore, the cost of running eSchool Manager was lower than the cost of running the two systems (School website and School portal) independently.

Keywords: *eSchool Manager, Smart School System, School Portal, School Website.*

I. INTRODUCTION

In most primary and secondary Schools in South-West Nigeria, the use of manual and paper-based documentation system for performing various tasks makes the work very tedious and consumes a lot of time that would have been used for other productive purposes. In some cases, report cards of students are prepared manually, while parents need to come to the School physically to collect report cards and payment receipts of their wards. Result computation, class and overall positions placement are done manually, just as the student's performances in a particular subject in relation to his/her counterpart in the class are either absent or done manually. Similarly, hostel allocation is done manually, and the integration of Artificial Intelligence in the School portal is absent, among others.

However, in Schools where automation is used, it is only one or two aspect(s) result computation that is/are computerized without addressing other numerous tasks that need automation. In some other Schools, it is only the School website that displays information about the School to the visitors to the site is up and running. Thus, Schools that implement automation either choose the partial result computation or build the School website for the purpose of displaying the Schools' information to the public, but not both. This fragmented approach to automation increases overall cost of maintaining several websites for the same School.

It is against this background that an integrated Smart School Management System that combines the School website and the School portal into one-stop solution is proposed.

- *Problem Statement*

The current system employed by Schools to manage student data, attendance, grades and other tasks such as library operations, School bus tracking, hostel allocation,

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etc lead to inefficiencies, inaccuracies and a waste of hard-earned resources. Similarly, the fragmented approach to solving some of the problems hinders effective decision-making, communication among stakeholders and expensive to maintain. There is, therefore, the need to develop an integrated and comprehensive smart School management system that will address these challenges.

➢ *Objectives of the Study*

- The Objectives are:

✓ To design an integrated Smart School Management System that will address the challenges found in the existing systems.
✓ To implement and evaluate the system.

II. LITERATURE REVIEW

The study of Ibrahim-Adedeji and Ebole (2020) led to the development of a computerized examination results management systems for Lagos State Polytechnic. Apart from the fact that this study is not concerned with education at the primary and secondary levels, it dealt with only result computation, leaving other routine tasks to be done manually in the polytechnic under study. In a related development, Iweriebor (2017) studied the manual computation of students' result and transcript processing in University of Port Harcourt and developed an automated processing of results. Again, it only solved the issue of result processing at the University education level, leaving the primary and secondary levels untouched. In addition, other routine tasks done manually at the university were not covered by the study. Similarly, Ukem and Ofoegbu (2017) developed an application for result processing for the University education system. Just like other preceding authors cited in the literature, the work is done for result computation at university level, leaving other lower levels of education to manual process. Furthermore, other routine tasks done in the university under study were not covered.

The study of Onyemaobi and Oji (2020) led them to the development of a result processing system for a secondary School in Lokoja, Kogi State of Nigeria. The system solved only the problem of manual computation of result without addressing other routine tasks and the issue of promotion, position of student in a subject, class teacher and principal's remarks, among others. Ezenma, Emmanuel and Choji (2017) developed a result processing software for secondary School. It did not consider promotion issues, principal and class teacher comments and other issues associated with results as well as several routine tasks. Similarly, Adesina et al. (2022) developed a result processing software for secondary School. Just like the preceding authors, the developed system apart from dealing with the calculation of students' results, did not address other issues associated with result processing such as student's performance in a particular subject in relation to his/her counterpart in the class, among others. Also, the system did not address other routine tasks that are still carried out manually. Pawar et al. (2023) developed a School management system for India Schools. This study did not address the issue of School bus tracking system, student's performance in a particular subject in relation to his/her counterpart in the class, CBT, AI-Enhanced Teaching, assigning promoted students to their new classes, principal's and class teacher's comments, online allocation of hostel rooms to boarding students, etc.

However, distantly related to this study are the works of Msafiri, Kangwa and Cai (2023) on a systematic literature review of ICT integration in secondary education and Sangectha, Krishnapriya and Janani (2018) on vehicle tracking system. Furthermore, Oguguo et al. (2023) worked on online teaching and assessment during COVID times, while Toma et al. (2023) studied the effects of ICT integration in teaching using learning activities. Similarly, Antonietti et al. (2023) developed a technology scale to measure how teachers integrate technology into learning activities. These studies stated in this paragraph did not address the issues our study is set to address. Some of these issues include School bus tracking system, student's performance in a particular subject in relation to his/her counterpart in the class, CBT, AI-Enhanced Teaching, etc.

From the available literature, two missing gaps were identified. Firstly, there is the need to address the fragmentation in order to reduce cost of implementation. Secondly, there is the need to develop an enhanced system that will address the tracking of the School bus, the student's performance in a particular subject in relation to his/her counterpart in the class, CBT, AI-Enhanced Teaching, assigning promoted students to their new classes, principal's and class teacher's comments, online allocation of hostel rooms to boarding students, library operations, etc. This study, therefore, aimed to fill the two missing gaps in a one-stop solution.

III. METHODOLOGY

In the first phase of this study we conducted the needs assessment in order to determine the type and form of School management system needed by the proprietors of primary and secondary Schools in South-West Nigeria. The South-West Nigeria is made up of Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States. The outcome of this needs assessment showed that proprietors of primary and secondary Schools need a comprehensive School management system. This leads us to the second phase, which is design and evaluation of the proposed system.

➢ *Design of the Proposed System*

Based on the findings from the needs assessment study, an integrated Smart School Management System is proposed to solve the identified needs. It consists of a School website and a School portal fused into one-stop solution. The architecture of the integrated Smart School Management System, referred to in this study as School Manager is shown in figure 1.

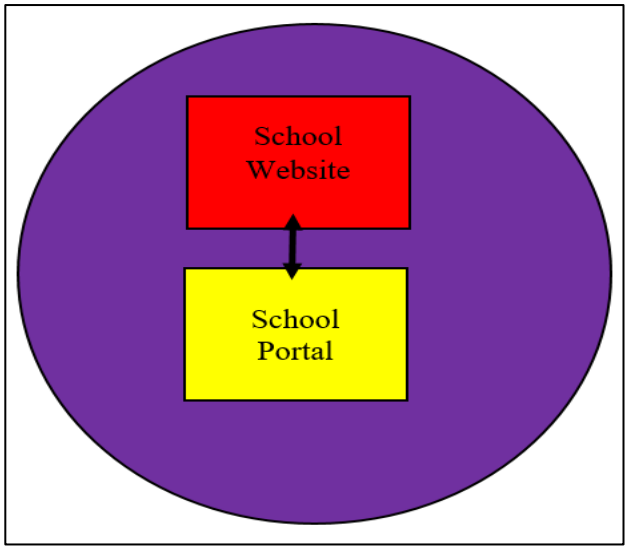

Fig 1 The Simplified Architecture of the Integrated Smart School Management System

The School website shows information about the School to the general public. It is primarily meant to promote the School and share basic information such as location, mission, vision, programmes, admissions, news, etc.

On the other hand, the School portal deals with result processing and other classified/sensitive information of the School and requires access control.

In this study, the combination of the two is known as integrated smart School management system, which is referred to as School Manager. It consists of: Human Resource Management, Financial Resource Management, Enhanced Exams and Records Management, E-Learning Management (CBT, LMS, and AI-Enabled Learning), Fleet/Equipment Management, Hostel Management, Library Management, Access Control System (Student dashboard, Parents Dashboard, Staff Dashboard and Admin dashboard, among others.

➢ *Population of the Study*

As stated earlier, the first phase of this study was the conduct of the needs assessment in order to determine the type and form of School management system needed by the proprietors of primary and secondary Schools in Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States. Thus, the population of the study is the primary and secondary Schools in these states.

➢ *Sample Size*

We applied random sampling in selecting few primary and secondary Schools used to evaluate the users' satisfaction after the deployment of the system (School Manager).

IV. IMPLEMENTATION

The School Manager was implemented using JAVA, PHP, Python, Microsoft Visual Studio.NET, and SQL.

➢ *Pilot Testing*

The evaluation of the system was conducted on a pilot scale using the Schools randomly selected from the population of the study.

➢ *Training and Support*

The staff of the Schools selected were trained on the use and operations of School Manager. Thereafter, support services were carried out through phone calls, WhatsApp (messages, audio, video calls) and other social networks media, in addition to physical visits to the Schools.

➢ *Evaluation of the proposed system*

At the end of using the School Manager for two academic terms of the pilot tests, a questionnaire was administered to the staff, students, parents and visitors to the site to elicit their responses on user satisfaction. We tested the users' satisfaction using the following sub-headings:

- *General Satisfaction*

This section is used to test the users' satisfaction in terms of the overall experience encountered when using the software. Does the software meet their expectations? and how likely are they to continue to use the software? among others.

- *Ease of Use and Interface*

This section was used to find out how easy it is to navigate through the software in general and the software's user interface in particular. We also find out from the users how quickly are they able to find the information or features they needed, among others.

- *Functionality*

This section was used to find out how satisfied are the users with the core features of the software (e.g., grading, reports, AI-enabled learning, School bus tracking system, etc.

- *Support and Help*

In this section, we tested how satisfied are the users with the customer support or helpdesk services as well as the tutorials, FAQs, or other help documentation provided, and how quickly were their issues resolved when they reached out for help, etc.

- *Communication and Feedback*

The users' satisfaction in terms of their communications and updates about new features or fixes and whether they felt that their feedbacks were considered and addressed were tested.

➢ *Data Analysis*

The users' satisfaction levels were calculated using the Customer Satisfaction Score (CSAT) metrics. The results are presented in table 1.

Table 1 CSAT Scores

USERS' SATISFACTION TESTS	CSAT SCORES	
	School Manager	Existing Systems
General Satisfaction	78%	68
Ease of use and Interface	84%	80
Functionality	88%	65
Support and Help	81%	75
Communication and Feedback	80%	72
Average CSAT Score	82%	72%

V. RESULTS AND DISCUSSION

In discussing the results, the industry-based interpretation guideline was used. The guideline is presented in table 2.

Table 2 Industry-Based Interpretation Guideline

Range of CSAT Score	Interpretation
0-35	Very bad/highly unsatisfied
36-49	Poor/unsatisfied
50-65	Average/quite satisfied
66-79	Good/satisfied
80-100	Excellent/highly satisfied

From table 2, a score below 50 speaks of poor customer satisfaction that needs immediate action. Since almost half of the customers are not satisfied with the quality of the service or product, there is definitely room for a lot of improvements. A CSAT score range of 50-65 indicates average satisfaction, which is a clear sign of a promising perspective if a proactive approach towards customer engagement is adopted, while a CSAT score between 80 and 100 signifies an excellent result that every company should aspire to, accounting for exemplary customer service standards and impressive customer satisfaction level.

From the combined interpretation of tables 1 and 2, both the School Manager and existing systems recorded good satisfaction with the users in terms of general satisfaction index. However, the score of School Manager was 78%, while that of the existing system was 68%, which showed that School Manager has high general satisfaction level. On the ease of use and interface metric, both recorded excellent satisfaction level, with satisfaction level of that of School Manger (84%) slightly higher than that of existing systems (80%). The functionality test showed an excellent satisfaction level for School Manager (88%), while that of the existing systems showed average satisfaction level with a score of 65%. The support and help measurement level was 81% for School Manager, signifying an excellent satisfaction, while that of the existing systems was 75% showing good satisfaction. Finally, the communication and feedback level of satisfaction was 80% for School Manager, which translated to excellent satisfaction, while that of the existing systems was 72%, indicating good satisfaction level. On the whole, School Manager has a higher user acceptance level than the existing systems.

VI. CONCLUSION, RECOMMENDATION AND RECOMMENDATION

- *Conclusion*

The School Manager, from the testimony of the users is a new dawn in the administration of the primary and secondary Schools as it helps in automating virtually all the tasks, hitherto done manually. It is a novel study aimed to improve the town and gown relationship.

- *Recommendation*

The School Manager is recommended for adoption by all the stakeholders in the primary and secondary education sub-sector.

- *Future Work*

In the next phase of this study, the integrated Smart School Management System performance will be measured using key performance metrics such as response time, throughput, memory usage, CPU usage, uptime, downtime, reliability.

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- *Conflict of Interest*

The author declares here that there is no conflict of interest.

- *Ethical Compliance*

The author complied with relevant ethical guidelines.

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