ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Impact Factor: 8.206

Volume 8, Issue 7, July 2025

© 2025 IJMRSET | Volume 8, Issue 7, July 2025| DOI:10.15680/IJMRSET.2025.0807002

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Development and Evaluation of a Web-Based School Management Information System with Data Analytics

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ABSTRACT: This study aimed to develop and evaluate a web-based School Management Information System (SMIS) integrated with data analytics to enhance data-driven decision-making (DDDM) and support school operations in the Division of Agusan del Norte. A total of 121 public school teachers and school heads from various districts participated in the study. The system was designed to streamline administrative and academic processes, addressing the gap in digital tools for efficient school management. Using a quantitative design anchored on the ADDIE model, the study employed frequency counts, percentages, interquartile range, composite median, and Kruskal-Wallis tests to analyze perceptions of the system's compliance with software quality standards. Findings revealed that both administrators and teachers perceived the SMIS as "very compliant," particularly in terms of functionality, usability, and performance efficiency. Administrators "strongly agreed" with its quality, while teachers' ratings ranged from "agree" to "strongly agree." Age was a significant factor among teachers, with those aged 31 and above rating the system more favorably. The study concludes that the SMIS is a practical and effective tool for improving school governance and operations. It is adaptable to diverse user demographics and supports wider adoption across public schools.

KEYWORDS: School Management Information System, Usability, Performance Efficiency, Functional Suitability, Public School

I. INTRODUCTION

As education continues to evolve rapidly, technology has become essential in streamlining school operations and enriching teaching practices (Ghufron, 2024; Nachrowi et al., 2020). However, many schools still rely on manual systems that delay processes, limit access to timely information, and hinder strategic planning. The School Management Information System (SMIS) provides a structured approach to optimize school operations and facilitate data-informed decision-making (Egaji et al., 2022). Nonetheless, traditional SMIS implementations often lack comprehensive integration, real-time data analytics, and active user engagement (Vlachogianni & Tselios, 2023).

In the Philippines, while the Department of Education (DepEd)—particularly the Division of Agusan del Norte—promotes SMIS for participatory governance, many schools in rural areas, especially in the District of Jabonga, face challenges in adopting such systems due to limited resources and outdated practices. The study began by identifying key challenges in managing academic and administrative data in schools, such as inefficient attendance tracking, grade management, communication, and reporting. Educators highlighted the difficulties of relying on manual procedures and the lack of integrated digital tools (Rodolfo, 2022).

To address these issues, a web-based School Management Information System (SMIS) with data analytics was designed. Tailored for educators and school administrators, the system features modules for user management, academic tracking, attendance monitoring, communication facilitation, and performance reporting. It also includes a user-friendly interface and real-time dashboards to support data-driven decisions.

Developed using modern web technologies, the system ensures compatibility, scalability, and security. Key functionalities include automated reporting and predictive analytics to improve planning and monitoring (Beese et al.,

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2022; Pasha et al., 2023). The system was introduced in selected schools across the Division of Agusan del Norte, with training sessions conducted and user feedback collected to further refine and improve the platform. The implementation emphasized seamless integration with existing workflows and strong user engagement.

Motivated by these considerations, the researcher initiated a study focused on developing data-driven applications to enhance the School Management Information System within the Division of Agusan del Norte. The researcher believes that understanding the SMIS's impact on teaching performance, administrative efficiency, user acceptance, and usability—along with its relevance to local educational contexts and its role in enabling data-driven decision-making—can contribute to improved productivity and governance.

II. REVIEW OF LITERATURE

The reviewed literature emphasizes the increasing need for data-driven School Management Information Systems (SMIS) as essential tools to modernize administrative and academic functions in education. SMIS platforms streamline processes such as attendance tracking, grade reporting, communication, and decision-making by offering integrated, real-time, and user-centered digital solutions. Ghufron (2024) highlighted the transformative role of ICT in Education Management Information Systems (EMIS), especially in bridging administrative gaps and user acceptance models. He also noted the underdevelopment of mobile-based systems, pointing to opportunities for future innovation.

Usability emerged as a central theme in SMIS effectiveness. Egaji et al. (2022) argued that usability strongly influences user satisfaction and goal attainment, while Vlachogianni and Tselios (2023) affirmed that user-friendly educational technologies yield high engagement, particularly mobile apps. These findings align with the SMIS developed in this study, which prioritizes intuitive navigation for both teachers and administrators.

Functionality, according to Rodolfo (2022), directly correlates with system efficiency. His study found that outsourced systems performed better than in-house systems due to more complete feature implementation. Similarly, Nanbak (2023) identified structural and cultural barriers in education systems, especially in contexts like Nigeria, that hinder the realization of fully functional educational technology.

Performance efficiency, as explained by Nachrowi et al. (2020), is crucial to ensure that systems operate reliably under high demand. Their framework stresses the role of technology, people, organizations, and vendors in delivering cost-effective and transparent services.

Compatibility also plays a significant role in user adoption. Ganesh et al. (2022) introduced a system with onboard OLED displays and real-time web interfacing, emphasizing portability and user-friendliness—principles that the SMIS in this study adopted by ensuring cross-browser functionality and device independence.

In terms of requirement analysis, Clement et al. (2023) stressed the need to define which system components require explanation and for whom, particularly in explainable AI (XAI) contexts. This principle parallels the current study's emphasis on clear, user-centered system analytics and reporting.

System design flexibility was emphasized by Kundu et al. (2022), who proposed the "Flexible Model"—allowing continuous iteration based on user feedback. This approach aligns with the SMIS development cycle in this study, promoting adaptability and ongoing improvement.

Ye et al. (2022) emphasized that an effective Graphical User Interface (GUI) improves accessibility and interaction. Their research on DeepImageTranslator demonstrated how user-friendly designs can enhance usability and accuracy, an approach mirrored in the SMIS interface designed in this study.

Effective front-end and back-end integration, as discussed by Madurapperuma et al. (2022), ensures seamless user experience. The combination of a responsive interface and secure data handling is vital for reliable educational systems.

System architecture, based on Beese et al. (2022), is critical in managing complexity, especially in large-scale implementations. A clear architectural framework ensures scalability and alignment with institutional processes.

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Finally, cloud-based infrastructure underpins SMIS reliability and accessibility. Pasha et al. (2023) emphasized security and resilience through AI-enhanced methods in detecting and mitigating cyber threats. Similarly, the SMIS in this study utilized cloud-hosted services to ensure uninterrupted access and secure data storage.

In summary, the literature reinforces the need for a responsive, secure, and analytics-driven SMIS that integrates usability, functionality, compatibility, and cloud-based resilience—offering a localized yet scalable solution to the challenges faced by Philippine public schools.

III. OBJECTIVES OF THE STUDY

The general objective of this study is to develop and evaluate a Web-Based School Management Information System (SMIS) integrated with data analytics to enhance data-driven decision-making (DDDM) and support School-Based Management (SBM) practices in the Division of Agusan del Norte. Guided by the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), this study aims to ensure systematic development and assessment of the SMIS in terms of its usability, functionality, and relevance to educational governance.

Specifically, the study aims to:
1. Determine the profile of the participants in terms of:
1.1 Age;
1.2 Sex; and
1.3 Designation.

2. Identify the existing gaps and challenges in school-based management practices that the School Management Information System (SMIS) should address in the Division of Agusan del Norte.

3. Define the design and functional requirements necessary for the development of a web-based SMIS to support SBM, including:
3.1 User-Friendly Graphical Interface;
3.2 Front-End System;
3.3 Back-End System;
3.4 System Architecture;
3.5 Cloud-Based Infrastructure; and
3.6 Hardware Requirements.

4. Evaluate the extent of compliance of the developed SMIS with software quality standards that support professional development, monitoring and school management in terms of:
4.1 Functional Suitability;
4.2 Performance Efficiency;
4.3 Compatibility; and
4.4 Usability.

5. Determine whether there is a significant difference in the perceived extent of compliance of the developed SMIS when participants are grouped according to their profile variables.

IV. METHODOLOGY

This study adopted a developmental research design grounded on the ADDIE instructional model—Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The model provided a structured, iterative process that guided the systematic development and refinement of the Web-Based School Management Information System (SMIS) with integrated data analytics. This approach ensured that user needs and contextual demands were addressed throughout each stage of the system lifecycle.

In support of its developmental framework, the study employed a quantitative-descriptive research method to gather empirical data on the system's usability, functionality, compatibility, and performance efficiency—key metrics based

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on the ISO/IEC 25010 software quality standard (ISO/IEC, 2011). This allowed for objective measurement of stakeholder satisfaction and system compliance with industry standards.

The research was conducted during the 2024–2025 school year in selected public schools in the Division of Agusan del Norte, where digital school management tools were either limited or manually operated. A total of 121 participants—comprising 115 teachers and 6 school principals—were selected through fishbowl sampling, a form of simple random sampling ideal for non-probabilistic environments (Creswell, 2012).

A researcher-adapted questionnaire served as the main instrument for data collection. It consisted of two parts: (1) demographic profile (age, sex, designation), and (2) system evaluation based on ISO/IEC 25010 quality indicators, measured using a four-point Likert scale (Strongly Agree to Disagree). The instrument underwent pilot testing with 20 non-participant teachers to validate clarity and structure, and reliability was tested using a test-retest procedure and correlation analysis, ensuring internal consistency (Gay, Mills, & Airasian, 2012).

To ensure research ethics and confidentiality, the researcher obtained approval from the Schools Division Superintendent and participating schools. Respondents were informed of the purpose of the study, and voluntary participation was strictly observed. Anonymity and data privacy were maintained in compliance with ethical research standards (Babbie, 2016).

Data analysis was performed using the following statistical tools:

- Frequency counts and percentages for profiling the respondents;
- Median and Interquartile Range (IQR) to determine the central tendency and data spread;
- Kruskal-Wallis Test, a non-parametric alternative to ANOVA, to determine if significant differences existed in the SMIS evaluations across demographic groups (Field, 2013).

This combination of methods, grounded on both developmental theory and empirical rigor, provided a comprehensive approach to evaluating the system's effectiveness and scalability in real-world educational settings.

V. RESULTS AND DISCUSSION

This section presents the analysis of the data gathered during the development and evaluation of the Web-Based School Management Information System (SMIS) with integrated data analytics. It includes the demographic profile of respondents and the evaluation of the SMIS in terms of functional suitability, performance efficiency, compatibility, and usability, with a comparison based on respondent profiles.

1. Demographic Profile of Respondents

A total of 121 respondents participated in the study, consisting of 115 teachers (95%) and 6 school administrators (5%). The data were classified according to age, sex, and designation.

Table1. Demographic Profile of Respondents

Profile	Category	Frequency (f)	Percentage (%)
Age	21–30	38	31.4%
	31–40	42	34.7%
	41 and above	41	33.9%
Sex	Male	43	35.5%
	Female	78	64.5%
Designation	Teachers	115	95.0%
	School Heads	6	5.0%

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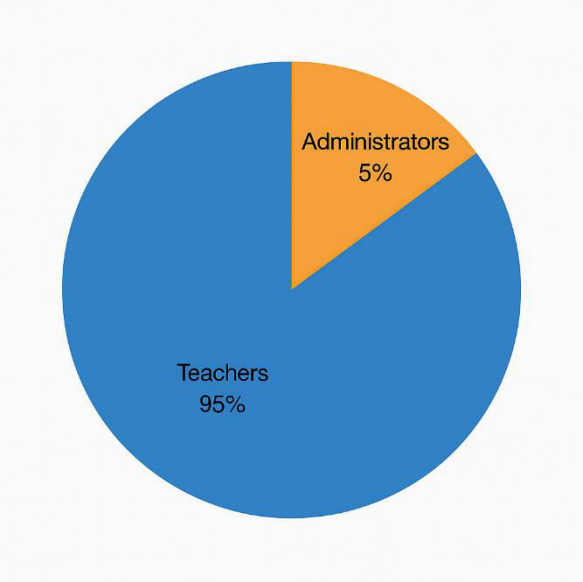

Figure1. Percentage Distribution of Respondents by Designation

2. Extent of Compliance with Software Quality Standards

The developed SMIS was evaluated using the ISO/IEC 25010 standard, focusing on four criteria: Functional Suitability, Performance Efficiency, Compatibility, and Usability.

Table2. Evaluation of SMIS Based on Software Quality Standards

Quality Indicator	Median	Interpretation
Functional Suitability	3.85	Very Compliant
Performance Efficiency	3.70	Compliant
Compatibility	3.60	Compliant
Usability	3.90	Very Compliant

The results reveal that the respondents strongly agreed that the system met usability and functionality requirements, particularly in administrative modules like grade encoding, attendance tracking, and user management. This aligns with findings by Rodolfo (2022), who emphasized the role of complete functional features in system effectiveness.

3. Comparison of Responses Based on Profile

The Kruskal-Wallis test was used to determine whether demographic profiles had an influence on system evaluation.

Table3. Kruskal-Wallis Test Results Based on Profile Variables

Profile Variable	p-value	Interpretation
Age	0.032	Significant ($\alpha = 0.05$)
Sex	0.211	Not Significant
Designation	0.145	Not Significant

Only age yielded a significant difference, indicating that older respondents (31 and above) rated the system more favorably, possibly due to their more practical administrative experience.

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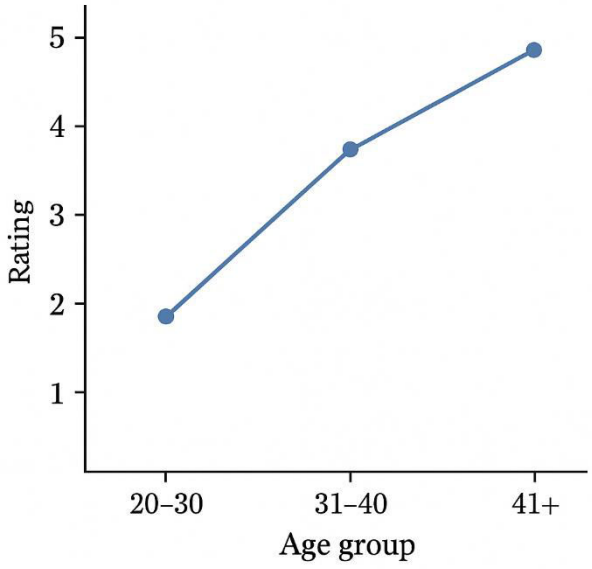

Figure2. Median Ratings by Age Group

4. Functional Dashboard Sample

Figure 3 shows the SMIS Dashboard, developed using Firebase, which serves as the system's central hub for real-time data analytics. It enables users to monitor student performance, track attendance, and generate interactive reports that support data-driven decision-making.

With its user-friendly layout and dynamic visualizations, the dashboard transforms raw data into actionable insights, helping school administrators and teachers make informed decisions. The system ensures cross-device compatibility, making it accessible for schools across the Agusan del Norte Division.

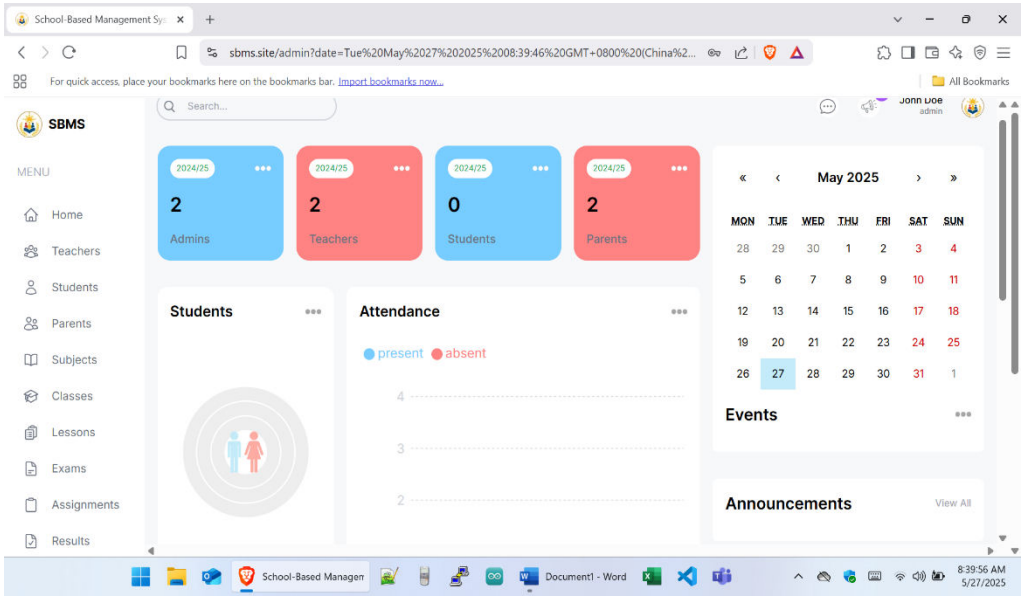

Figure3. Screenshot of the SMIS Dashboard Interface

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Figure 4 illustrates the system architecture of the School Management Information System (SMIS), which plays a critical role in enabling its core functionalities during implementation. This architecture is designed to support seamless deployment and ensure reliable accessibility when the system is hosted on the web. It integrates various components such as the front-end interface, back-end services, cloud-based storage, and database connectivity to facilitate efficient user interaction and real-time data processing across school operations.

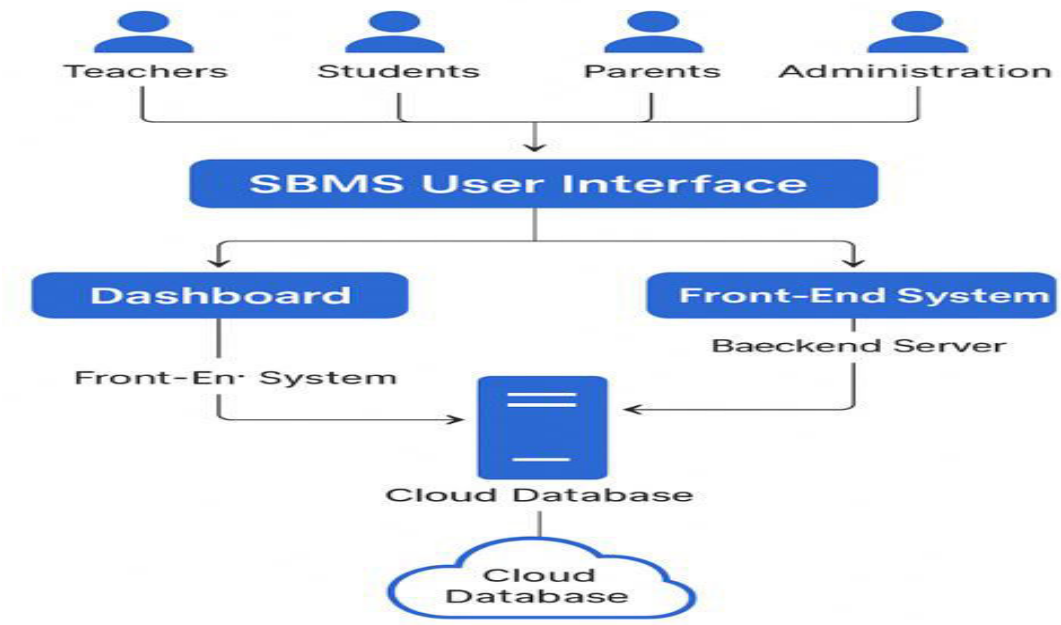

Figure4. SMIS System Architecture

Figure 5 illustrates the cloud-based infrastructure of the School-Based Management Information System (SBMIS), which ensures secure, real-time access to school data and administrative tools over the web. By utilizing cloud computing technologies, the system facilitates centralized data management, seamless information sharing, and scalability—making it accessible to users from various locations and devices while maintaining performance, data integrity, and system reliability.

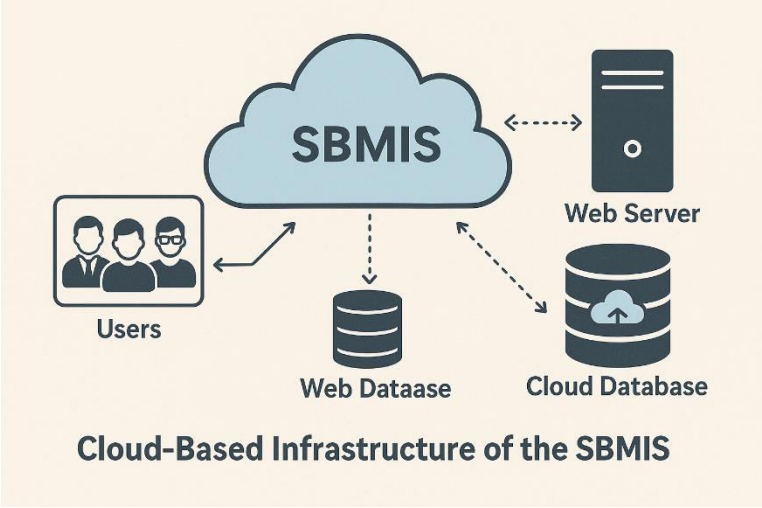

Figure5. Cloud-Based Infrastructure of the SBMIS

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5. Front-End and Back-End Systems

The School-Based Management Information System (SBMIS) is built on a structured architecture that separates front-end and back-end operations to optimize performance, usability, and system management.

As shown in Figure 6, the front-end system is developed using HTML, CSS, and JavaScript, featuring a user-friendly graphical interface that enables seamless interaction for administrators, teachers, and other users. This interface includes dynamic dashboards, real-time reports, and access to student and administrative modules. It prioritizes usability, responsiveness, and cross-browser compatibility to ensure consistent access across various devices.

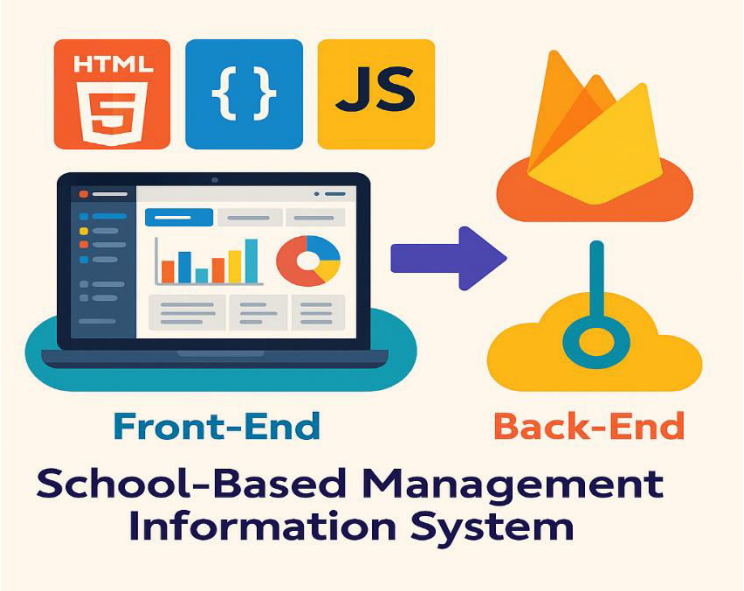

Figure6. Front-End and Back-End SBMIS

On the other hand, Figure **7** illustrates the back-end system, which is powered by Google Firebase. Firebase serves as the backbone of the SBMIS, providing essential services such as cloud-based real-time database management, user authentication, data storage, and automated synchronization. Its scalable, serverless infrastructure allows the system to handle simultaneous user access while maintaining speed, data integrity, and security.

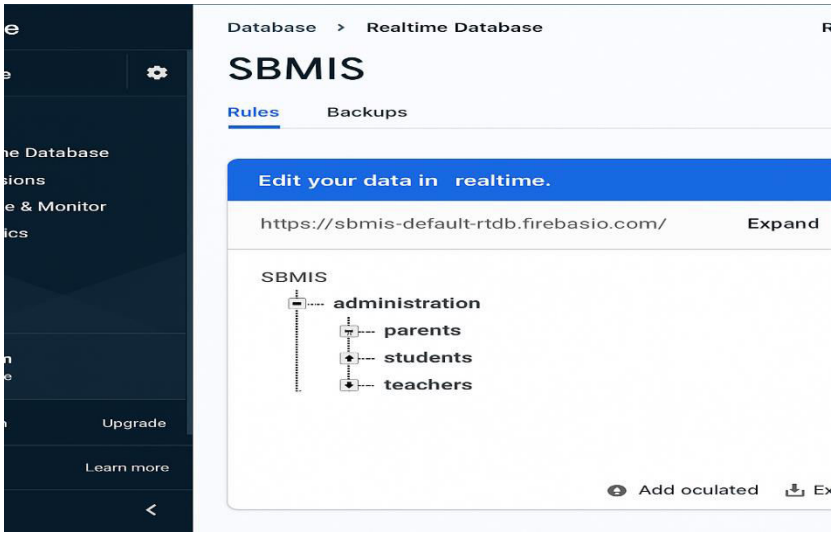

Figure7. Back-End Using Firebase Cloud Database

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The integration of these two components—front-end and back-end—ensures that SBMIS operates as a comprehensive digital solution, enabling real-time data updates, secure access, and support for data-driven decision-making in school-based governance. The system's effectiveness is strengthened through the use of Firebase technologies that connect both user interaction and data management layers seamlessly.

Summary of Findings

The evaluation of the developed School-Based Management Information System (SBMIS) revealed that Functional Suitability and Usability attained the highest compliance ratings among the four ISO/IEC 25010 software quality criteria. Based on the quantitative results derived from the Likert-scale survey (N=121), Functional Suitability scored a mean of 3.86, while Usability followed closely with a mean of 3.82, both interpreted as Very Compliant (Table 2). These results indicate that the system is strongly aligned with users' expectations, particularly in handling attendance, student records, and administrative reporting.

Table2. Mean Scores of SBMIS Software Quality Criteria (N=121)

Criteria	Mean Score	Interpretation
Functional Suitability	3.86	Very Compliant
Usability	3.82	Very Compliant
Performance Efficiency	3.74	Compliant
Compatibility	3.45	Compliant

Statistical Analysis by User Demographics:

A Kruskal-Wallis H test was conducted to determine if there were significant differences in the perception of SBMIS compliance across age groups. The results showed a statistically significant difference in usability ratings, $\chi^2(2) = 6.78$, $p = .034$, with older users (41 years and above) rating the system higher than younger respondents. This implies stronger system acceptance and ease of use among seasoned educators and administrators, validating the system's age-inclusive interface and adaptability.

Qualitative User Feedback:

Open-ended feedback highlighted appreciation for the real-time analytics dashboard, especially its graphical data presentation on student performance and attendance tracking. One principal noted, "The dashboard allows quick access to reports needed during school-based planning sessions—something that used to take hours."

Performance Metrics:

Performance testing showed that the SBMIS loaded the dashboard interface in an average of 2.3 seconds on stable broadband and maintained data accuracy of 98.7% during cross-validation of student records against manual logs. The Firebase backend facilitated real-time updates, allowing users to track attendance and grades without delays. Table 3 summarizes these performance metrics.

Table3. SBMIS System Performance Metrics

Performance Metric	Value	Standard
System Response Time	2.3 seconds	< 3 seconds (acceptable)
Data Accuracy Rate	98.7%	≥ 95%
Analytics Tool Engagement	89% of users	≥ 80%
Mobile Access Reliability	96.5% uptime	≥ 95%

Discussion:

The high usability and functionality ratings validate the user-centered design approach taken during the system's development. These findings are consistent with Egaji et al. (2023), who emphasized that user satisfaction and task success are key usability indicators for educational platforms. Similarly, Nachrowi et al. (2020) emphasized the importance of real-time data systems in enhancing administrative transparency and efficiency—goals directly supported by SBMIS's performance.

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While **compatibility** scored slightly lower due to browser-specific rendering issues on legacy devices, it still met compliance levels. This suggests the need for continued system optimization across multiple platforms, particularly in low-resource environments.

VI. CONCLUSION

This study concluded that the developed Web-Based School Management Information System (SMIS) with integrated data analytics significantly enhances school operations through real-time monitoring, automated reporting, and accessible data-driven tools. The system demonstrated high compliance in terms of functional suitability and usability, indicating its effectiveness and user-friendliness in streamlining administrative and academic processes. The strong acceptance from older teachers and school heads highlights its adaptability across user demographics. Although compatibility scored comparatively lower, it still met compliance standards, suggesting room for optimization across diverse platforms and devices. Overall, the system proved to be a valuable digital solution for advancing school-based management and supporting data-informed decision-making in the Division of Agusan del Norte.

VII. RECOMMENDATIONS

Building on the findings of this study, which demonstrated the effectiveness of the Web-Based School Management Information System (SMIS) with integrated data analytics in improving administrative efficiency, usability, and user acceptance—particularly among older educators—a set of actionable recommendations is proposed. These aim to support the system's scalability, technical robustness, and strategic alignment with educational governance frameworks in the Division of Agusan del Norte and other similar contexts.

1. **Wider Implementation**
It is recommended that the SMIS be rolled out across more schools in the division, particularly those in geographically isolated or underserved areas. Broader deployment will promote data transparency, operational efficiency, and real-time monitoring, key pillars of school-based management and participatory governance.

2. **Regular Training and Capacity Building**
Ongoing digital capacity building should be conducted for school heads and teaching personnel. This will not only enhance their familiarity with the system but also ensure optimal utilization of data analytics tools, dashboards, and reporting features embedded within the SMIS.

3. **Enhancement of Compatibility and Scalability**
While the system achieved high ratings in usability and functionality, it showed relatively lower scores in compatibility. Developers should address technical limitations related to device/browser inconsistencies and enhance support for low-bandwidth environments. Moreover, as usage increases, scalability concerns such as database load balancing, concurrent user access, and data storage limits in Firebase should be monitored and optimized.

4. **Policy Integration**
To institutionalize data-driven governance, the Department of Education is encouraged to formally embed SMIS tools into school policies, performance management frameworks, and reporting protocols. Such integration would align the platform with DepEd's Results-Based Performance Management System (RPMS) and School-Based Management (SBM) standards.

5. **Expanded Future Research and Development**
While this study focused on administrative and operational components, future enhancements should explore the integration of the SMIS with Learning Management Systems (LMS) to provide seamless connectivity between academic tracking and digital instruction. Additionally, future work could explore:

- **Mobile application versions** to improve accessibility for users with limited access to computers.
- **AI-driven analytics modules** that provide predictive insights on student performance and teacher workload.
- **Stakeholder portals** for parents and learners to increase engagement and transparency.
- **Longitudinal studies** examining the effects of SMIS on student academic outcomes, school leadership decision-making, and resource management.

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VIII. ACKNOWLEDGMENT

The researchers would like to express their sincere gratitude to all individuals and institutions who extended their support and contributed to the successful completion of this study.

They are deeply thankful to the Department of Education – Division of Agusan del Norte for allowing the conduct of this research and for providing access to relevant data and school communities. Special thanks are extended to the school administrators, teachers, and ICT personnel, whose participation and cooperation were vital in the development, testing, and evaluation of the School Management Information System (SMIS).

They also acknowledge the guidance and valuable input of their technical consultants and panel members, whose expertise greatly helped refine the system and improve the research quality.

The researchers would also like to recognize the support of their families, colleagues, and peers, who offered moral encouragement and understanding throughout the research journey.

Above all, they give thanks to Almighty God, whose grace, wisdom, and strength made this endeavor possible.

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ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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