BUDGET AND FINANCIAL MANAGEMENT INFORMATION SYSTEM FOR PUBLIC ELEMENTARY SCHOOLS: ANALYTICS AND PREDICTIVE INSIGHTS FOR MOOE ALLOCATION USING LINEAR REGRESSION

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Abstract: Public elementary schools in the Philippines face persistent challenges in managing their financial resources, primarily due to reliance on manual processes that are prone to errors, inefficiencies, and a lack of transparency. To address these concerns, this study developed a Budget and Financial Management Information System (BFMIS) tailored to the operational needs of public elementary schools. The system integrates Artificial Intelligence (AI) and linear regression analytics to automate budget planning, optimize the allocation of Maintenance and Other Operating Expenses (MOOE), and enhance financial reporting. Using Agile methodology, the system was designed with a user-centered approach and developed through iterative cycles involving continuous stakeholder feedback. Core features include modules for budget allocation, expenditure tracking, predictive budgeting, and automated report generation in compliance with the Department of Education (DepEd) financial policies. The system underwent black-box testing and was evaluated against ISO/IEC 25010 (software quality) and ISO 27001 (information security) standards. Furthermore, User Acceptance Testing (UAT) was conducted using the Technology Acceptance Model (TAM) to assess perceived usefulness, ease of use, and user satisfaction among school administrators, financial officers, and DepEd auditors. Results showed that BFMIS significantly improved accuracy in budget forecasting, enhanced accountability through audit trails and real-time dashboards, and facilitated informed financial decision-making. The integration of predictive analytics reduced human error and supported proactive planning and equitable resource utilization. This research contributes a scalable, AI-driven solution for improving financial management processes in the Philippine public education sector.

Keywords: BFMIS, Public Elementary Schools, Predictive Analytics, MOOE, Agile, Linear Regression, Black box, TAM

I. INTRODUCTION

Public elementary schools in the Philippines face major challenges in managing their financial resources due to the absence of a dedicated financial management system.

Current manual processes often lead to errors, inconsistent records, and difficulty in tracking expenditures, which compromises transparency, accountability, and compliance with government regulations.

To address these issues, the researcher proposes a Budget and Financial Management Information System powered by Artificial Intelligence (AI). This system will streamline financial processes by enabling efficient data creation, storage, organization, and analysis. AI features will provide real-time analytics, predictive insights using linear regression, and data-driven recommendations to support informed decision-making.

Designed as a user-friendly and secure Knowledge Management System (KMS), the proposed solution aims to enhance financial planning, optimize resource use, and ensure compliance. Ultimately, it empowers schools with the tools needed for sustainable and transparent financial management.

A. Research Problem

The study aimed to answer the following key research questions:

1. What are the financial management challenges currently faced by public elementary schools?

2. How can a Budget and Financial Management Information System improve the efficiency of budget allocation and expenditure tracking?

3. In what ways can the proposed system enhance financial transparency, accountability, and compliance with government regulations?

4. What are the key features and functionalities required for an effective financial management system tailored to public elementary schools.

II. RESEARCH OBJECTIVES

This study aims to develop a Budget and Financial Management Information System (BFMIS) tailored for public elementary schools. The system integrates linear regression analytics to optimize MOOE allocation based on historical spending patterns. It enhances expenditure tracking through real-time monitoring, ensures compliance with DepEd Order

No. 60, s. 2016, and promotes transparency and accountability through dashboards and audit trails. Designed to minimize manual errors and support data-driven decision-making, BFMIS provides predictive insights and automates financial reporting, ultimately improving school resource utilization and educational outcomes.

A. Specific Objectives

1. Design and develop an AI-driven BFMIS integrating linear regression to automate budget creation, optimize MOOE allocation, and streamline expenditure tracking.

2. Incorporate AI-based reporting to generate real-time financial reports aligned with DepEd policies, automating submission of expenditure logs, variance analyses, and compliance reports.

3. Validate the system through black-box testing and pilot implementation in selected schools, assessing compliance with ISO/IEC 25010 and ISO 27001 and addressing MOOE allocation inefficiencies.

4. Assess user acceptance using the Technology Acceptance Model (TAM) through structured testing with school administrators, financial officers, and auditors.

5. Develop an implementation plan detailing stakeholder roles, training, timelines, and risk mitigation to ensure successful and sustainable BFMIS adoption in public elementary schools.

B. Theoretical Framework

Fig. 1, Agile Software Development (Agile Alliance, 2001) flexibility is especially valuable in public school financial management, where compliance with Department of Education (DepEd) policies and the need for transparency are critical, and policies may change during development. The approach enables easy adaptation to new guidelines or stakeholder requests without disrupting the project. Agile also emphasizes collaboration, involving school administrators and auditors in regular reviews to ensure the system meets transparency and accountability standards.

Continuous testing and automated validation at every stage help catch errors early, ensuring accuracy in financial data. Agile prioritizes high-impact features, optimizing resource use and delivering a reliable system faster. Regular retrospective meetings drive ongoing improvement, keeping the BFMIS sustainable and responsive to changing needs. Overall, Agile enables the development of a system that streamlines budget management, supports informed financial decisions, and ensures regulatory compliance for public schools.
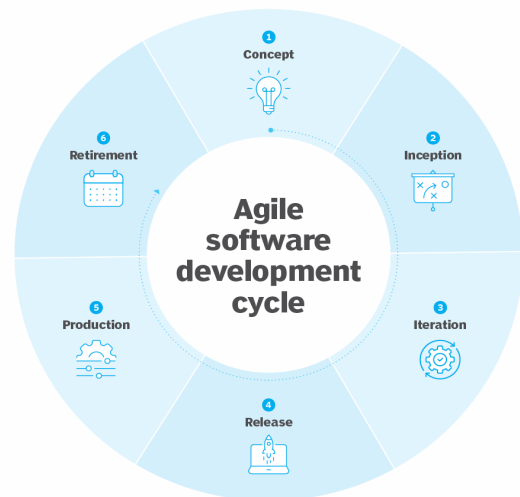

Figure 1. Agile Software Development Cycle
Source: https://www.wrike.com/agile-guide/agile-development-life-cycle/

B. Conceptual Framework

Fig. 2, conceptual framework of (BFMIS) follows a structured Input-Process-Output model. It begins with the Input phase, where administrators enter budget data, expenditures, and user roles. The Process phase involves storing and organizing data using a relational database, with AI-driven linear regression analyzing financial patterns to support decision-making. In the Output phase, the system generates financial reports and predictive insights, offering clear overviews of fund utilization and recommendations for future allocations. Overall, BFMIS enhances transparency, accuracy, and efficiency in public school finances.
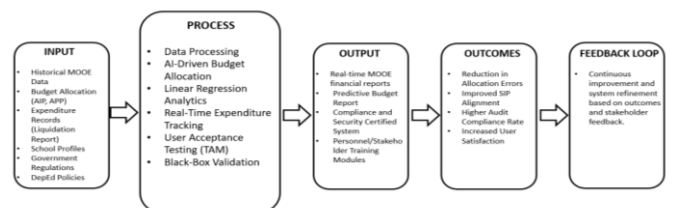

Figure 2. Conceptual Framework of the BFMIS

C. Scope and Limitations of the Study

This study presents the development of a Budget and Financial Management Information System (BFMIS) for public elementary schools, functioning as a Knowledge Management System (KMS) integrated with AI. The system streamlines budget allocation, expenditure tracking, and financial reporting through key features like linear regression-based analytics, real-time reporting, and role-based access control. While it enhances transparency and decision-making, limitations include dependency on accurate data input, lack of cloud support, basic security, and manual updates for policy changes. The system lays a foundation for improved accountability and future advancements in AI and scalability.

D. Significance of the Study

This study introduces a Budget and Financial Management Information System (BFMIS) that leverages automation and AI to improve school financial processes. Using a relational database and linear regression analytics, the system ensures organized financial records, accurate expenditure tracking, and predictive insights. It simplifies

reporting for compliance and reduces manual errors. Administrators gain better budget oversight, teachers and staff access real-time data for planning, and government agencies receive accurate reports. Ultimately, BFMIS enhances transparency, accountability, and resource allocation, contributing to improved educational outcomes.

III. RELATED LITERATURE

Budget and financial management information systems are crucial for optimizing resource allocation in public elementary schools, particularly concerning the Maintenance and Other Operating Expenses (MOOE). These system helps to ensure that funds are used effectively to support educational goals and improve school operations.

A. Budget Allocation

Effective budget allocation is central to school management. As highlighted by Amado et al. (2025), involving stakeholders like parents and teachers in budgeting leads to better resource use and alignment with school needs. Strategic investments in technology and instructional materials, noted by Hargreaves and Fullan (2015), enhance teaching quality and motivate teachers. Beronibla (2024) emphasizes transparency through inclusive budgeting and monitoring systems, with regular audits to maintain financial integrity.

B. Maintenance and Other Operating Expenses (MOOE)

In the Philippine context, the Maintenance and Other Operating Expenses (MOOE) are central to school operations. These government-allocated funds cover basic expenses such as utilities and minor repairs. DepEd Orders No. 13, s. 2016, and No. 122, s. 2017, provide guidelines on the use and reporting of MOOE, ensuring that school heads practice responsible spending and maintain financial transparency. However, schools often face shortages in covering even basic needs, prompting calls for increased budget support and capacity building for school heads (Almazan, 2023). Despite these constraints, the proper use of MOOE significantly contributes to daily operations, teacher development, and student welfare (Gaspar et al., 2022).

C. Annual Procurement Plan

Another critical component of financial planning is the Annual Procurement Plan (APP). Mandated under RA 9184, the APP ensures that all procurement activities are properly planned, aligned with institutional goals, and included in the approved budget. In public schools, it consolidates procurement needs and supports the Annual Implementation Plan (AIP). It serves as a control mechanism for fiscal discipline and compliance, requiring approval by the school head and consistency with government standards. The APP enhances transparency and efficiency in resource utilization, as highlighted by Beronibla (2024), and reflects international best practices in strategic procurement planning (Office of Procurement Regulation, 2021).

D. Annual Implementation Plan

The Annual Implementation Plan (AIP) is a key tool for school-based management, translating long-term goals into yearly actions. In the Philippines, DepEd mandates the AIP (DepEd Order No. 44, s. 2015), which outlines programs, budgets, and timelines for the fiscal year. It is developed collaboratively by school leaders and stakeholders to align resources with school needs (DM No. 004, s. 2023).

Globally, similar plans like Victoria, Australia's AIP link strategic goals with clear targets and funding (Department of Education Victoria, 2020). The AIP supports transparency, accountability, and shared governance through regular monitoring and evaluation, fostering continuous improvement (Smith & Jones, 2019).

E. AI in Predictive Analytics and Financial Management

Advancements in Artificial Intelligence (AI) have significantly influenced financial forecasting and management. AI technologies, particularly predictive analytics, use sophisticated algorithms and machine learning to identify complex patterns within large datasets, far beyond the capabilities of traditional linear forecasting methods. As described by Faheem et al. (2024), AI allows financial analysts to incorporate a wide array of data sources, including social media sentiment and macroeconomic indicators, to generate real-time, adaptable insights.

F. Linear Regression

Linear regression is a fundamental predictive analytics tool that forecasts outcomes like budget needs based on historical data (IBM). It estimates a best-fit linear equation to reveal trends and relationships, aiding decision-makers in predicting future results. Roustaei (2024) highlights its effectiveness in identifying patterns, especially with limited data. Wasserbacher and Spindler (2022) note that digital financial systems and data analytics further strengthen the use of regression models for financial planning and analysis.

G. Black Box Testing

Fig. 3, Black box testing evaluates a system's behavior based on inputs and expected outputs without considering internal code, making it ideal for validating functionality, security, and role-based access in financial systems (Byol & Foygel, 2023). Sun and Li (2023) applied black box testing to a Family Financial Management System to verify user authentication and data integrity, highlighting its importance in securing financial operations. Pressman and Maxim (2014) stress that black box testing from a user's perspective efficiently detects functional errors and input issues, recommending multiple test cases per module to ensure reliability. For systems like the Budget and Financial Management Information System (BFMIS), black box testing is crucial for validating critical features such as financial data accuracy and access control.

Figure 3. Black Box Testing Model
Source: https://www.testbirds.com/en/blog/black-box-testing-enhancing-user-experience/

H. Technology Acceptance Model (TAM)

Venkatesh and Davis (2000) expanded TAM by including social influence and cognitive factors, showing that user

acceptance evolves with experience. Delima and Tejero (2022) found that perceived usefulness and ease of use significantly impact satisfaction among school financial managers. Sun and Li (2023) confirmed TAM's relevance by highlighting the need for security, data integrity, and role-based access to build user trust. Byol and Foygel (2023) emphasized that positive perceptions driven by intuitive dashboards and secure features increase long-term adoption, particularly for sensitive financial systems.

I. Synthesis

The literature highlights the vital role of Budget and Financial Management Information Systems (BFMIS) in improving resource allocation and transparency, especially for managing Maintenance and Other Operating Expenses (MOOE) in public elementary schools. Technology-enabled budgeting supports accurate expenditure tracking, regulatory compliance, and alignment with educational goals.

Challenges include limited digital tools and reliance on manual processes, as noted by Upadhyaya (2016) and Zuhro et al. (2024), who stress the need for infrastructure and training to maximize system benefits. School-based budgeting frameworks (Demas & Arcia, 2015) promote autonomy and accountability but financial transparency remains hindered by budget constraints and inadequate training (Almazan, 2023; Gaspar et al., 2022).

AI-driven predictive budgeting, supported by Faheem et al. (2024) and Harshitha et al. (2025), along with linear regression models (Roustaei, 2024; Wasserbacher & Spindler, 2022), enhances forecasting and financial planning. Black box testing is critical for ensuring system reliability, security, and usability, as emphasized by Byol and Foygel (2023), Sun and Li (2023), and Pressman and Maxim (2014).

The Technology Acceptance Model (TAM), originally from Davis (1989) and expanded by Venkatesh and Davis (2000), offers a framework for understanding user adoption based on perceived usefulness and ease of use. Studies like Delima and Tejero (2022) confirm TAM's effectiveness in school financial systems.

Overall, the literature supports BFMIS development to overcome manual inefficiencies, meet compliance, and provide predictive insights. Integrating AI, rigorous testing, and user-focused design ensures a reliable, accepted system that enhances financial transparency in education.

IV. METHODOLOGY

This chapter explains the methods and procedures used in the development and evaluation of the Budget and Financial Management Information System (BFMIS). It outlines the research design, population and sampling techniques, data collection instruments, validation procedures, statistical treatments, project design, development model, and the testing and evaluation process.

A. Research Design

This study employed a descriptive-developmental research design. The descriptive part analyzed current budget and financial management practices, focusing on Maintenance and Other Operating Expenses (MOOE) in public elementary schools. The developmental aspect involved designing and implementing the Budget and Financial Management Information System (BFMIS), integrating AI—specifically linear regression—to enhance predictive budget forecasting.

The population included school heads, financial officers, and DepEd auditors from selected public elementary schools under Laguna's Schools Division Office. A purposive sample of at least 30 participants directly involved in financial management was selected.

Data collection combined document analysis, interviews, and surveys. Documents from Pook Elementary School (2022–2024 MOOE records) were gathered and cleaned for system testing. Structured interviews with administrators and financial officers identified challenges and system needs. Surveys, based on the Technology Acceptance Model (TAM), were conducted during user acceptance testing to evaluate system usability, features, and user attitudes toward the BFMIS.

Table 1 presents the TAM-based questionnaire used in User Acceptance Testing (UAT), assessing quality factors, perceived ease of use, perceived usefulness, system features, and user satisfaction.The questionnaire was validated by information systems experts to ensure clarity and relevance, with their feedback incorporated for refinement.Survey data were analyzed using descriptive statistics (frequencies, percentages, means, standard deviations). Regression analysis tested the AI component's accuracy in forecasting MOOE allocation. TAM constructs were quantitatively evaluated to measure system acceptance and user behavior.

Table 1. Sample Technology Acceptance Model (TAM) Questionnaire Structure

Criteria	Sample Question Item	Scale
Quality Factors	"The system provides correct and accurate results in displaying real-time data comparing budget allocations versus actual expenses."	1 (Strongly Disagree) – 5 (Strongly Agree)
Perceived Ease of Use	"The system is easy to navigate."	1 – 5
Perceived Usefulness	"The system enhances transparency in financial reports."	1 – 5
System Features and Functionality	"The dashboard provides relevant and clear financial insights."	1 – 5
User Satisfaction and Acceptance	"I am satisfied with the system's performance."	1 – 5

The system development followed Fig. 4 Agile Development Methodology, chosen for its iterative, flexible approach suited to the dynamic financial management needs of public schools allowing frequent collaboration and feedback from stakeholders including school principals, financial officers, and DepEd auditors. Each development sprint included planning, designing, building, and testing essential functionalities, prioritizing compliance, accuracy, and predictive analytics capabilities.

The Budget and Financial Management Information System (BFMIS) was developed using several key software tools are XAMPP provides a local server environment with Apache, MySQL, and PHP for development and testing. PHP

handled dynamic web pages, user authentication, and budget/expense tracking. MySQL served as the relational database for secure and efficient data management. Dompdf enabled PDF report generation for easy sharing and archiving. PhpSpreadsheet allowed exporting reports to Excel for detailed analysis. Python was used for predictive analytics, applying linear regression for budget forecasting. Scikit-learn built and validated the regression models. JSON facilitated data exchange between Python analytics and the PHP front-end for dynamic visualization. These tools were chosen for their reliability, integration ease, open-source nature, and alignment with the Agile development approach.
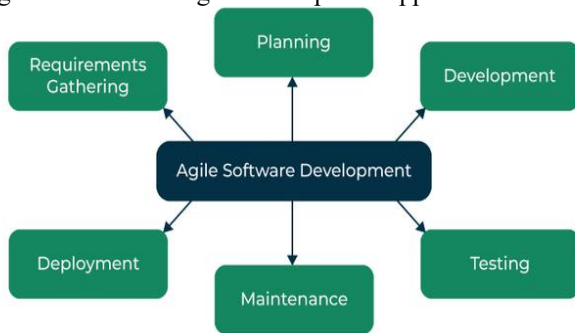
Figure 4. Agile Software Development Methodology Model
Source:https://www.geeksforgeeks.org/software-engineering-agile-software-development/

B. Testing and Evaluation Procedure

• Black-Box Testing

Employed to test inputs and outputs without exposing system logic, using equivalence partitioning to ensure system robustness. Table 2 summarizes the Black Box testing conducted on key system functions, evaluating performance based on functional requirements without examining internal code, following the 3–5 test case guideline (Pressman & Maxim, 2014) for balanced coverage and efficiency. Testing covered modules according to complexity, criticality, and coverage.

Table 2. Black Box Test Case Table

Function / Module	Test Case IDs	No. of Test Cases	Aligned with 3–5 Rule
Login Functionality	TC001–TC003, TC029, TC030	5	Yes
Role-Based Access Control	TC004, TC005, TC027	3	Yes
Dashboard Overview	TC006–TC010	5	Yes
Budget Management	TC011–TC015, TC031	6	Slightly exceeds (✓ critical module)
Expense Management	TC016–TC020, TC032	6	Slightly exceeds (✓ related module)
Report Generation	TC021–TC022,	3	Yes
	TC037		
Prediction Module	TC023–TC025	3	Yes
User Management	TC026–TC028	3	Yes
Security Testing	TC033–TC035	3	Yes
Total	—	**37**	—

• Usability Testing

User interface assessments with administrators ensure accessibility and ease of use (Nielsen, 1994), while compliance validation verifies that automated reports adhere to DepEd financial regulations (Department of Education, 2023). Pilot implementation involves real-world deployment in selected schools to test system functionality and reliability (Pressman & Maxim, 2020), followed by feedback analysis through the collection of stakeholder input for system improvements (Patton, 2015). ISO compliance testing validates the system against ISO/IEC 25010 (software quality) and ISO 27001 (security) standards (ISO, 2011; ISO, 2013). User Acceptance Testing (UAT) uses surveys and interviews guided by the Technology Acceptance Model (TAM) to assess user intentions and satisfaction (Davis, 1989), complemented by quantitative analysis through statistical review of UAT data to derive actionable insights (Field, 2018). Finally, implementation planning develops a phased rollout roadmap including pilot stages, full deployment, training, stakeholder roles, and risk management aligned with ISO standards (Kerzner, 2017).

Together, these methods ensure the development of a robust, user-friendly, and compliant financial management system that improves budgeting, transparency, and efficiency in public elementary schools, supporting predictive budget planning aligned with the schools' improvement and procurement plans.

V. RESULTS AND DISCUSSIONS

This chapter presents the presentation, analysis and discussions based on the methods employed to achieve the study's objectives. The presentation is structured according to the specific research objectives and includes a comprehensive explanation of the system's design, the integration of linear regression analytics, and the results of multiple testing phases. It also highlights how the predictive model supports budget allocation optimization, how the system automates financial reporting aligned with DepEd policies, and how it performs in terms of usability, functionality, and user acceptance.

The Budget and Financial Information System (BFMIS) was developed using user-centered and AI-driven linear regression analytics that automate budget creation, optimize MOOE allocation, and track expenditures.

Fig. 5 presents the BFMIS dashboard, providing real-time insights into a school's financial status. It enhances transparency through live data access, summary reports, and audit logs. Predictive analytics aid budget planning, supporting findings by Martinez and Reyes (2021). Audit logs and access controls promote accountability, aligning with Byol and Foygel's (2023) fraud prevention insights. Automated reporting ensures timely compliance, as highlighted by Ali et al. (2022).
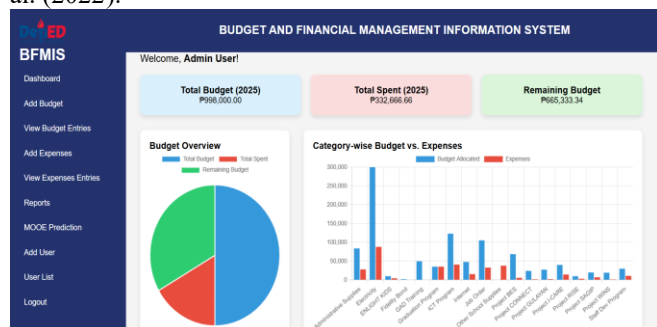

Figure 5. BFMIS Dashboard

Fig. 6 displays the BFMIS Add Budget page, where users input project-specific budget details such as category, amount, and fiscal year. Designed for school administrators and finance officers, the interface supports accurate, real-time data entry and easy updates. Its user-friendly layout enhances adoption and reduces errors (Hussein et al., 2022). By replacing manual methods, it improves data consistency and compliance (Abubakar & Sulaiman, 2021) while supporting better financial planning and accountability in public education (Delos Santos & Gomez, 2023).
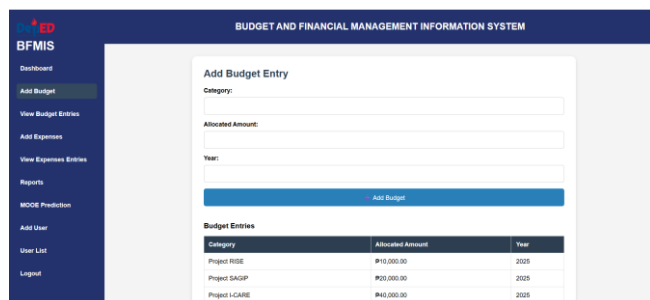

Figure 6. BFMIS Add Budget Page

Fig. 7 shows the View Expense Entries module of BFMIS, which provides a clear summary of recorded expenses by project and fiscal year. It displays key details like category, budget, actual spending, percentage used, and remarks. Users can filter, update, or delete entries, with color-coded percentages aiding quick assessment. Designed for usability and transparency (Hussein et al., 2022), the module promotes accurate expense tracking, reduces errors, and aligns with DepEd financial guidelines for better accountability and MOOE management.
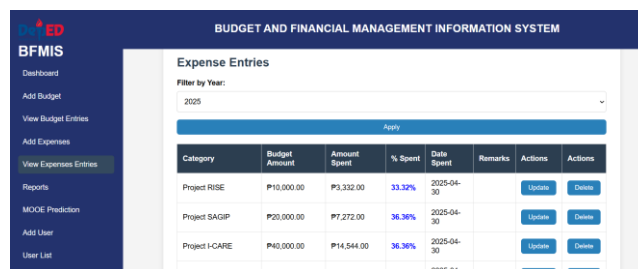

Figure 7. View Expense Entries Page

Figure 8 showcases BFMIS's predictive insight feature, which uses linear regression to analyze historical data and recommend future budget allocations. By comparing predicted (green) and actual (blue) values, the system enables data-driven decisions that enhance MOOE planning and resource optimization.

Key benefits include smart recommendations that automatically suggest budget allocations based on trends, such as rising utility or material costs, reducing guesswork (Alvarado & Reyes, 2021); misalignment detection that highlights discrepancies between planned and predicted spending for timely adjustments (Caballero et al., 2020); proactive planning that empowers administrators to anticipate and respond to funding needs in evolving areas (Lee & Santos, 2022); evidence-based decisions that support budget proposals with data-backed insights (Delos Reyes & Bautista, 2023); and user-friendly visuals featuring color-coded, intuitive charts that improve accessibility even for non-technical users (Tolentino & Uy, 2021). Overall, this feature transforms BFMIS into a practical AI-powered tool for transparent, efficient, and strategic school budgeting.
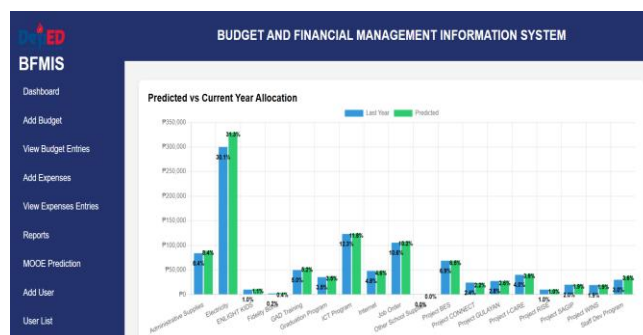

Figure 8. MOOE Prediction Page

Figure 9 presents the BFMIS Budget and Expense Report page, summarizing allocations, actual spending, and utilization rates across MOOE categories from January 1 to May 15, 2025. This real-time report supports accountability and informed decision-making by showing how funds are being used.

The report includes columns for School Year, Category, Allocated Budget, Total Expenses, and % Utilization. For instance, 100% spending in the Graduation Program reflects full budget use, while mid-range figures in other programs indicate ongoing or scheduled disbursements.

The % Utilization metric—calculated by dividing expenses by the budget—offers a quick view of financial efficiency, helping identify over- or under-utilized funds. Automated calculations and clear visualizations reduce manual errors and promote transparency.

Aligned with studies on digital finance tools (Gao et al., 2021; Tolentino & Uy, 2021), this page enhances budget tracking, enables timely reallocations, and strengthens school financial governance.
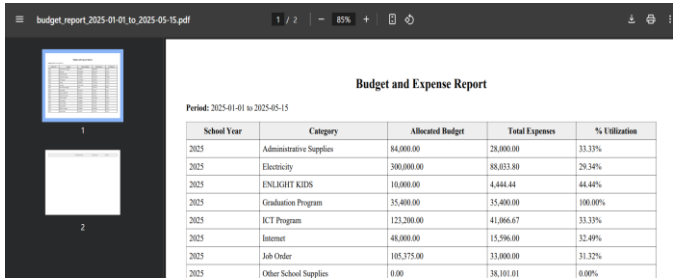

Figure 9. Budget and Expense Report Page

Table 3 outlines the core functional modules of the BFMIS, each addressing key financial management needs in public schools while promoting automation and data-driven decision-making. Budget Allocation Module, built with PHP and MySQL, this module allows structured input and secure storage of MOOE data, enhancing accuracy and accessibility (Abubakar & Sulaiman, 2021). AI-Powered Prediction Module, developed in Python using Scikit-learn, it uses linear regression to forecast future budget needs, enabling proactive and strategic planning (Delos Santos & Gomez, 2023). Budget Visualization Module uses Chart.js and JSON to display real-time comparisons of planned vs. actual spending, supporting transparency and informed decision-making (Hussein et al., 2022). Automated Reporting Module, generates PDF and Excel reports via DomPDF and PhpSpreadsheet, streamlining compliance and reducing manual work (Ramírez-Alujas & Dassen, 2020). Together, these modules demonstrate how BFMIS enhances financial transparency, efficiency, and responsiveness in public elementary schools.

To address Objective No. 2, BFMIS includes an AI-driven reporting module that applies Linear Regression to forecast future MOOE allocations. This machine learning method analyzes historical spending trends to predict category-wise budget needs for the next fiscal year. As supported by Widanaputra et al. (2022), linear regression is effective for educational budget forecasting, enabling data-driven and proactive financial planning.

Table 3: Core Features of the Developed BFMIS

Module	Description	Key Technologies	Stakeholders Benefitted
Budget Allocation	Inputs and categorizes MOOE	PHP, MySQL	School Heads, Finance
AI-Powered Prediction	Predicts next year's budget via Linear Regression	Python, Scikit-learn	School Heads, Finance
Expenditure Tracker	Monitors actual vs. planned	Chart.js, JSON	School Heads, Finance, DepEd, Stakeholders

Report Generator	Auto-generates PDF/Excel reports	DomPDF, PhpSpreadsheet	All users

Figure 10 presents the comparison of current-year budget allocations and the system's predicted values for the next cycle. Notable increases were observed in categories like Electricity (+9.83%) and Fidelity Bond (+66.67%) due to historical spending trends and prior underestimations. ICT Program predictions showed minimal variance, indicating stable expenditure. Table 4 details these results, including absolute differences and percentage changes, confirming the accuracy of the Linear Regression model.
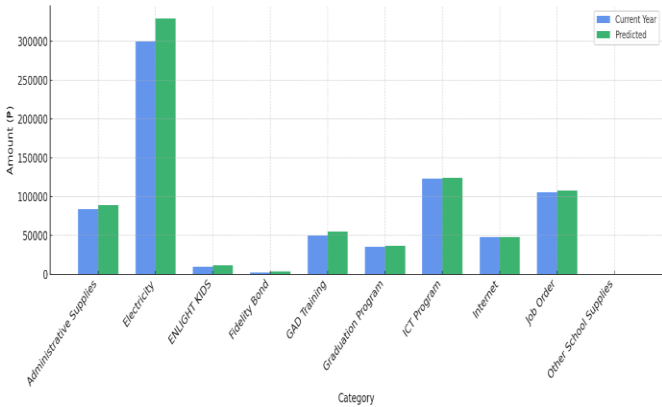

Figure 10. Actual vs. Predicted MOOE Allocations per Category

To evaluate the **model's reliability**, the following regression metrics such as Mean Absolute Error (MAE), Root Mean Square Error (RMSE) and R^2 Score were computed.

The results presented in Table 4 shows that the model maintains high predictive accuracy, with an R^2 value of 92.81%, indicating that most of the variance in the target budget can be explained by historical data. After generating the predictions, the system automatically populates MOOE expenditure logs, variance analysis reports, and DepEd-compliant financial summaries, all downloadable in PDF and Excel formats as shown in Figure 9. This feature aligns with reporting standards required by DepEd and significantly reduces manual report generation time.

Table 4: Regression Model Performance

Metric	Value	Interpretation
Mean Absolute Error (MAE)	₱1,532.75	Indicates low average error between predicted and actual values.
Root Mean Square Error (RMSE)	₱2,126.84	Confirms minimal large prediction errors, enhancing reliability.
R^2 Score	0.9281	High explanatory power—92.81% of variance is accounted for by the model.

Black-box testing involved 37 test cases (TC001– TC037) assessing core modules, user access, validation, responsiveness, and security. Conducted by IT professionals and developers, results showed strong compliance, with most testers reporting full success. Only one tester reported four failures related to UI responsiveness (TC010), missing field validation (TC012), incorrect feedback for over-budget entries (TC017), and display issues when the budget is zero (TC020). Additional issues included input sanitization vulnerabilities (TC030), UI inconsistencies across roles, and acceptance of invalid numeric data. These align with prior studies emphasizing strong input validation and consistent UI design. Despite minor issues, the system showed no major bugs or crashes, confirming it is functionally complete and ready for deployment with slight improvements in validation and UI responsiveness.

- *User Feedback and Observations*

"The system works as intended and performs in accordance with its expected features. It passed all necessary functional tests, making it suitable and ready for deployment. The interface is user-friendly, easy to navigate, and responds well to defined inputs."

The **evaluation of user acceptance** and behavioral intention to use the (BFMIS) was conducted using the (TAM) through structured (UAT) with school administrators, financial officers, and DepEd auditors, focusing on perceived usefulness, perceived ease of use, and attitude toward using the system.

As shown in Table 5, the Budget and Financial Management Information System (BFMIS) received consistently high ratings across all quality dimensions based on user evaluations. Users strongly agreed on the system's accuracy, functionality, and security, with the highest rating given to secure access and user role management (Mean = 4.70), affirming the system's reliability in protecting sensitive financial data (Byol & Foygel, 2023). They found the system easy to navigate, input data, and retrieve reports (Weighted Mean = 4.61), reflecting its high usability and user-friendly interface design (Hussein et al., 2022). Respondents also acknowledged the system's role in enhancing transparency, efficiency, and decision-making in budget management (Weighted Mean = 4.51), consistent with findings from Delima and Tejero (2022). Key features such as the dashboard, AI predictions, and policy compliance were positively received, with dashboard clarity rated highest (Mean = 4.67), supporting better financial insights (Tolentino & Uy, 2021). Additionally, users expressed high satisfaction and a strong likelihood of regular use (Weighted Mean = 4.51), indicating readiness for adoption and long-term integration, in line with the Technology Acceptance Model (Venkatesh & Davis, 2000). The low standard deviation across all categories (ranging from 0.47 to 0.62) signals consistent agreement among respondents, validating the system's effectiveness, trustworthiness, and alignment with user needs.

Table 5. Summary of Evaluation Results for the Budget and Financial Management Information System (BFMIS)

Dimension	Highest-Rated Criterion	Mean	Weighted Mean	Verbal Interpretation
System	Secure user role &	4.70	4.62	Strongly
Quality	password protection			Agree
Ease of Use	Ease of retrieving reports and data	4.63	4.61	Strongly Agree
Perceived Usefulness	Enhances transparency in financial reports	4.67	4.51	Strongly Agree
System Features & Functionality	Dashboard provides relevant and clear financial insights	4.67	4.51	Strongly Agree
User Satisfaction & Acceptance	Likely to use the system regularly and satisfied with performance	4.53	4.51	Strongly Agree

In Fig. 11, Implementation Plan, the BFMIS is recommended to be implemented from June 2025 to December 2026 through a phased rollout to ensure readiness, training, and policy alignment. Phase 1 (June–July 2025) focuses on system finalization, stakeholder consultation, and pilot school selection. Phase 2 (July–August 2025) involves creating training materials and conducting sessions to build user capacity. In Phase 3 (August–October 2025), the system will go live in pilot schools, with ongoing feedback and adjustments based on monitoring. Phase 4 (October 2025–February 2026) will see the refined system deployed nationwide, supported by policy integration and helpdesk activation. Finally, Phase 5 (January–December 2026) ensures sustainability through continuous updates, integration with DepEd systems (BEIS and EMIS), and a full impact assessment to guide long-term adoption.
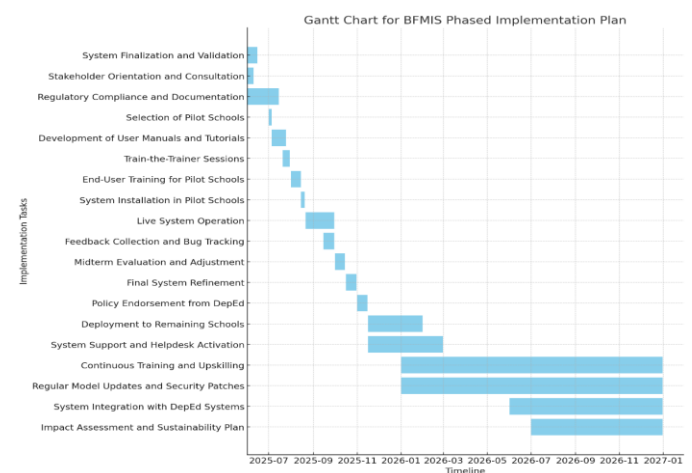

Figure 11. BFMIS Phased Implementation Plan

As shown in Table 6, the Risk Mitigation Strategies ensures a structured, scalable, and user-centered approach to transforming financial management in public elementary schools. These mitigation strategies reflect a comprehensive approach to implementation planning, incorporating both technical safeguards and user-centered practices in line with global standards for ICT deployment in education (UNESCO, 2022).

Table 6. Risk Mitigation Strategies

Identified Risk	Mitigation Plan
Resistance to change	Early orientation and stakeholder engagement
Low digital literacy in some schools	Tiered training support and digital mentoring
Data privacy and system breaches	Secure role-based access and encryption protocols
Budget inaccuracies or prediction discrepancies	Continuous model validation and override options
Network or device incompatibility	Offline-first design and minimum hardware specs

VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. Summary

The BFMIS was designed to address manual inefficiencies in budgeting by offering digital, AI-driven tools for transparency and decision-making. The system's core modules are the Budget Allocation Module, which facilitates structured input of MOOE items based on specific categories. AI-Powered Prediction Module that utilizes a Linear Regression algorithm to estimate future MOOE allocations.

The model achieved the accuracy of $R^2 = 0.9281$, Mean Absolute Error (MAE) = ₱1,532.75, Root Mean Square Error (RMSE) = ₱2,126.84. Expenditure Tracker displays real-time spending versus planned allocation using dynamic summaries and tables, and the Automated Reporting Module generates DepEd-compliant PDF and Excel reports for easier audit and submission.
A total of 37 black-box test cases were conducted to validate functionality, usability, data accuracy, and security, all of which were passed successfully.

The User Acceptance Evaluation shows that users highly rated BFMIS across five key areas on a 5-point scale: System Quality (4.47), Ease of Use (4.46), Usefulness (4.37), Features (4.37), and Satisfaction (4.37). These scores indicate the system is reliable, easy to use, valuable, well-equipped, and well-liked, suggesting strong user approval and readiness for adoption.

To support deployment, a five-phase implementation plan was proposed: pre-implementation, training, pilot rollout, full deployment, and sustainability. Risk mitigation strategies were included to address issues such as digital skill gaps, system resistance, forecasting challenges, and cybersecurity concerns.

B. Conclusions

The BFMIS successfully achieved its goals, offering a reliable digital solution that automates budgeting, improves accuracy, and promotes financial accountability. Its use of Linear Regression enhanced the predictive quality of MOOE forecasts, while the system's user interface, role-based access, and real-time data display supported positive user experiences.

All modules performed as expected based on testing. While minor improvements in UI responsiveness and input validation were noted, the system is technically robust and ready for implementation.

The implementation framework ensures scalability and regulatory compliance. Its phased structure and risk controls promote a smooth, sustainable rollout.

C. Recommendations

To support the broader deployment and sustainability of the BFMIS, it is recommended that the Department of Education (DepEd) formally adopt and integrate the system into the national school budgeting framework. Regular training sessions should be conducted alongside the establishment of a dedicated help desk to provide technical support and ensure us   er proficiency. Quarterly updates must be implemented to maintain system security and the accuracy of AI-powered forecasts.

Future development should ensure integration with existing DepEd platforms such as BEIS and EMIS to streamline data flow and reduce redundancy. Expanded pilot implementations across schools with varying ICT capacities are encouraged to evaluate system adaptability in diverse contexts. Within 12 months of deployment, a comprehensive impact assessment should be conducted to evaluate system performance, user satisfaction, and improvements in financial accuracy.

Lastly, continuous risk monitoring must be embedded into system operations to address emerging challenges and ensure long-term success. Regular assessments and mitigation strategies will help sustain BFMIS effectiveness and institutional trust.

VII. ACKNOWLEDGMENT

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