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Addressing Data Availability And Quality Issues In LGU Educational Systems For Effective Machine Learning Integration

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This study addresses the challenges of data availability and quality in Local Government Unit (LGU) educational systems. Local Government Units (LGUs) have major difficulties in implementing Machine Learning (ML) because of the presence of inconsistent, incomplete, and invalid data. The study used both quantitative and qualitative data gathering from the LGU stakeholders to evaluate existing data practices, establish standardized data collection procedures, develop a data management tool, and analyze the impact of technological solutions on enhancing data quality. According to study results, participants recognize the value of data in making decisions. However, due to inadequate technology infrastructure and a lack of standard operating procedures, data handling is still inefficient. The paper outlines a suggested architecture and information system to improve communication between schools and Local Government Units (LGUs), automate processes, and provide standardized data formats in order to improve data gathering. The results of the evaluation show that the suggested technical solution, which includes automated data collection systems and standardized data formats, made data easier to find and significantly reduced gaps and discrepancies. The proposed recommendations aim to lay the foundation for more effective, data-driven educational planning in LGUs, ensuring better outcomes for resource management and policy development. Future research should focus on long-term implementation strategies for ML integration, addressing both technical and organizational barriers. Future research should prioritize the development of long-term implementation strategies for machine learning integration, specifically targeting technological and organizational obstacles.

Index Terms— Data Availability, Data Quality, Education Management System, Local Government Units

I. INTRODUCTION

The implementation of Republic Act (RA) 9155, referred to as the Governance of Basic Education Act of 2001, sets forth directives for the decentralization of school management and governance. It also recognizes the significant contribution of Local Government Units (LGUs)

in providing educational services [1]. Engaging local government units as key collaborators with the national government in providing essential educational services. Their involvement, especially in offering financial assistance, is essential in the domains of educational planning and resource distribution [2]. Local government units contribute significantly to the efficient and effective use of the Special Education Fund for projects and programs at both the school and division levels [3]. Strategic educational planning can greatly improve student results and optimize administrative functions [4].

Utilizing machine learning for educational planning and guaranteeing data accuracy presents numerous substantial challenges. A significant obstacle is the quality and accessibility of data [5], [6], [7]. Effective planning in education necessitates precise and thorough data, as any shortcomings or inaccuracies can result in less than ideal resource distribution [8]. Precision may be affected by factors like susceptibility to mistakes, challenges in gathering data, and lengthy procedures [9]. The demand for superior, multi-dimensional datasets and the complex nature of non-linear relationships presents significant challenges for machine learning applications in the field of education [10]. Forecasting enrollment trends with precision is especially difficult in small samples because of various internal and external influences, even with the progress made in predictive models [11]. Regrettably, numerous Local Government Units (LGUs) encounter notable obstacles in this aspect, as data obtained from schools sometimes lacks certain information, displays inconsistencies, or is completely absent [3], [12]. The lack of data presents a significant obstacle to effectively using machine learning technologies in educational settings as well as the ability to make timely corrective adjustments in education policies, programs, and projects. [3], [13].

Objectives of the study

The existing condition of data accessibility and quality within local government unit (LGU) educational systems presents a notable obstacle to the effective implementation of machine learning (ML) technology [8]. The absence of reliable and comprehensive data causes predictive models to fall short in delivering accurate insights, ultimately resulting in suboptimal educational planning and resource management. The issue is further complicated through elements like the lack of established data collection methods, inadequate data management systems, and limited technological proficiency [6]. Therefore, addressing these challenges associated with data is essential to enable Local Government Units (LGUs) to effectively leverage Machine Learning (ML) technologies and make informed, data-driven decisions that improve educational outcomes.

The objective of this study deals with the urgent problems related to the availability and quality of data in local government unit (LGU) educational systems. The study intends to facilitate the integration of ML in educational planning. The stated objectives are as follows:

1. Evaluate the present condition of data accessibility and accuracy
2. Establish and execute uniform procedures for gathering and merging data
3. Evaluate the effectiveness of technological solutions in improving data availability

This research holds great importance for improving educational strategies within Local Government Units (LGUs). This study seeks to address essential issues concerning data accessibility and quality to create a solid foundation for the integration of machine learning technology within educational frameworks. The findings will provide practical solutions and effective strategies for enhancing data management, essential for accurate predictive analytics

and efficient decision-making, while facilitating the integration of machine learning to harness its potential for significant transformation, leading to more informed, efficient, and equitable educational policy. Moreover, the results of this research will contribute to the broader academic dialogue on data-informed educational strategies, aiding Local Government Units (LGUs) in their efforts to improve resource allocation and enrich the educational experience.

II. LITERATURE REVIEW

A. Overview of data availability issues in educational planning

Having access to and ensuring the accuracy of data are crucial for successful educational planning, but they can pose substantial difficulties, particularly in Local Government Units (LGUs). Insufficient, contradictory, and obsolete facts can significantly impede the capacity to make well-informed decisions. A significant challenge faced by many Local Government Units (LGUs) is the presence of disjointed data systems and the absence of established methods for data collection and management [13]. This fragmentation leads to significant data gaps that are essential for the formulation and implementation of policies. Furthermore, it highlights that the lack of skilled personnel in data management exacerbates these issues, complicating the efforts of LGUs to maintain the accuracy and timeliness of educational information [5], [6], [7].

B. ML applications in educational policy

In recent years, advancements in technology, especially in the field of Machine Learning (ML), have created new opportunities for making decisions based on data. Machine learning plays a vital role in transforming school planning by offering predictive insights like enrollment trends and resource needs [14]. Local government units and educational institutions have the opportunity to utilize predictive models grounded in machine learning to examine extensive datasets and anticipate upcoming trends and outcomes. This can aid in generating enrollment projections and distributing resources efficiently, thus ensuring the optimal use of educational resources [15], [16], [17]. Moreover, techniques from educational data mining, including Artificial Neural Networks, Support Vector Machines, and Decision Trees, are employed to enhance educational environments and support students in achieving greater academic success [18], [19]. Nonetheless, the successful application of machine learning in educational policy relies significantly on the availability of high-quality data. The absence of reliable data diminishes the forecasting accuracy of machine learning models, leading to a reduction in significant policy recommendations.

C. Best practices in data collection and management

Effective gathering and organization of data are essential to leveraging machine learning in the field of educational planning. Effective approaches in this area require the implementation of standardized protocols for data collection, the utilization of dependable systems for data management, and the provision of suitable training for personnel. The adoption of standardized data formats across all educational institutions within a local government unit ensures consistency and comparability of data [20]. In addition, employing automated data collection techniques can significantly reduce errors associated with manual data entry and enhance data accuracy [21]. Centralized data repositories facilitate efficient data storage and retrieval,

enhancing overall data governance. It is essential to establish continuous training programs for data management personnel to maintain data integrity and guarantee compliance with data protection regulations [22].

A research investigation demonstrated that an extensive data management system can improve the quality and accessibility of data within educational institutions [23]. The research highlighted the importance of engaging stakeholders, establishing clear data governance policies, and leveraging advanced technologies in data management practices. Applying these optimal strategies enhances the reliability of information while simultaneously improving the overall efficiency of educational planning and policy development.

III. METHODOLOGY

A. Research Design

This research utilized a mixed-methods approach, combining quantitative and qualitative techniques to address issues concerning data availability and quality in local government unit (LGU) educational systems. The main aim was to create and establish standardized approaches for gathering and integrating data, evaluate the efficiency of technical solutions, and improve data management practices. This methodological approach facilitated an in-depth analysis of the challenges and possible solutions focused on enhancing data management for more efficient educational planning.

B. System Development

The development process adhered to an Agile approach, with the system being built incrementally through iterative cycles known as sprints. Every iteration produced operational elements of the system, enabling consistent input from users and stakeholders. Ongoing engagement with stakeholders was upheld during the development phase, guaranteeing that modifications were implemented based on continuous feedback. This method provided adaptability, allowing the system to progress over time to meet shifting demands, eventually leading to an end result that matched user needs and anticipations.

The research was carried out in Goa, a municipality located in Camarines Sur, Philippines. The local government unit has implemented a data management system known as "e-SITIO: Real-Time Comprehensive Knowledge Management System (CKMS)," serving as a thorough repository of community data collected from its residents. The researchers leveraged the existing system to create a module aimed at improving data availability within local government unit educational system.

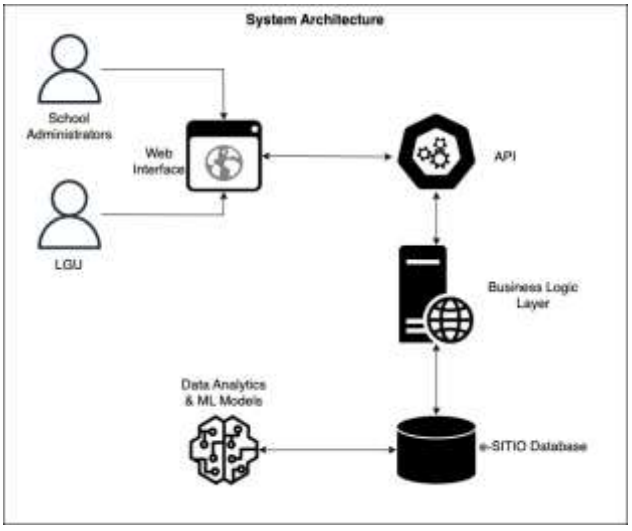


Figure 1 System Architecture

The system architecture, as shown on Figure 1, was designed for standard data collection and integration with "e-Sitio", aims to facilitate the management of educational data for school administrators and local government unit (LGU) officials. The primary method for user engagement was via a web interface. An API gateway was implemented to facilitate communication between the front-end and back-end systems, including "e-Sitio." A structured layer was incorporated into the design to ensure the processing, validation, and adherence to data compliance standards. The primary "e-Sitio" database served as the key repository for newly added and modified data, ensuring the accuracy of the information maintained within it. The system featured visual dashboards for real-time reporting and is set to introduce advanced analytics and machine learning models, offering valuable insights for educational planning to policymakers, local government unit officials, and school administrators. Leveraging the existing infrastructure facilitated data acquisition, ensured consistency, and streamlined the update process. It ensured that all educational data was centralized and managed from a single location.

C. Data Interpretation and Analysis

The survey data were meticulously interpreted and analyzed to examine the viewpoints of LGU concerning the availability and quality of data. A detailed examination was conducted on the quantitative data to uncover challenges and identify potential enhancements in the availability and quality of data within educational systems of Local Government Units (LGUs). Participants also provided responses to open-ended questions, yielding qualitative insights into their perspectives, reflections, and suggestions. The qualitative data underwent thematic analysis to uncover recurring patterns and themes. The study offered an in-depth exploration of the current state and perspectives regarding the availability of data within local government units through the integration of both quantitative and qualitative analyses.

IV. RESULTS

This research investigates the challenges and potential innovations in data accessibility and quality within educational systems of Local Government Units (LGUs), emphasizing the incorporation of machine learning (ML). A comprehensive survey was conducted involving various stakeholders such as administrators, policymakers, education officers, and office staff within the local government unit's educational system. The findings emphasize the significant impact of data on educational planning and the advantages of making decisions based on data analysis. The results of the survey highlight the necessity for uniform data gathering techniques, better cooperation between educational institutions and local government units, as well as strengthened training and communication strategies.

Table 1 shows that majority (92%) of respondents perceive data as "Extremely Important" in educational planning. The remaining 8% view it as "Very Important." This highlights the critical role data plays in effective decision-making within the LGU educational system.

Table 1. Importance of Data in Educational Planning

Importance Level	**Percentage**
Extremely Important	92%
Very Important	2%

Respondents identified resource allocation (88%) and policy formulation (84%) as the key areas benefiting from data-driven decision-making as presented in Table 2. Student performance tracking (80%) and teacher performance tracking (72%) also ranked highly, indicating that data significantly enhances the management of educational outcomes and resources.

Table 2. Aspects of Educational Planning Benefiting from Data-Driven Decision Making

Aspect	**Percentage**
Resource Allocation	88%
Policy Formulation	84%
Teacher Performance Tracking	72%
Student Performance Tracking	80%
Curriculum Development	68%

A majority of respondents (78%) highlighted the lack of standardized data collection as a major challenge, followed by barriers in collaboration between schools and LGUs (70%) shown in Table 3. Data management inefficiencies (65%) further exacerbate these issues, underscoring the need for systemic improvements in data governance.

Table 3. Challenges in Data Availability and Quality

Challenge	**Percentage**
Lack of Standardized Data Collection	78%
Collaboration Barriers	70%

Data Management Inefficiencies	65%

Respondents expressed significant backing for the use of machine learning in streamlining data collection (85%) and in establishing uniform data procedures (76%) as shown in Table 4. Moreover, 67% were of the opinion that machine learning has the potential to improve data analytics, facilitating a more profound understanding of educational trends and enhancing decision-making abilities.

Table 4. Potential Role of Machine Learning in Data Management

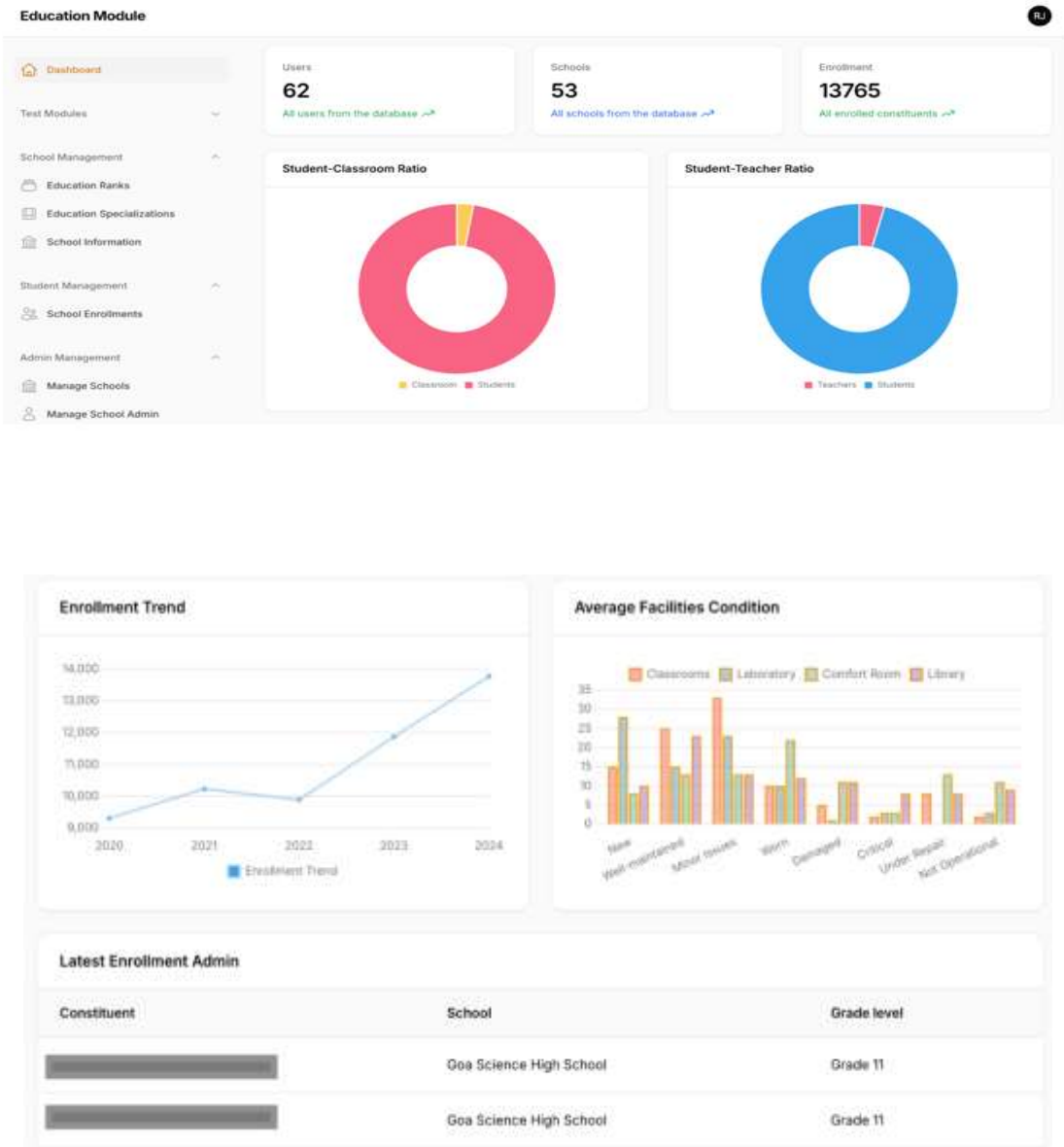


Figure 2 - LGU Dashboard

Role of Machine Learning	**Percentage**
Data Collection Automation	85%
Data Standardization	75%
Advanced Analytics	67%

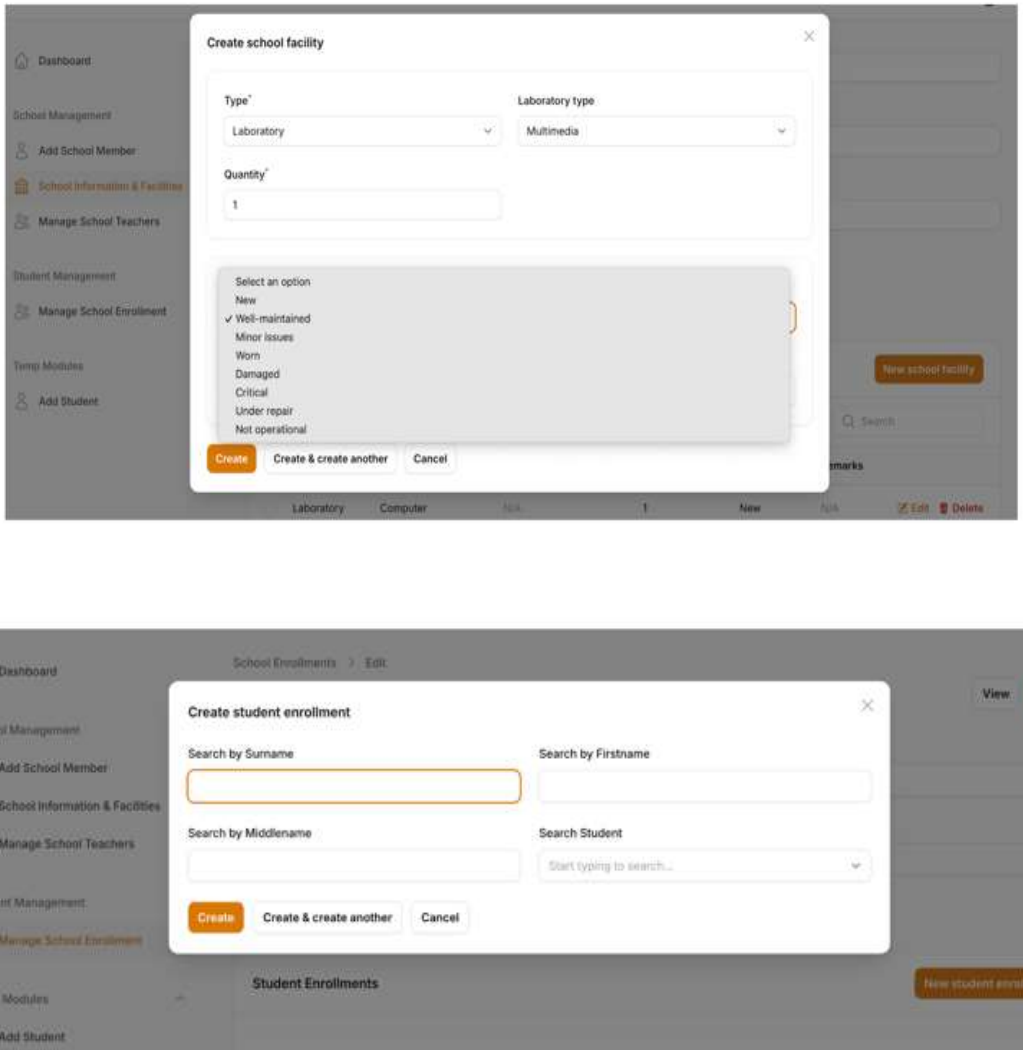
Respondents provided numerous important suggestions to improve the accessibility and standard of information in local government unit educational frameworks. The establishment of standardized data collection frameworks across all local government units and educational institutions was emphasized as essential for enhancing the reliability and consistency of data. This consistent methodology would rectify inconsistencies and guarantee uniformity of data among various institutions. Furthermore, participants highlighted the necessity for enhanced communication and training, proposing that more robust collaboration between local government units and educational institutions, bolstered by consistent communication and thorough training initiatives, would result in more precise and comprehensive data gathering. Finally, it was suggested that the incorporation of sophisticated data management tools, especially the application of specialized technologies like machine learning algorithms, could enhance the collection, storage, and use of data for improved decision-making. These suggestions indicate a structured method for improving data management within local government unit educational system.

Proposed Education Management System

Utilizing the responses and recommendations, the following system features were developed. Figure 2 shows the Admin Dashboard presenting various information such as number of schools in the LGU, number of enrollees, enrollment trends over the past 5 years and average facilities condition of schools in the LGU.

Figure 3 illustrates how schools in the LGU contributes to the database by providing data using a standardized data collection module. As shown in Figure 3, schools can manage enrollment and manage school facilities using the proposed system. Providing real-time, accurate data, produces comprehensive data-driven charts as shown on Figure 1.

The proposed system utilizes the existing "e-sitio" database that provides a comprehensive data of all the constituents in the LGU. These data are then fetch using an API developed by the researchers to avoid duplication of data. The system also allows contributing new data to the existing database but with limitation which requires administrator approval. Another useful feature is providing printable reports and exporting reports.



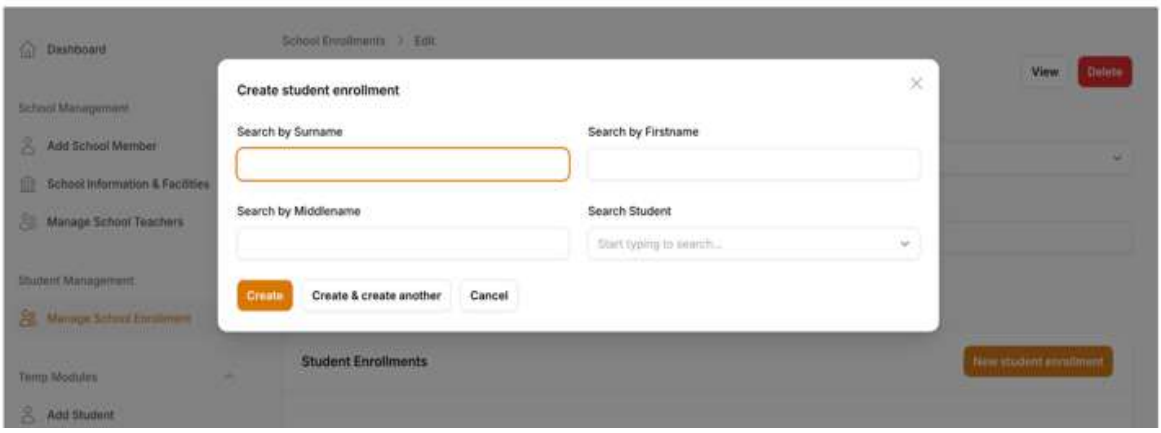


Figure 3 Standardized Data Collection

Effectiveness and Usability Testing

After the development of the proposed educational system module, another survey was conducted aimed to evaluate the effectiveness and ease of use of a newly proposed educational data collection system. The respondents, ranging from school administrators to IT staff and LGU officials, provided insights into their experiences with the system, focusing on usability, efficiency, and areas for improvement. The results of the survey are presented below with relevant data analysis, percentages, and insights drawn from the responses.

The majority of respondents (30%) were Education Officers, followed by LGU officials (26%), school administrators (24%), and IT staff (20%) as presented at Table 5. This distribution highlights a balanced participation from different stakeholders in the educational system, which provides a comprehensive view of the system's usability from various roles.

Table 5. Role of Participants in the Educational System

Role in Educational System	Percentage
School Administrator	24%
Education Officer	30%
IT Staff	20%
LGU Official	26%

Table 6 shows significant portion of respondents (44%) use data collection systems on a weekly basis, while 36% use them monthly. Only 20% indicated rare usage. This shows that most participants are familiar with the regular use of such systems, allowing them to provide valuable insights regarding the proposed system's functionality.

Table 6. Frequency of Data Collection System Usage

Frequency of Use	Percentage
Weekly	44%
Monthly	36%
Rarely	20%

Half of the respondents (50%) indicated that they are very familiar with previous data collection methods, while 36% are familiar, and 14% are somewhat familiar. Table 7 suggests that the majority of users are experienced with traditional systems, providing a solid basis for comparing the new system's improvements.

Table 7. Familiarity with Previous Data Collection Methods

Familiarity Level	Percentage
Very Familiar	50%
Familiar	36%
Somewhat Familiar	14%

Most respondents (70%) rated the login process as "very easy," while 20% rated it as "easy" (4 out of 5). Only 10% found the process moderately easy as shown on Table 8. This indicates that the login process of the system is well-optimized, with minimal difficulties experienced by users.

Table 8. Ease of Logging into the System

Ease of Login (1-5)	Percentage
5 (Very Easy)	70%
4	20%
3	10%

The majority of respondents (60%) found it very easy to input new educational data, while 30% rated it as easy. Only a small percentage (10%) rated the experience as moderately easy. This shows that the system provides a user-friendly interface for data entry as presented in Table 9.

Table 9. Ease of Inputting New Educational Data

Ease of Data Input (1-5)	Percentage
5 (Very Easy)	60%
4	30%
3	10%

V. DISCUSSION

The survey findings underscore the necessity of addressing fundamental challenges in data availability and quality before fully integrating machine learning (ML) into LGU educational systems. Standardization and improved communication between schools and LGUs are essential to ensuring that data is accurate, reliable, and actionable for educational planning and policy formulation. ML offers dual benefits in this context: it can automate data collection processes and enable advanced analysis of educational trends, ultimately improving resource allocation and educational outcomes.

The results reveal the central role of data in enhancing decision-making within LGUs. A significant majority of respondents (92%) rated data as "Extremely Important" for educational planning, with resource allocation (88%) and policy formulation (84%) cited as key areas benefiting from data-driven strategies. These findings align with global trends where data is increasingly leveraged to optimize resource use and enhance educational outcomes. However, the absence of standardized data collection practices (78%) and communication barriers between schools and LGUs (70%) were frequently highlighted as major obstacles to data accuracy and completeness. Outdated data management systems (65%) compound these issues, limiting the effective use of data in policy decisions.

The potential of ML to address these challenges was supported by 85% of respondents, who believed ML could automate data collection, while 76% indicated that ML could enhance data standardization. These results suggest that ML can play a transformative role in addressing data management inefficiencies by introducing more consistent, scalable solutions. Respondents emphasized the need for standardized data frameworks (82%) and improved communication (75%) between LGUs and schools, along with regular staff training (70%) to ensure effective data management practices.

In conclusion, while data remains pivotal for effective educational planning, overcoming the challenges of data management and availability is crucial. ML integration offers a promising solution but requires the establishment of standardized practices and enhanced collaboration among stakeholders. The survey results also demonstrate the effectiveness and usability of the newly proposed data collection system. The system was evaluated by a diverse group of stakeholders, including school administrators, education officers, IT staff, and LGU officials, ensuring comprehensive feedback.

Education officers, representing the largest group of respondents at 30%, provided critical insights into the system's functionality. Regular use of data systems by 80% of respondents indicates familiarity with data collection processes, while half of the respondents were well-positioned to assess improvements due to their familiarity with prior systems. The user experience was overwhelmingly positive: 70% found the login process easy, and 60% rated data entry as intuitive. The system's ability to generate visualizations and reports was

identified as the most useful feature by 40% of respondents, underscoring its capacity to streamline reporting.

Despite these strengths, 20% of respondents reported minor challenges, such as slow response times and interface confusion. Additionally, some users suggested integrating messaging and notification features, reflecting modern trends in data systems aimed at enhancing workflow efficiency.

Overall, the system demonstrates significant improvements in data collection and reporting, with high user satisfaction regarding ease of use and functionality. Addressing the minor issues raised and incorporating additional features could further enhance system utility and user experience. This evaluation offers valuable insights into the deployment of digital systems in educational settings, where data-driven decision-making increasingly relies on efficient data collection and integration systems.

CONCLUSION

The integration of machine learning (ML) within the educational systems of Local Government Units (LGUs) offers significant opportunities for enhancing decision-making, optimizing resource distribution, and advancing policy-making. However, this research highlights significant obstacles concerning availability of data, quality, and management that need to be addressed to facilitate successful ML integration. Identified as significant obstacles were the absence of standardized data collection methods, barriers to collaboration between educational institutions and the local government unit, and inefficiencies in data management.

The study showed that streamlining the collection of data and implementing standardized formats can significantly enhance the reliability and accessibility of data. Furthermore, the proposed system, combined with current infrastructure such as the "e-SITIO" system, offers a compelling approach to optimize data management and improve educational planning. The results from the usability testing indicated that stakeholders perceived the system as effective and user-friendly, underscoring its capacity to enhance data-driven decision-making.

Future research should focus on long-term strategies for ML integration in the LGU, especially in addressing both technological and organizational obstacles. Continuous improvements in data management, involvement of stakeholders, and employee education are all vital for enabling local government units to maximize the benefits of machine learning technology. Lastly, the effective integration of ML depends on creating a robust base of high-quality, accessible data, while also guaranteeing that educational policies and resource management are fair and efficient.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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