Asian Journal of Multidisciplinary Studies
Vol. 8, No. 1, (2025)
ISSN 2651-6691 (Print)
ISSN 2651-6705 (Online)

Digital Learning Governance: Integrating Learning Analytics Into School Managerial Decision-Making

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Article Info:
Received: ***01 Feb 2025****; Revised:* ***09 April 2025****; Accepted:* ***21 July 2025****; Available Online:* ***20 August 2025***

Abstract - *The advancement of educational technology has accelerated the adoption of learning analytics (LA) to support managerial decision-making at the school level. This article conducts a systematic literature review of 20 recent studies (2019–2025) examining the implementation of LA in school/K–12 contexts and educational leadership and management. The findings indicate that LA enhances the visibility of learning data for school principals and policymakers, strengthens evidence-based decision-making, and supports strategic planning processes. However, its implementation is constrained by technical, ethical, and human resource capacity challenges. Recommendations emphasize the development of user-friendly dashboards, robust data governance frameworks, capacity building for school leaders, and the formulation of clear data privacy and protection policies..*

Keywords *– Learning Analytics (LA), School Management/Educational Leadership, Evidence-Based Decision-Making*

INTRODUCTION

Digitalization of learning in modern education has generated massive volumes of data from multiple primary sources, including Learning Management Systems (LMS) such as Google Classroom and Moodle, interactive learning platforms (e.g., Wordwall and e-learning systems), automated digital assessments, and application-based attendance systems that record students' real-time activities. These data encompass login logs, learning duration, quiz results, forum interaction patterns, and attendance records. Such data enable in-depth analysis to support personalized learning through algorithms such as Adaptive Moving Self-Organizing Maps, which cluster students based on activity patterns, while simultaneously facilitating evidence-based decision-making in school management through demographic dashboards and the integration of national education platforms from the Ministry of Education (e.g., ARKAS and PMM) to enhance efficiency and digital literacy. However, the management of these data also presents challenges, including student data privacy concerns, the need for robust infrastructure, and effective teacher–student collaboration to optimize utilization, as evidenced by studies on digitalization in Indonesian primary schools [1], [2], [3], [4].

Learning analytics (LA) processes large-scale data derived from digital learning—such as LMS activity logs, digital assessment outcomes, and attendance records—into actionable information to understand learning processes (e.g., student engagement patterns, self-regulated learning, and social interaction) and learning outcomes (academic performance and dropout risk prediction), thereby supporting evidence-based decision-making. At the school level, principals and managerial teams face key challenges in integrating LA into operational decisions (e.g., daily resource allocation based on real-time dashboards), curricular decisions (e.g.,

adapting lesson plans through temporal analysis of student learning patterns), and policy decisions (e.g., formulating digital school strategies that account for data privacy and fairness). This approach requires a three-stage framework—Data → Indicators → Decisions—and strong collaboration among stakeholders to transform data signals into effective pedagogical actions, despite persistent constraints related to infrastructure and data literacy in Indonesian primary schools [5].

The integration of LA into school governance has the potential to improve the accuracy of managerial decision-making, enhance resource allocation efficiency, and strengthen responsiveness to the needs of students and educators. Nevertheless, the adoption of LA in the K–12 context remains relatively nascent and requires contextual adaptation in system design, data privacy policies, and capacity building among stakeholders. This assertion is supported by recent review studies and case-based implementations of K–12 learning analytics dashboards [6]

OBJECTIVES OF THE STUDY

Generally, this study aimed to determine the effective practices on organization management of PadyaRescue, Inc. (PRI), a youth volunteer group in Pangasinan, Philippines. A short profile of the PRI officers was collected highlighting the motivators in joining the group. It looked into the relationship between the perceived importance of the different organization management pillars or elements, to the effective practices of PRI.

These shall be a basis for more responsive capacity-building proposals for the youth group. Using the basic Importance-Effectiveness Matrix, it aimed to identify specific indicators of organization management that the group should maintain, reassess, and improve.

MATERIALS AND METHOD

1. Research Questions

The research questions for examining the implementation of Learning Analytics (LA) in school management are formulated with a specific focus on the Indonesian primary and secondary education context, where data generated from LMS and digital learning platforms have become increasingly abundant.

a. How is Learning Analytics (LA) utilized to support managerial decision-making in schools, including the analysis of attendance patterns, student performance, and teacher resource allocation through the integration of LMS data such as Google Classroom or platforms provided by the Indonesian Ministry of Education?
   This question explores the *Data → Indicators → Decisions* framework in supporting daily operational decisions, such as identifying students at risk of dropout based on activity log data.
b. How can effective Learning Analytics (LA) dashboards and visualizations be designed for school principals and stakeholders, incorporating interactive elements such as real-time student progress charts, interaction heatmaps, and curricular trend predictions using tools such as Google Data Studio? These dashboard designs should be user-friendly and emphasize key indicators—such as engagement rates and outcome predictions—to facilitate collaboration within school managerial teams.
c. What are the main barriers (technical, ethical, and resource-related) to integrating Learning Analytics (LA) into school governance, including limitations in broadband infrastructure in rural schools, student data

privacy issues in accordance with data protection regulations, and insufficient data literacy among school principals? These barriers often hinder the scalability of LA adoption and necessitate targeted professional development and comprehensive digital school policies.

2. Data Sources and Search Strategy

a. Research on Learning Analytics (LA) for supporting school managerial decision-making draws upon major academic databases, including **Scopus, Web of Science, ERIC, IEEE Xplore, ACM Digital Library, and Google Scholar**, to access recent literature on LMS-based data analytics within the Indonesian educational context. This includes bibliometric studies on digital technology trends in primary schools and post-pandemic LMS implementation.

The first research question examines how LA integrates multi-platform student activity data to inform operational and curricular decisions, adopting frameworks such as the **HOT-Fit Model** derived from Schoology-based analyses. The second focuses on effective dashboard design with interactive visualizations (e.g., engagement heatmaps and performance prediction), aligned with systematic reviews of teachers' digital competencies. The third investigates technical barriers (e.g., infrastructure limitations in eastern Indonesia), ethical challenges (e.g., data privacy in blended learning), and resource constraints (e.g., curriculum adaptation), as identified in two-decade reviews of teachers' responses to curriculum change.

A **PRISMA-based systematic approach** is applied to synthesize evidence published between **2010–2025**, with particular emphasis on relevance to school principals in early childhood and primary education settings [7], [8], [9], [10], [11], [12].

b. The primary search keywords include *"learning analytics," "school leadership," "K–12," "decision making," "dashboard," "school management,"* and *"data-driven decision"*, designed to capture the intersection between learning data analytics and school leadership in primary and secondary education.

c. The literature search period is limited to **2019–2025**, with a particular focus on **2023–2025** publications to capture recent post–COVID-19 developments that accelerated LMS adoption and data analytics in Indonesian K–12 education, such as the implementation of Schoology and other multi-platform systems.

3. Inclusion and Exclusion Criteria

a. Inclusion Criteria

Included studies consist of:

- Empirical research examining LA applications using LMS data in K–12 contexts (e.g., student activity pattern analysis for dropout prediction);
- Systematic or narrative reviews synthesizing trends, benefits, and barriers of data-driven decision-making in post-pandemic education;
- Studies on LA dashboard development focusing on interactive visualization design (e.g., engagement heatmaps and real-time indicators for school principals);
- Research conducted in K–12 contexts or explicitly discussing managerial implications for operational and curricular decision-making in Indonesian primary and secondary schools.

a. All included studies were published between **2019–2025**, reflecting the recent evolution of digital learning systems such as Schoology and Ministry of Education platforms [5], [11], [12].

b. **Exclusion Criteria**
Excluded studies include:

- Research focused solely on higher education without managerial implications for K–12 contexts;
- Poster papers or conference abstracts lacking full empirical content;
- Editorials, opinion pieces, or non-substantive commentaries that do not present empirical evidence, systematic reviews, or LA dashboard development.

These exclusions ensure a focused corpus relevant to Indonesian school principals in post-pandemic contexts where LMS such as Schoology are used for operational and curricular decision-making[5], [11], [12].

4. Selection and Synthesis Procedures

The literature screening process follows a multi-stage procedure:

1. Title and abstract screening using inclusion and exclusion criteria to identify relevant publications from databases such as Scopus and Google Scholar;
2. Full-text review of shortlisted articles to verify empirical depth and relevance;
3. Quality appraisal using tools such as the **Mixed Methods Appraisal Tool (MMAT)** or **CASP**, assessing validity, reliability, and potential bias;
4. Systematic data extraction covering study objectives, educational context (K–12 post-pandemic), research methods (quantitative, qualitative, or mixed), and key findings related to managerial decision-making (e.g., dropout prediction and ethical constraints).
    a. Initial title/abstract screening targeted an acceptance rate of approximately **20–30%**, followed by quality assessment (minimum score >70%) and structured data extraction using NVivo or Excel to support high-quality evidence synthesis for school governance recommendations [8], [9], [10], [11].
    b. A **thematic narrative synthesis** was conducted by grouping findings from empirical and review studies to identify dominant patterns, such as the use of interactive dashboards (e.g., engagement heatmaps and dropout prediction tools) to support school principals' operational decision-making in post-pandemic K–12 contexts. Benefits include improved curricular efficiency through data-driven decision-making using LMS platforms like Schoology, reduced managerial bias, and enhanced personalized learning in Indonesian primary schools. Identified implementation challenges encompass technical barriers (limited broadband infrastructure), ethical issues (student data privacy and algorithmic fairness), and resource constraints (limited data literacy among managerial teams and teacher resistance to digital curriculum change). These themes inform coherent narratives such as *"LA adoption for transformational school leadership"* and *"contextual mitigation strategies"*, culminating in practical governance recommendations [8], [9], [10], [11].

5. Final Number of Studies

Through systematic screening across Scopus, Web of Science, ERIC, IEEE Xplore, ACM Digital Library, and Google Scholar within the **2019–2025** period, a total of **20 highly relevant and recent studies** were selected. These include empirical analyses of LMS platforms such as Schoology in

Indonesian K–12 education (e.g., student activity pattern analysis for dropout prediction), bibliometric reviews of post-pandemic digital technology trends, the development of interactive dashboards with engagement heatmaps and real-time indicators for school principals, and discussions of technical and ethical barriers such as infrastructure limitations and data privacy in blended learning environments. Collectively, these studies highlight emerging patterns of LA adoption for operational and curricular decision-making that reduce managerial bias and enhance personalized learning in primary and secondary schools.

RESULTS AND DISCUSSION

Table 1. Summary of Previous Research

NO	RESEARCHER (YEAR)	SUB-SECTOR	DATA	PERIOD	SUMMARY
1	Armalina et al. (2025)	Learning Analytics	Learning interaction data	2015–2024	The systematic literature review demonstrates that learning analytics plays a strategic role in data-driven learning evaluation and continuous improvement of educational quality.
2	Choiruddin & Pratama (2022)	Student Monitoring System	Student attendance and activity data	One academic year	The monitoring system enables teachers and parents to track students' learning progress in real time, improving communication and academic supervision.
3	Colling (2024)	Teacher Dashboard	Student process data	One semester	The dashboard bridges the gap between teachers' instructional needs and student learning process data through a human-centered design approach.
4	Colling et al. (2024)	K–12 Learning Analytics	LMS data and student writing data	One semester	The dashboard enhances English teachers' instructional decision-making by providing actionable learning analytics insights.
5	Hadiyanto et al. (2024)	School Digital Management	Management and instructional data	2023	School digitalization improves governance effectiveness and the quality of instructional services.
6	Han et al. (2025)	Big Data in Education	Educational big data	National scope	The use of big data strengthens educational transformation and

					supports evidence-based instructional and policy decisions.
7	Hasna (2024)	Digital School Governance	SWOT analysis data	2023	Digital governance implementation faces human resource and infrastructure challenges despite its strong potential for school development.
8	Innarcaya & Nasution (2024)	Curriculum Change	Teacher response data	2004–2024	Teachers respond adaptively to curriculum changes, although sustained systemic support is required.
9	Kharis & Zili (2022)	Educational Data Mining	Student academic data	One year	Educational data mining supports the analysis of learning patterns to enhance instructional quality.
10	Laksitowening et al. (2025)	Higher Education E-learning	LMS data	Multi-semester	Integrating business intelligence and learning analytics improves the quality of academic decision-making in higher education.
11	Maharani et al. (2025)	Blended Learning	Bibliometric data	2014–2024	Blended learning dominates 21st-century elementary education research and shows a positive impact on student learning outcomes.
12	Manongga et al. (2023)	Teacher Training	Training program data	2023	Data science training enhances teachers' and students' data literacy and analytical skills.
13	Musakirawati (2023)	Educational Evaluation	Student achievement data	One year	The education report platform supports data-driven evaluation of school quality and performance.
14	Padilla-Escorcia et al. (2025)	Teacher Digital Competence	International study data	2010–2025	Teachers' digital competence is a key determinant of effective technology-enhanced learning.
15	Pan et al. (2024)	LMS Analytics	Learning intervention data	Multi-semester	Learning analytics–based instructional interventions positively influence student learning outcomes.
16	Possaghi et al. (2025)	Multimodal Learning	Multimodal learning data	One year	Multimodal dashboards enhance instructional orchestration and

		Analytics			decision-making among K–12 teachers.
17	Putra et al. (2024)	Game-Based Learning	Student activity data	One semester	The use of Wordwall increases elementary students' learning motivation and engagement.
18	Putri et al. (2022)	Digital Learning Research	Publication data	2012–2021	Research trends in digital learning at the elementary level increased significantly after the COVID-19 pandemic.
19	Sulistyo (2023)	Flipped Classroom	Student demographic data	One semester	Dashboards support teachers in conducting reflective analysis of learning data.
20	Wiley et al. (2024)	Human-Centered Learning Analytics	Contextual learning data	Multi-context	A human-centered learning analytics approach improves teachers' adoption and sustained use of K–12 dashboards.

1. The Role of Learning Analytics in Supporting Managerial Decision-Making

Learning Analytics (LA) supports the identification of attendance patterns (e.g., fluctuations captured through digital attendance systems), student engagement (such as LMS login duration, forum interactions, and task completion rates), and dropout risk (via algorithmic prediction based on declining performance and low engagement trends). These insights enable school principals to implement early interventions, including personalized counseling, peer tutoring assignments, and remedial curriculum adjustments at the primary and secondary school levels. Additional benefits include operational cost savings and improved student retention rates of approximately 20–30%, as evidenced by post-pandemic LMS studies in Indonesia [5], [9], [11]. Several studies further demonstrate that dashboards specifically designed for teachers and principals effectively facilitate instructional and organizational decision-making [13].

2. Effective Dashboard Design and Visualization

Multimodal dashboards that integrate quantitative data—such as automated assessment scores, digital attendance records, and LMS engagement metrics (e.g., session duration and task completion rates)—with qualitative data, including teacher observations (classroom interaction notes, narrative feedback, and behavioral reports), significantly enhance usability for school decision-makers. Such dashboards provide a holistic perspective through interactive visualizations, including real-time trend graphs, participation heatmaps, and contextual narratives. These features allow principals to rapidly identify performance disparities and design targeted interventions, such as personalized remedial programs or additional teacher allocation. Empirical evidence from post-pandemic K–12 LA prototype studies indicates that these approaches reduce subjective bias in operational and curricular decision-making while improving management efficiency by approximately 25–40% [5], [9], [11]. Simple interfaces, prioritized key performance indicators (KPIs), and drill-down

functionality are consistently recommended as critical dashboard design principles [14].

3. Impact on Managerial Practices

Learning Analytics (LA) facilitates evidence-based practices in schools by enabling real-time data analysis to support targeted teacher professional development (e.g., identifying teachers whose classes exhibit low student engagement for digital literacy workshops), prioritization of at-risk students for remedial support (such as early counseling interventions for students with unstable attendance patterns), and optimization of operational resources (including performance-based class scheduling). However, its effectiveness strongly depends on school leaders' data interpretation capacity, including data literacy to distinguish meaningful signals from noise, the ability to contextualize LA insights within local school conditions, and communication skills to translate findings into actionable strategies without provoking resistance among teaching staff. Consequently, data-driven leadership training emerges as a critical prerequisite for ensuring that LA functions not merely as a reporting tool but as a catalyst for sustained managerial transformation [6].

4. Barriers and Challenges

a. Technical Challenges

Technical challenges in implementing Learning Analytics (LA) in schools include data integration across heterogeneous systems—such as LMS platforms (Schoology, Google Classroom), digital assessment tools, and attendance systems—which are often incompatible and require middleware APIs or ETL processes for real-time synchronization. Additional issues involve poor data quality due to missing values, duplication, and inconsistent formats resulting from post-pandemic blended learning environments, as well as infrastructure limitations such as uneven internet access (slow broadband in rural Indonesian regions), outdated hardware, and reliance on cloud systems without local backups, leading to analytics downtime of up to 30–45% in primary and secondary schools. These constraints significantly hinder LA dashboard scalability, with studies reporting that 35–45% of implementation failures stem from inadequate ICT infrastructure and lack of data standardization across Ministry of Education platforms such as *Rapor Pendidikan*. Potential solutions include the adoption of hybrid edge-computing architectures and strengthened data governance training to mitigate these risks in Indonesian K–12 contexts [15], [16], [17].

b. Ethical and Privacy Challenges

Ethical and privacy challenges in LA implementation encompass the protection of sensitive student data from unauthorized access or data breaches involving personal information (e.g., names, grades, and behavioral patterns derived from LMS logs). Parental consent is often insufficient due to limited dissemination of informed consent procedures regarding the use of children's data for dropout prediction or learning personalization. Furthermore, opaque algorithmic models (black-box systems) hinder principals' ability to verify potential racial, gender, or socioeconomic bias in intervention recommendations, potentially violating Indonesia's Personal Data Protection Law (UU PDP) and GDPR-inspired K–12 standards. These concerns frequently generate stakeholder resistance, with studies indicating that 40–50% of LA adoption failures are attributable to ethical apprehensions. Addressing these challenges requires robust governance frameworks incorporating data minimization, anonymization and pseudonymization techniques, and routine algorithmic audits to build trust. Context-specific solutions in Indonesia include embedding digital ethics into principal training programs and strengthening parent engagement through transparent data portals [5], [9], [12], [18]. Numerous studies emphasize the necessity of comprehensive training and governance policies [6].

5. Best Practices and Recommendations

a. Collaborative Dashboard Design

A collaborative approach to Learning Analytics (LA) dashboard design actively involves teachers, principals, and IT specialists from the outset to ensure optimal usability. Teachers contribute pedagogical insights, such as relevant engagement indicators (e.g., task completion frequency and classroom discussion patterns), principals define managerial priorities (e.g., retention metrics and resource allocation), and IT specialists address technical aspects including multi-LMS API integration and real-time visualization scalability. This process is typically conducted through iterative workshops, rapid prototyping (e.g., wireframing using Figma or Tableau Public), repeated usability testing, and continuous feedback loops. Empirical evidence suggests that such participatory design approaches can reduce adoption resistance by up to 50% by aligning system design with contextual school needs, resulting in holistic dashboards that integrate quantitative performance metrics with qualitative narratives for transformational decision-making.

b. Standardization of Core Indicators

Standardizing minimal indicator sets within LA dashboards—such as engagement (measured through LMS session duration, forum interaction frequency, and task completion rates), learning progress (percentage of curriculum target achievement per module or competency), and attendance (digital attendance patterns with an 80% threshold for risk flagging)—is essential to ensure valid and actionable comparisons across classes, grade levels, and schools. These protocols enable both horizontal benchmarking (e.g., Class A versus Class B within the same school) and vertical benchmarking (e.g., urban versus rural schools) through normalized 0–100 scoring scales with contextual weighting (engagement 40%, progress 40%, attendance 20%). Such standardization allows principals to identify systemic disparities, such as persistently low engagement in specific classes, and implement targeted interventions (e.g., teacher rotation or digital content upgrades) while maintaining cross-platform LMS data reliability and minimizing subjective definitional bias.

c. Data Governance Policies

Effective data governance for Learning Analytics (LA) implementation in schools requires a comprehensive framework defining roles, responsibilities, and standard operating procedures for managing student data from LMS platforms such as Schoology and Ministry of Education systems. This includes establishing a data stewardship team led by the principal to ensure compliance with Indonesia's Personal Data Protection Law through a Plan–Do–Check–Act (PDCA) cycle for regular audits and policy updates. Anonymization procedures should incorporate pseudonymization (replacing student identifiers with unique hashes), k-anonymity (minimum group size k = 5 to prevent re-identification), and differential privacy techniques (e.g., adding Gaussian noise to aggregated scores) to protect individual privacy while preserving analytical utility, such as dropout prediction accuracy. Accountability mechanisms include audited access logs, dynamic parental consent portals with opt-out options, and algorithmic transparency through explainable AI (XAI) methods such as SHAP values to clarify intervention recommendations for stakeholders. Collectively, these practices foster trust and reduce ethical and legal risks in Indonesian K–12 contexts (Choiruddin & Pratama, 2022; Kharis & Zili, 2022;Laksitowening et al., 2025).

Findings of the Systematic Literature Review

The findings of the Systematic Literature Review (SLR) indicate a strong potential of Learning Analytics (LA) to enhance managerial decision-making in schools, provided that adequate infrastructure and data integration are in place. Schools with stable broadband access and effective ETL tools to integrate data from LMS platforms,

attendance systems, and digital assessments are able to generate real-time insights, such as dropout risk predictions with accuracy levels of up to 85%. These insights enable principals to allocate early interventions more efficiently, including targeted counseling and remedial programs [15], [21].

LA dashboards designed to align with managerial needs—featuring concise key performance indicators (KPIs) such as engagement rates, learning progress achievement, and attendance thresholds, along with interactive drill-down features (e.g., clicking on heatmaps to access individual student details)—significantly improve usability for non-technical users such as school principals. As a result, the operational decision-making cycle is shortened from days to hours, while subjective bias in curricular prioritization is reduced [11], [12].

Comprehensive data governance policies, including anonymization techniques (k-anonymity and differential privacy) and accountability mechanisms such as audit logs and parental consent portals, emerge as critical prerequisites for mitigating ethical risks. These measures ensure that LA implementation is not only compliant with Indonesia's Personal Data Protection Law (UU PDP) but also fosters stakeholder trust in K–12 contexts, where student privacy concerns remain a primary barrier to adoption [18], [19]. Furthermore, recent studies published between 2023 and 2025 highlight a shift in LA research from algorithm-centric approaches toward practical implementation concerns—such as K–12 contextualization, human-centered dashboard design, and ethical deployment—thereby increasing the relevance of LA for school-level policymakers pursuing sustainable data-driven transformation (Nasution, 2024; Padilla-escorcia et al., 2025).

Practical Implications for School Principals and Educational Managers

1. Develop Priority-Based Learning Analytics Dashboards

School leaders are advised to develop LA dashboards that present **5–8 core indicators** within a single-screen view to support rapid situational awareness. Recommended indicators include:

(1) engagement rate (percentage of daily LMS interactions, displayed as a 0–100% gauge);
(2) learning progress (curriculum completion per class, stacked bar charts);
(3) attendance trends (weekly attendance patterns with alerts below the 80% threshold, line graphs);
(4) dropout risk (prioritized heatmaps using red–yellow–green coding);
(5) teacher performance (average student outcomes per teacher, bubble charts scaled by class size);
(6) class disparity (performance gaps across classes, donut charts);
(7) resource utilization (efficiency of teacher and classroom allocation, donut or pie charts); and
(8) real-time alerts (urgent intervention notifications via card badges).

These dashboards should employ responsive grid-based layouts (e.g., Power BI or Google Data Studio), intuitive semantic color schemes, large readable fonts (>16 pt), and one-click drill-down functionality to avoid cognitive overload. Such designs enable rapid scanning in under 30 seconds and support immediate decisions (e.g., prioritizing remedial interventions), consistent with human-centered design principles for K–12 analytics dashboards that facilitate instructional orchestration and contextual decision-making [14], [22], [23].

2. Establish Comprehensive Data Governance Policies

Schools should implement robust data governance frameworks for LA by defining role-based access controls (e.g., principals access aggregated dashboards, teachers access their own classes, parents opt in to view their child's progress),

limiting data retention periods (e.g., deleting alumni student data after two years while retaining aggregated trends, storing raw log data for a maximum of one year in compliance with UU PDP), and enforcing strict anonymization measures. These include pseudonymization (irreversible hashing of student IDs), k-anonymity (minimum group size of five students per segment), and differential privacy techniques (adding controlled noise to aggregate metrics to protect individual identities while preserving predictive utility). Governance policies should be reinforced through automated audit trails, dynamic parental consent portals, and sanctions for data misuse to ensure regulatory compliance and strengthen stakeholder trust in Indonesian K–12 settings [17], [18].

3. Strengthen Human Capacity through Data Literacy Programs

Capacity-building programs for principals and curriculum coordinators should be designed as **intensive three-day workshops** on LA data interpretation, comprising pre-tests, foundational theory on dashboard KPIs (e.g., engagement metrics and dropout prediction), hands-on analysis of real LMS data (Schoology or Google Classroom), and post-tests using simulated remedial decision scenarios. These workshops should be followed by **six months of continuous coaching**, delivered through weekly one-hour virtual mentoring sessions to support dashboard implementation at participants' schools. The program should include personalized action plans (e.g., identifying three priority interventions based on student risk heatmaps) and peer review mechanisms. Designed in modular levels (beginner to advanced), the program aims to improve data literacy by 40–60%, measured through pre–post assessments and three-month follow-up surveys, in collaboration with local education authorities for certification and integration with national platforms such as *Rapor Pendidikan* [24].

4. Conduct Small-Scale Pilot Testing Prior to Full Deployment

Before full-scale implementation, LA dashboards should undergo pilot testing in **2–3 representative schools** (e.g., one urban school with strong infrastructure, one rural school with limited connectivity, and one private school with mature LMS usage) over a period of **4–6 weeks**. This phase should involve 10–15 principals or curriculum coordinators as early adopters to evaluate dashboard usability, focusing on priority indicators such as engagement rates and dropout risk. Usage data (e.g., click rates, screen scan time under 30 seconds, drill-down frequency) should be collected alongside structured feedback through Likert-scale surveys and semi-structured interviews addressing pain points such as alert overload or slow data integration. Pilot results should inform iterative refinement (e.g., reducing KPIs from eight to six to mitigate cognitive overload or optimizing mobile responsiveness for field access), with a target **Net Promoter Score (NPS) above 70** prior to national-scale rollout, ensuring contextual adaptation to Indonesian infrastructure variability and diverse levels of data literacy [13], [14], [22].

CONCLUSION AND RECOMMENDATION

The integration of learning analytics into digital learning governance offers tangible opportunities to enhance the quality of managerial decision-making in schools, ranging from early interventions for at-risk students to more effective resource allocation and program evaluation. The success of learning analytics implementation is contingent upon three interrelated factors: managerial-oriented dashboard design, robust data governance frameworks, and the strengthening of data literacy capacities among school principals and staff.

Based on the findings of this review, several practical recommendations are proposed: (1) the

development of simplified key performance indicators (KPIs) with intuitive drill-down functionality to support rapid and informed decision-making; (2) the establishment of comprehensive data privacy and governance policies to ensure ethical, legal, and trustworthy use of student data; (3) the implementation of structured data literacy training programs for school leaders and educators to translate analytics into actionable strategies; and (4) the adoption of iterative pilot testing of learning analytics solutions with active participation from school stakeholders to ensure contextual relevance and sustainable adoption. Collectively, these measures position learning analytics not merely as a technical tool, but as a strategic enabler of evidence-based and resilient school governance in digital learning environments.

Acknowledgment

The authors would like to express their sincere gratitude to **Universitas Bina Bangsa** for the institutional support, facilities, and academic environment provided, which enabled the successful completion of this study.

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