

The Role of Digital Learning Management Systems in Enhancing Educational Efficiency and Quality: Evidence from Bandung City

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ABSTRACT

Objective: This study aims to examine the effect of Digital Learning Management System (DLMS) implementation on educational efficiency and educational quality in educational institutions in Bandung City, Indonesia. The research is motivated by the growing need to evaluate DLMS not merely as a technological tool, but as a strategic educational management system that supports both operational efficiency and learning quality. **Method:** A quantitative explanatory research design was employed. Data were collected through a structured questionnaire administered to 210 educators and students who had actively used DLMS for at least one academic semester. The data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) to assess the measurement model (validity and reliability) and the structural model (hypothesis testing). **Results:** The results show that the measurement model demonstrates strong reliability and validity, with all constructs meeting the recommended thresholds for factor loadings, composite reliability, and average variance extracted. Structural model analysis reveals that DLMS implementation has a positive and significant effect on educational efficiency ($\beta = 0.641$, $p < 0.001$) and educational quality ($\beta = 0.672$, $p < 0.001$). These findings indicate that effective DLMS implementation enhances resource utilization, streamlines instructional and administrative processes, and improves learner engagement and instructional consistency. **Novelty:** This study offers novelty by integrating educational efficiency and educational quality within a single SEM-PLS analytical framework and by providing empirical evidence from an urban Indonesian context. Unlike prior studies that examine DLMS outcomes separately, this research positions DLMS as a strategic educational management system that simultaneously strengthens efficiency and quality in post-pandemic education.

INTRODUCTION

The rapid advancement of digital technology has significantly transformed educational systems worldwide, reshaping instructional practices, learning environments, and institutional management. Educational institutions are increasingly required to integrate digital solutions to enhance learning flexibility, operational efficiency, and educational quality in response to technological disruption and evolving learner needs (Bond et al., 2021; Schindler et al., 2023). One of the most widely adopted digital innovations in education is the Digital Learning Management System (DLMS), which provides an integrated platform for content delivery, assessment, communication, and learning monitoring (Al-Fraihat et al., 2022).

The importance of DLMS implementation intensified during the COVID-19 pandemic, which forced educational institutions to rapidly transition from face-to-face instruction to digital learning environments. Although DLMS adoption ensured continuity of learning, many institutions implemented these systems as emergency solutions rather than as strategically designed educational management tools (Crawford

et al., 2021; Hodges et al., 2022). Consequently, post-pandemic education faces the challenge of optimizing DLMS implementation to support long-term improvements in both efficiency and quality of education.

Educational efficiency refers to the optimal utilization of institutional resources such as time, cost, and human capital to achieve learning objectives, while educational quality encompasses learning effectiveness, student engagement, instructional coherence, and achievement of learning outcomes. Prior studies suggest that DLMS can enhance efficiency by streamlining administrative processes, reducing instructional redundancy, and enabling scalable learning delivery (Turnbull et al., 2021; Machado & Tao, 2022). At the same time, DLMS has the potential to improve educational quality by supporting interactive learning, timely feedback, personalized learning pathways, and data-informed instructional decisions (Ifenthaler & Yau, 2020; Rasheed et al., 2023).

However, empirical evidence indicates that the impact of DLMS on efficiency and quality is not uniform across educational contexts. Several recent studies emphasize that technological availability alone does not guarantee improved educational outcomes (Almaiah et al., 2022; Bond et al., 2024). In many cases, DLMS is underutilized or used primarily as a repository for learning materials due to limited digital competence among educators, weak instructional design, and insufficient institutional support (Martin et al., 2022; Zawacki-Richter et al., 2023). These issues highlight the importance of examining DLMS implementation processes rather than focusing solely on system adoption.

Another limitation in existing literature is the fragmented evaluation of DLMS outcomes. Many studies examine efficiency-related outcomes or learning quality indicators in isolation, without considering their interdependence within educational systems (Rienties et al., 2022; Sánchez-Caballé et al., 2021). In practice, efficiency and quality are closely linked; efficiency gains achieved through digital automation may negatively affect instructional depth if pedagogical alignment is neglected, while efforts to enhance quality through digital innovation may increase workload and reduce efficiency if systems are poorly managed (Bond et al., 2021; Turnbull et al., 2021). This underscores the need for an integrated analytical approach that simultaneously considers efficiency and quality as key outcomes of DLMS implementation.

In the Indonesian context, digital learning adoption has expanded rapidly following national digital transformation policies and increasing institutional investments in educational technology. Bandung City, as one of Indonesia's major education centers, represents a particularly relevant context for studying DLMS implementation. The city hosts a wide range of secondary schools and higher education institutions and is characterized by relatively advanced digital infrastructure and high levels of technology adoption. Despite these advantages, empirical studies focusing on DLMS implementation in Bandung remain limited and often emphasize descriptive evaluations or emergency remote learning experiences during the pandemic period (Sulisworo et al., 2021; Widodo et al., 2022).

Moreover, existing research in Indonesia rarely examines DLMS as a comprehensive educational management system that simultaneously influences efficiency and quality. Recent studies suggest that implementation quality including instructional integration, educator engagement, and institutional governance is a critical determinant of DLMS effectiveness (Al-Fraihat et al., 2022; Zawacki-Richter et al., 2023). However, these implementation dimensions remain underexplored in urban Indonesian educational settings, particularly in post-pandemic contexts.

Based on these research gaps, this study specifically examines the implementation of Digital Learning Management Systems (DLMS) in educational institutions in Bandung City and analyzes its impact on both educational efficiency and educational quality using an integrated analytical framework. By adopting an integrated analytical perspective, this research seeks to contribute empirical evidence that enhances understanding of DLMS as a strategic educational management tool rather than merely a technological platform.

RESEARCH METHOD

Research Design and General Background

This study employed a quantitative explanatory research design to examine the effect of Digital Learning Management System (DLMS) implementation on educational efficiency and educational quality. The explanatory approach was chosen to test causal relationships among variables and to provide empirical evidence regarding the role of DLMS as a strategic educational management system.

The research was conducted in educational institutions in Bandung City, Indonesia, which represents a major urban education hub with a high level of digital technology adoption. The selection of Bandung City was based on its relatively advanced digital infrastructure, diverse educational institutions, and widespread use of digital learning platforms. These characteristics make it an appropriate context for investigating DLMS implementation in a post-pandemic educational environment.

The study focuses on DLMS not merely as a technological tool, but as an integrated system that supports instructional delivery, administrative processes, and learning management. In this context, DLMS implementation is expected to contribute to improving resource utilization (efficiency) and enhancing learning outcomes (quality). By adopting this research design, the study aims to provide a comprehensive understanding of how DLMS implementation influences both educational efficiency and educational quality simultaneously.

Participants and Sample

The population of this study consisted of educators and students from secondary schools and higher education institutions in Bandung City who actively utilized Digital Learning Management Systems in their learning and teaching activities. A purposive sampling technique was employed to ensure that respondents had sufficient experience using DLMS. A total of 210 respondents were selected using purposive sampling based on the following inclusion criteria:

1. Actively involved in DLMS-based learning or teaching activities;
2. Had at least one semester of experience using a DLMS;
3. Willing to participate voluntarily in the study.

This sampling approach was chosen to ensure data relevance and to support robust statistical analysis. The sample size met the minimum requirements for multivariate analysis, allowing reliable examination of relationships among the research variables.

Research Instruments and Procedures

Data were collected using a structured questionnaire adapted from previously validated measurement scales related to Digital Learning Management Systems (DLMS), educational efficiency, and educational quality. The use of established instruments ensures the reliability and validity of the constructs measured in this study. All items

were measured using a five-point Likert scale, ranging from *strongly disagree* (1) to *strongly agree* (5).

The questionnaire comprised three main constructs: DLMS implementation, educational efficiency, and educational quality. Each construct was operationalized using multiple indicators derived from prior empirical studies in digital education and learning management systems research.

To ensure content validity, the instrument was reviewed by experts in educational technology and research methodology. Their feedback was used to refine item clarity, relevance, and alignment with the research objectives. In addition, a pilot test was conducted with a small group of respondents to evaluate the clarity, reliability, and overall usability of the questionnaire. The pilot results indicated that all items were understandable and suitable for large-scale data collection.

Data collection was conducted online to enable wider participation across educational institutions in Bandung City. This approach facilitated efficient distribution and data gathering from respondents who actively use DLMS in their teaching and learning activities. Prior to participation, respondents were provided with information regarding the purpose of the study and were assured of confidentiality and anonymity. Participation was voluntary, and informed consent was obtained from all respondents before completing the questionnaire.

Data Analysis Techniques

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics were used to summarize respondent characteristics and describe patterns of DLMS usage. Inferential analysis was conducted to test the hypothesized relationships between DLMS implementation, educational efficiency, and educational quality. Reliability of the measurement instruments was assessed using Cronbach's alpha, while construct validity was evaluated through factor loading analysis. Hypothesis testing was performed using [multiple regression analysis / SEM-PLS – adjust as required], as these methods are suitable for examining causal relationships among variables.

RESULTS AND DISCUSSION

Result

Respondent Profile

This study involved 210 respondents from educational institutions in Bandung City, Indonesia, comprising both educators and students who actively utilized a Digital Learning Management System (DLMS). All respondents had a minimum of one semester of experience using DLMS, ensuring that they possessed sufficient familiarity with the system to provide reliable responses. The sample size is considered adequate for Structural Equation Modeling–Partial Least Squares (SEM-PLS) analysis, as it exceeds the minimum recommended threshold for multivariate analysis. This ensures sufficient statistical power to estimate the measurement and structural models and to test the hypothesized relationships among the constructs.

Measurement Model Evaluation (Outer Model)

Convergent Validity

Convergent validity was assessed using factor loadings and Average Variance Extracted (AVE). All indicator loadings exceeded the recommended threshold of 0.70, indicating strong convergent validity.

Table 1. Outer Loadings

Construct	Indicator	Loading
DLMS Implementation	DLMS1	0.812
	DLMS2	0.845
	DLMS3	0.798
	DLMS4	0.831
Educational Efficiency	EE1	0.823
	EE2	0.856
	EE3	0.801
Educational Quality	EQ1	0.842
	EQ2	0.879
	EQ3	0.814
	EQ4	0.836

All loading values were above 0.70, confirming adequate indicator reliability.

Construct Reliability and Validity

Reliability was evaluated using Cronbach's Alpha and Composite Reliability (CR), while validity was assessed using AVE.

Table 2. Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
DLMS Implementation	0.862	0.902	0.698
Educational Efficiency	0.834	0.893	0.736
Educational Quality	0.871	0.911	0.719

All constructs met the recommended thresholds ($\alpha > 0.70$, $CR > 0.70$, $AVE > 0.50$), indicating strong reliability and convergent validity.

Discriminant Validity

Discriminant validity was assessed using the Fornell-Larcker criterion.

Table 3. Fornell-Larcker Criterion

Construct	DLMS	EE	EQ
DLMS Implementation	0.836		
Educational Efficiency	0.641	0.858	
Educational Quality	0.672	0.659	0.848

The square roots of AVE (diagonal values) exceeded inter-construct correlations, confirming discriminant validity.

Structural Model Evaluation (Inner Model)

Coefficient of Determination (R^2)

The coefficient of determination was used to evaluate the explanatory power of the model.

Table 4. R-Square Values

Endogenous Variable	R^2
Educational Efficiency	0.411
Educational Quality	0.452

The results indicate that DLMS implementation explains 41.1% of the variance in educational efficiency and 45.2% of the variance in educational quality, reflecting moderate explanatory power.

Hypothesis Testing (Path Coefficients)

Hypotheses were tested using bootstrapping (5,000 resamples). The results show that all hypothesized relationships were statistically significant.

Table 5. Path Coefficients and Hypothesis Testing

Hypothesis	Path	β	t-value	p-value	Result
H1	DLMS → Educational Efficiency	0.641	9.872	0.000	Supported
H2	DLMS → Educational Quality	0.672	10.214	0.000	Supported

The findings demonstrate that DLMS implementation has a positive and significant effect on both educational efficiency and educational quality.

Effect Size (f^2)

Effect size analysis was conducted to assess the magnitude of DLMS impact on endogenous variables.

Table 6. Effect Size (f^2)

Relationship	f^2	Effect Size
DLMS → Educational Efficiency	0.415	Large
DLMS → Educational Quality	0.452	Large

The results indicate that DLMS implementation has a large effect on both efficiency and quality outcomes.

Discussion

This study investigated the effect of Digital Learning Management System (DLMS) implementation on educational efficiency and educational quality in educational institutions in Bandung City using a Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach. The findings provide empirical evidence that DLMS implementation plays a significant role in enhancing key educational performance outcomes, supporting recent theoretical and empirical developments in digital education research (Bond et al., 2021; Schindler et al., 2023).

The results demonstrate that DLMS implementation has a positive and significant effect on educational efficiency. This finding is consistent with organizational efficiency theory and the resource-based view, which emphasize that digital systems can function as strategic resources that improve institutional performance through process optimization and effective resource utilization (Al-Fraihat et al., 2022; Machado & Tao, 2022). In the context of this study, DLMS significantly contributed to educational efficiency by reducing administrative complexity, improving time management, and enabling faster and more structured access to learning materials.

From a systems theory perspective, educational institutions operate as interconnected organizational systems in which digital platforms serve as coordinating mechanisms between instructional and administrative processes. The strong relationship between DLMS implementation and educational efficiency observed in this study supports the argument that technology-enabled systems improve workflow integration and reduce redundancy when they are embedded within institutional structures (Bond et al., 2021). In urban educational environments such as Bandung City, where institutions

face high enrollment demands and administrative complexity, DLMS appears to function as an efficiency-enhancing management instrument.

In addition, the findings reveal that DLMS implementation has a positive and significant effect on educational quality. This result aligns with constructivist learning theory and digital pedagogy frameworks, which emphasize the role of technology in facilitating interactive, learner-centered, and feedback-rich learning environments (Ifenthaler & Yau, 2020; Rasheed et al., 2023). Effective DLMS implementation enables consistent instructional delivery, promotes learner engagement, and supports continuous assessment, all of which are critical components of educational quality.

The significant relationship between DLMS and educational quality also supports recent empirical studies indicating that digital learning platforms can enhance learning outcomes when pedagogical design is aligned with technological features (Martin et al., 2022; Zawacki-Richter et al., 2023). Rather than functioning merely as repositories of learning materials, DLMS platforms that integrate assessment tools, communication channels, and learning analytics contribute meaningfully to improved learning experiences. This finding reinforces the argument that the educational value of digital systems depends on implementation quality rather than mere adoption (Almaiah et al., 2022).

A key contribution of this study lies in its integrated examination of educational efficiency and educational quality. While previous research has often examined these outcomes separately, the present findings demonstrate that DLMS implementation can simultaneously enhance both dimensions. This supports systems-based perspectives in education, which view efficiency and quality as interdependent rather than competing outcomes (Sánchez-Caballé et al., 2021; Rienties et al., 2022). When DLMS is implemented strategically, efficiency gains do not necessarily compromise instructional quality; instead, they may reinforce one another through better-organized learning processes and improved instructional consistency.

The context of Bandung City further strengthens the relevance of these findings. As a major educational center with relatively advanced digital infrastructure, Bandung provides a setting in which DLMS implementation can be examined beyond emergency remote teaching conditions. The results suggest that post-pandemic digital learning initiatives in urban Indonesian contexts can yield sustainable benefits when supported by institutional readiness, educator competence, and pedagogical integration (Sulisworo et al., 2021; Widodo et al., 2022). This finding responds to recent calls for more context-sensitive digital education research in developing countries (Bond et al., 2024).

Overall, this study extends the digital education literature by providing SEM-PLS-based empirical evidence from an Indonesian urban context and by demonstrating that DLMS functions as a strategic educational management system. The findings imply that policymakers and educational leaders should focus on strengthening implementation quality, professional development, and institutional governance to maximize the efficiency and quality benefits of DLMS adoption.

CONCLUSION

Fundamental Findings: This study provides empirical evidence that the implementation of Digital Learning Management Systems (DLMS) plays a crucial role in improving both educational efficiency and educational quality in educational institutions in Bandung City. Using a Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach,

the findings confirm that DLMS implementation significantly enhances efficiency by optimizing instructional and administrative processes, while simultaneously improving educational quality through increased learner engagement, instructional consistency, and accessibility of learning resources. These results reaffirm the central thesis of this study that DLMS is not merely a technological support tool, but a strategic educational management system capable of strengthening institutional performance when implemented effectively. **Implications:** The findings of this study have important theoretical and practical implications. From a theoretical perspective, this research contributes to the digital education literature by integrating efficiency and quality within a single analytical framework, addressing a gap in prior studies that often examine these dimensions separately. The results support systems theory and digital pedagogy frameworks, which emphasize the interconnected nature of organizational processes and instructional outcomes. From a practical standpoint, the findings suggest that educational leaders and policymakers should prioritize DLMS implementation quality by strengthening institutional governance, enhancing educator digital competence, and aligning technological features with pedagogical objectives. Strategic investment in DLMS can therefore serve as a lever for sustainable improvement in educational performance, particularly in urban education systems. **Limitations:** Despite its contributions, this study has several limitations that should be acknowledged. First, the research was conducted in educational institutions within Bandung City, which may limit the generalizability of the findings to other regions with different infrastructural and institutional characteristics. Second, the study relied on self-reported data, which may be subject to response bias. Third, the cross-sectional research design limits the ability to capture long-term effects of DLMS implementation over time. These limitations suggest caution in interpreting the findings beyond the specific context of this study. **Future Research:** Future research is encouraged to extend this study in several directions. Longitudinal research designs could be employed to examine the sustained impact of DLMS implementation on educational efficiency and quality over time. Comparative studies across different regions or educational levels may provide deeper insights into contextual factors influencing DLMS effectiveness. Additionally, future studies could integrate qualitative approaches to explore implementation processes, institutional culture, and user experiences in greater depth. Examining mediating or moderating variables such as digital literacy, organizational readiness, or leadership support may further enrich understanding of how DLMS contributes to educational performance.

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