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TOWARDS SMART EDUCATION GOVERNANCE: A SYSTEMATIC LITERATURE REVIEW ON THE INTEGRATION OF ENTERPRISE APPLICATIONS, DIGITAL LEARNING SYSTEMS, KNOWLEDGE MANAGEMENT, AND BUSINESS INTELLIGENCE

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Abstract

Digital transformation demands more efficient, transparent, and accountable education governance. However, studies on the four main pillars of Management Information Systems (MIS): enterprise applications, digital learning systems, knowledge management, and business intelligence, are generally conducted separately, resulting in the lack of a conceptual framework that integrates them. This study aims to formulate an integrative conceptual framework that explains the interrelationships of these four pillars in supporting education governance in the digital era. The study employed a qualitative approach with the PRISMA-based Systematic Literature Review (SLR) method. Literature searches were conducted through Google Scholar using Harzing's Publish or Perish applications with predetermined inclusion criteria, resulting in six articles meeting the requirements for thematic analysis. The synthesis results indicate that enterprise applications provide an integrated data foundation, digital learning systems support technology-based learning processes, knowledge management maintains the sustainability of institutional knowledge, and business intelligence transforms data into a basis for strategic decision-making. These four pillars form a complementary information value chain, with successful implementation determined by the alignment of institutional strategy, human resource digital competence, and leadership commitment. The resulting conceptual framework is expected to serve as a reference for the development of empirical research and the formulation of digital education governance policies.

Keywords: business intelligence; educational governance; digital learning systems; knowledge management; management information systems

INTRODUCTION

Digital transformation has become a mainstream phenomenon transforming nearly every aspect of organizational life, including the education sector. The rapid development of information and communication technology is driving educational institutions, at both primary, secondary, and tertiary levels, to transform their management practices from manual systems to digitally integrated systems (Judijanto et al., 2025). The Covid-19 pandemic significantly accelerated this process, forcing educational institutions to shift from conventional face-to-face models to more technology-based learning and administration environments, while creating new opportunities and challenges in digital-based education management (Bahrodin et al., 2026).

Educational governance is required to prioritize the principles of efficiency, transparency, and accountability in every decision-making process. Management Information Systems (MIS)

serve as strategic instruments that enable educational institutions to systematically manage data, information, and knowledge to support more accurate and timely planning, implementation, and evaluation of educational programs (Sahrul et al., 2026). Government policies, such as technology-based teacher and principal performance management regulations, also emphasize the urgency of digitizing educational governance as a national strategic agenda to improve the quality and equitable access to learning services (Disdikbud Kubar, 2025).

The implementation of MIS in educational governance in the digital era cannot be separated from four main, interrelated pillars. First, enterprise applications, which include integrated systems such as Enterprise Resource Planning (ERP), are used to manage the administrative and operational processes of educational institutions comprehensively, including student data, human resources, finance, and infrastructure in one integrated system (Rahman & Prabowo, 2025). Second, digital learning systems, which transform the way we learn through online learning platforms such as Learning Management Systems (LMS) and various other technology-based interactive media (Haikal et al., 2025). Third, knowledge management, which functions to manage institutional knowledge assets (both explicit and tacit) so that they can be documented, shared, and utilized sustainably to improve the performance of educational organizations (Khoiriyah & Triwiyanto, 2025). Fourth, business intelligence, which utilizes large amounts of data to generate strategic information that supports evidence-based managerial decision-making (Dewi et al., 2024).

Although these four components conceptually complement each other in building an adaptive education governance ecosystem, their implementation in the field still faces various obstacles: low digital competency among educators and education personnel, limited technological infrastructure, and suboptimal system utilization. At the higher education level, studies on ERP implementation show that the majority of projects face a fairly high failure rate due to organizational resistance, business process complexity, and a lack of human resource readiness in adopting new systems (Wijayanto, 2020). This confirms that the success of digitalizing education governance depends not only on technological aspects, but also on managerial aspects, organizational culture, and the readiness of all stakeholders.

Previous studies have examined the role of information systems in educational management, although they generally only address one component of MIS at a time. Regarding enterprise applications, Subbarao et al. (2026) found that ERP implementations in higher education institutions face a project failure rate of 60–80% due to the complexity of business process reengineering and organizational resistance within the academic environment (Subbarao et al., 2026). Regarding digital learning systems, Wiragunawan (2022) found that Learning Management Systems (LMS) provide easy and flexible access to information and learning materials for students (Wiragunawan, 2022). Regarding knowledge management, Rukmana & Widhianto (2023) emphasized that implementation in higher education requires a shift in organizational mindset, particularly regarding the role of lecturers as key actors in knowledge management (Rukmana & Widhianto, 2023). Regarding business intelligence, Primadewi, Yudatama, and Nugroho (2017) measured the level of BI maturity in higher education using the TDWI framework and found that the institutions studied still needed strengthening in data management and IT-based performance measurement (Primadewi et al., 2017).

In summary, each component of MIS (enterprise applications, digital learning systems, knowledge management, and business intelligence) has been extensively studied in its own context using a variety of methodological approaches, ranging from literature reviews and qualitative case studies to framework-based maturity measurements. However, research explicitly linking these four components into a single conceptual framework for digital education governance remains limited.

Based on these previous studies, three research gaps can be identified. Conceptually, studies on enterprise applications, digital learning systems, knowledge management, and business intelligence are generally conducted separately; few have integrated all four into a comprehensive governance framework. Methodologically, most previous research consists of single case studies, literature reviews, or maturity measurements at a single institution or a

single MIS component; systematic studies that integrate all components are still limited. Contextually, research that specifically examines the interrelationships of these four components as a whole in supporting education governance in the digital era (particularly in Indonesia) is still rare.

This research offers a novelty in the form of an integrative conceptual framework that connects the four components of MIS as an interrelated whole in supporting educational governance in the digital era. Based on this gap, this research aims to formulate the intended integrative framework (explaining the role and relationship between enterprise applications, digital learning systems, knowledge management, and business intelligence) so that it can serve as a basis for developing an effective, efficient, and service-oriented educational MIS. In addition to its conceptual contribution, the resulting framework is also intended to provide input for educational authorities in designing digital governance policies at the institutional and system levels, bridging the gap between theory, practice, and policy, so that stakeholders can implement synergistic information technology solutions to strengthen decision-making, improve the quality of learning, and optimize managerial and administrative processes in the provision of educational services.

THEORETICAL REVIEW

a. Management Information System

Management Information Systems (MIS) are defined by Laudon and Laudon (2020) as a combination of people, technology, and business processes designed to collect, process, store, and distribute information to support organizational decision-making, coordination, and control (Laudon & Laudon, 2020). In the educational context, this theory serves as a foundation for understanding how educational institutions manage academic data, administrative data, and institutional knowledge in an integrated manner. O'Brien and Marakas (2011) added that the success of a MIS is not solely determined by technological sophistication, but also by the alignment of information systems with organizational strategy and governance, an important foundation for viewing MIS as an instrument of educational governance in the digital era, rather than simply an administrative tool (O'Brien & Marakas, 2011).

b. Enterprise Applications

The concept of enterprise applications is largely based on Davenport's (1998) idea of enterprise systems, which are integrated software that unites various organizational functions (from finance, human resources, to academic services) into a single database, thereby creating information consistency across all work units (Davenport & Prusak, 2000). Davenport emphasized that implementing enterprise systems requires a restructuring of the organization's business processes, not simply the installation of technology. O'Brien and Marakas (2011) classify enterprise applications into several main categories, such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Knowledge Management System (KMS), which in the educational context can be adapted into integrated academic, personnel, and financial information systems to support efficient institutional governance (O'Brien & Marakas, 2011).

c. Digital Learning System

Horton (2011) defines e-learning as the use of information technology and networks to provide flexible and interactive learning experiences, without being bound by space and time, and emphasizes the importance of mature instructional design so that technology truly supports the achievement of learning objectives, not just as a delivery medium (Horton, 2011). Rosenberg (2001) complements this view by emphasizing that e-learning is a comprehensive strategy for conveying knowledge effectively through digital networks (including content management, student interaction, and learning evaluation) which in modern education is realized through a Learning Management System (LMS) as the backbone of a digital learning system (Rosenberg, 2001).

d. Knowledge Management

The most widely referenced knowledge management theory is the SECI (Socialization, Externalization, Combination, Internalization) model developed by Nonaka and Takeuchi

(1995), as discussed in Reichwald & Wigand (2008), which explains how tacit and explicit knowledge are converted through the processes of socialization, externalization, combination, and internalization in learning organizations. This model is relevant for understanding how the knowledge of lecturers, educational staff, and research results can be managed and disseminated within educational institutions (Reichwald & Wigand, 2008). Davenport and Prusak (2000) strengthen this framework by defining knowledge management as the process of effectively capturing, distributing, and utilizing knowledge to improve organizational performance, which is reflected in the management of research repositories, documentation of good learning practices, and a culture of knowledge sharing among academics (Davenport & Prusak, 2000).

e. Business Intelligence

Turban, Sharda, and Delen (2023) describe business intelligence (BI) as a combination of processes, technologies, and applications designed to collect, store, access, and analyze data to help users make better, evidence-based decisions (Turban et al., 2023). Negash (2004) asserts that BI combines data collection processes with knowledge management and analytical tools to present complex, competitively valuable information to decision-makers (Negash, 2004). In educational governance, this theory serves as a foundation for understanding how academic data, lecturer performance, and institutional achievements can be processed into dashboards or analytical reports that support strategic planning and more objective and measurable evaluations of educational quality.

METHODS

This research uses a qualitative method with a Systematic Literature Review (SLR) approach. A literature review is a data collection technique that involves identifying, evaluating, and synthesizing previous research relevant to a topic, resulting in a more comprehensive and balanced understanding. The purpose of the SLR is to review and update previous findings in line with the focus of this research, while simultaneously strengthening the theoretical foundation and deepening understanding of the topic under study.

A literature search was conducted on June 26, 2026, through Google Scholar using Harzing's Publish or Perish application. This application was chosen because it aggregates and standardizes citation metadata extracted from Google Scholar's extensive and multidisciplinary index, allowing for consistent and exportable recording of search results from a variety of national and international sources, partially compensating for the limitations of using a single search engine. Article selection was based on the eligibility criteria summarized in Table 1.

Table 1. Data Inclusion Criteria

Criteria	Inclusion
Year	Articles published between 2020-2026
Language	Indonesian or English
Topics	Management Information Systems in Educational Governance in the Digital Era
Keywords	Enterprise Application, Digital Learning System, Knowledge Management, and Business Intelligence in Education Transformation
Journal Types	Research articles and literature review articles relevant to the topic
Text Availability	<i>Full Text/Open Access</i>
Search Source	<i>Google Scholar using Harzing's Publish or Perish application</i>

This study applied the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol. The search used the keywords "Enterprise Application, Digital Learning System, Knowledge Management, and Business Intelligence in Educational Transformation" through Google Scholar using Harzing's Publish or Perish, with a maximum of 100 articles retrieved to maintain control over the selection process. Of the 100 identified records, 20 were removed by automation before screening, leaving 80 records to be screened; 12 of these were excluded at this stage, leaving 68 reports for full-text search. Of these, 32 could not be retrieved for full-text, leaving 36 reports for eligibility assessment. During the eligibility assessment stage, 17 articles were excluded for being off-topic, 6 for limited access,

and 7 for being outside the 2020–2026 timeframe, resulting in 6 articles included in the final synthesis. The complete article selection process is presented in Figure 1.

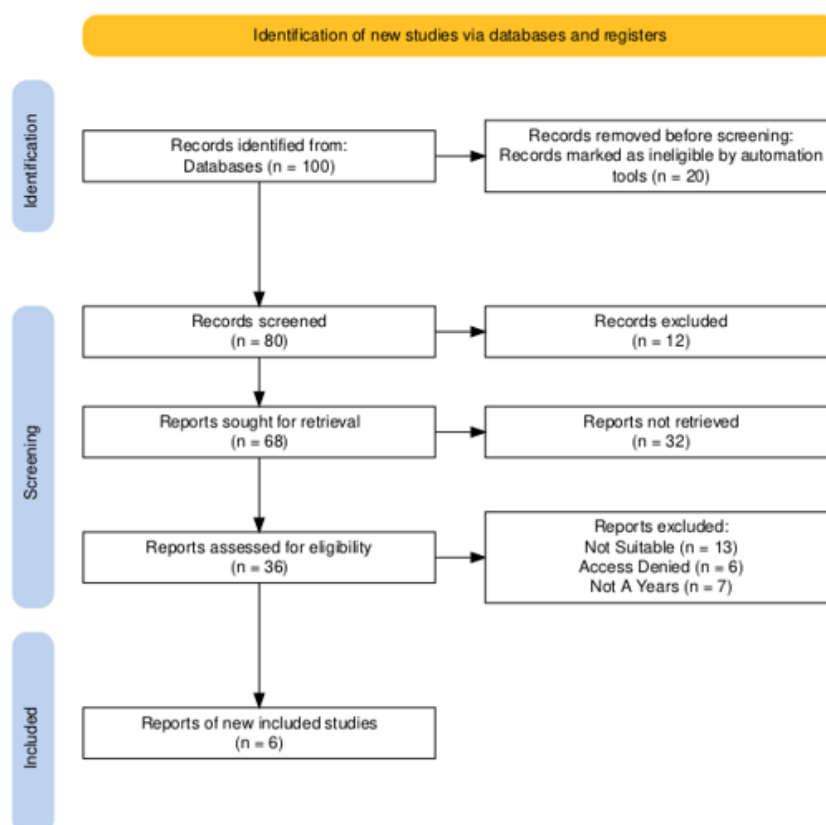


Figure 1. PRISMA Flow Diagram

The six included articles were then analyzed using a thematic synthesis procedure. First, bibliographic data and key findings for each article were extracted into a review matrix (author, year, title, journal, and key results). Second, each finding was coded and classified into one of the four MIS pillars (enterprise applications, digital learning systems, knowledge management, or business intelligence) based on its primary focus. Third, the coded findings within each pillar were compared and synthesized to identify recurring patterns, overlaps, and gaps between pillars. Fourth, the four pillar-level syntheses were cross-analyzed to develop an integrative conceptual framework, which is presented in the Results and Discussion section. This coding and synthesis process was iterative, with categories revisited and refined as each article was reviewed, to ensure the resulting framework was grounded in the extracted evidence rather than a priori assumptions.

The validity of the data in this study was maintained through source triangulation techniques (comparing findings from six articles, including institutional case studies, literature reviews, and framework-based maturity assessments) and through credibility checks by limiting inclusion to peer-reviewed journal articles with full text availability. As a systematic review with a single database of six articles, the findings of this study are conceptual in nature, not statistical generalizations; this limitation is explicitly stated and discussed further in the Conclusions section

RESULTS AND DISCUSSION

The data analyzed in this study comes from six previous studies that discuss Management Information Systems in Educational Governance in the Digital Era, with a focus on Enterprise Applications, Digital Learning Systems, Knowledge Management, and Business Intelligence.

Table 2. Literature Review Results

Name, Year of Publication, Research Title	Journal	Research result
Ilham Agustian Widia Yusuf and Zaini Hafidh. (2024). Analysis of the Use of Management Information Systems in the Curriculum Field at SMA PGII 1 Bandung.	Journal of Educational Governance (JTKP).	The research results show that the Management Information System facilitates the integration of school curriculum management, but its success depends on the maturity of the system design concept from the planning stage.
Angeline, Friska Loren, Jacky Angelo, and Sully Tania. (2024). Application of Enterprise Architecture for Educational Information System Integration: A Literature Study.	JDMIS: Journal of Data Mining and Information.	The research results show that implementing Enterprise Applications with the right framework can improve information system integration, data accuracy, operational efficiency, and resource optimization in educational institutions.
I Gusti Ngurah Wiragunawan. (2022). Utilization of Learning Management System (LMS) in Managing Online Learning in Educational Units.	EDUTECH: Journal of Technology-Assisted Educational Innovation.	The research results show that the Digital Learning System provides easy access to information and learning materials flexibly and supports effective management of online learning.
Silvia Ningsih, Muhamad Suhardi, Indah Nurmala Sari, Dita Sri Wulan, M. Fadillah, and Nadia Amalia. (2025). Implementation of Learning Management System (LMS) in Higher Education Environment.	EDUTECH: Journal of Technology-Assisted Educational Innovation.	Research shows that the Digital Learning System is now more than just an online learning management tool, but a comprehensive digital learning system that supports personalization, collaboration, and learning evaluation. However, its utilization is still hampered by the low digital literacy of lecturers.
Ramadhan Rakhmat Sani, Titien Suhartini Sukanto, and Richard Emmerig. (2023). Knowledge Management System Design in Study Programs as a Media for Sharing Knowledge.	JUSTIN (Journal of Information Systems and Technology).	Research shows that limited facilities and regulations can hinder the speed of knowledge sharing. To address this, Knowledge Management was developed and designed to simplify the access, storage, and distribution of information, thereby accelerating knowledge exchange. With faster and more structured access to knowledge, it is hoped that the academic abilities of lecturers and students will improve through more efficient learning based on accessible resources.
Dea Putra and Hade Afriansyah. (2026). Utilization of Dashboards and Business Intelligence in Educational Data Management.	Journal of Educational Technology and Learning (JTPP).	The research results show that Business Intelligence contributes to increasing the effectiveness of data management, strengthening the evaluation process, and supporting data-based decision-making in educational institutions.

a. Enterprise Applications in Educational Governance

Enterprise applications are essentially more than just a collection of administrative software, but rather an information architecture that unifies data fragments scattered across various institutional work units (academic, personnel, finance, and infrastructure) into a single, interconnected database. When academic data, payment history, and facility usage are stored separately across multiple systems, each unit essentially operates with an incomplete picture,

resulting in decisions made at one point in the organization potentially being out of sync with real conditions at other points. The success of enterprise systems in fulfilling this strategic role is largely determined by top management commitment, user involvement, and project management readiness (Fadellelmoula, 2018).

One of the most prominent factors is business process reengineering, the need for institutions to adapt their own business processes to the working logic of the adopted enterprise system. This need highlights a paradox that is rarely recognized at the outset of implementation: enterprise systems are designed with business process logic that tends to be generic so that it can be adopted across organizational types, while educational institutions have unique work process characteristics, such as academic cycles that are not always linear or decision-making hierarchies that involve academic and structural authority. Institutions that ignore the need for business process reengineering tend to treat enterprise applications as purely technical projects, when in fact, their success is much more determined by the organization's willingness to review old work procedures that may have become ingrained in the organizational culture.

b. Digital Learning System in Learning Transformation

The advent of digital learning systems has significantly shifted the classic trade-off between access, quality, and cost in educational management, which has often been perceived as mutually exclusive. Learning Management Systems and various technology-based interactive media enable educational institutions to reach more students with greater flexibility in space and time, without having to proportionally multiply physical resources. However, the field of learning analytics in higher education remains essentially experiencing an "analytics glut but learning glut," with abundant technical capacity to collect and analyze learning data but limited concrete evidence that this actually improves the quality of student learning (Valenzuela et al., 2021).

This situation deepens the understanding that digital learning system governance cannot stop at system procurement decisions but must be followed by more substantive policies. The tendency to simplify the complexity of the teaching and learning process into mere indicators of digital engagement, without truly linking it to the pedagogical objectives formulated at the learning design stage, is a fundamental issue that requires serious attention. In other words, digital learning systems require educational institutions to manage two layers simultaneously: a technical technology layer and a substantive pedagogical layer. The failure to integrate the two is a key reason why investments in learning technology often do not directly correlate with improved learning outcomes.

c. Knowledge Management in Educational Institution Knowledge Management

Educational institutions are inherently knowledge-intensive organizations, where pedagogical knowledge, classroom management expertise, administrative wisdom, and even faculty research findings are largely stored in tacit form, knowledge embedded in individual experiences and difficult to fully document. Several tangible barriers often hinder the transfer of this tacit knowledge, including siloed work cultures, convoluted administrative bureaucracy, excessive workloads, and minimal recognition for individuals willing to share knowledge (Mpungose et al., 2026). This combination of barriers creates what is known as knowledge stickiness, a condition where critical knowledge tends to be embedded in individuals and is difficult to flow throughout the organization.

The most obvious implication of this knowledge stickiness is the risk of permanent loss of institutional knowledge whenever a senior educator or mentor retires or moves to another institution without adequate documentation. Knowledge-oriented leadership, an open organizational culture, and an adequate reward system consistently help mitigate this risk. This confirms that the success of knowledge management in educational institutions lies not in the sophistication of digital repositories, but rather in the extent to which a culture of knowledge sharing (through leadership, rewards, and collaboration across generations of staff) is truly embedded in daily institutional practices.

d. Business Intelligence in Data-Driven Decision Making

Business intelligence occupies the top position in an institution's information processing hierarchy, transforming raw data generated by enterprise applications and digital learning

systems into strategic information ready for decision-making. Higher education institutions need to utilize data analytics tools (ranging from educational data mining and learning analytics to business intelligence) to more accurately monitor student achievement, evaluate the performance of academic staff, and support other strategic decisions (Gaftandzhieva et al., 2023).

A critical point that requires careful attention is that, although data-driven decision support tools have proven to provide numerous benefits, their utilization in higher education institutions remains very limited. This gap between the technical potential of business intelligence and its actual use in the field confirms that dashboards or analytical reports that are never referenced in quality evaluation meetings, or performance indicators that are updated without ever triggering policy follow-up, are essentially forms of business intelligence that fail to fulfill their strategic function. Furthermore, because BI works with data that includes academic information, educator performance, and individual student achievements, educational governance in the digital era also demands the establishment of adequate data privacy and security policies, so that the use of data for strategic purposes does not conflict with the privacy rights of the individuals whose data is processed.

e. Implications of Enterprise Applications, Digital Learning Systems, Knowledge Management, and Business Intelligence for Educational Governance in the Digital Era

When these four pillars are viewed as a whole, a mutually reinforcing information value chain emerges. Enterprise applications generate clean, integrated administrative data, provided the institution is willing to reengineer its own business processes. Digital learning systems create a trail of learning processes and outcomes that is only meaningful when linked to a clear pedagogical framework. Knowledge management ensures that the knowledge inherent in these processes is not lost when personnel changes occur. Business intelligence processes all this data and knowledge into the basis for strategic decision-making, even though its utilization in the field still lags far behind its technical potential. The absence of any one pillar weakens the function of the others, so these four cannot be viewed as four stand-alone technology initiatives, but rather as a single information ecosystem that supports the three main principles of education governance: efficiency, transparency, and accountability.

Executive leadership, institutional strategy, resource readiness, and organizational culture are key determinants of digital governance success, far surpassing the role of technology itself (Bisri et al., 2023). Institutions that adopt these four pillars without a clear governance vision, digital competency readiness, and leadership commitment to evidence-based decision-making risk simply piling on technological infrastructure without truly transforming how the institution is managed. The practical implication is that educational governance transformation should not begin with the question of "what technology needs to be implemented," but rather with more fundamental questions: what decisions need to be improved, what knowledge needs to be maintained, and what accountability needs to be established.

At the policy level, this framework implies that education authorities (ministries, regional education offices, and higher education governing bodies) need to treat enterprise systems, digital learning platforms, knowledge management practices, and analytics dashboards as components of a unified regulatory and investment agenda, rather than as separate procurement decisions. Specifically, this suggests three policy directions: first, digital governance regulations and accreditation standards should require evidence of data integration across systems, rather than simply the existence of individual applications; second, capacity-building programs for educators and administrative staff should be funded as governance investments, alongside infrastructure procurement, given that the digital competence of human resources determines whether the four pillars function as an integrated ecosystem or simply as stand-alone tools; and third, privacy and data governance regulations need to be explicitly expanded to encompass business intelligence and knowledge management practices, given that these pillars process sensitive academic and personnel data. Positioning the four pillars as instruments for these broader governance goals (rather than simply stand-alone technical updates) is key to ensuring the sustainable integration of

enterprise applications, digital learning systems, knowledge management, and business intelligence, both at the institutional and policy levels

CONCLUSION

This study aims to formulate an integrative conceptual framework that explains the role and interrelationships between enterprise applications, digital learning systems, knowledge management, and business intelligence in supporting the transformation of education governance in the digital era, and a systematic literature review of six eligible studies (2020–2026), synthesized through the PRISMA protocol, confirms that these four pillars function not as stand-alone technology initiatives, but rather as a mutually supportive information value chain (enterprise applications provide an integrated administrative data foundation, digital learning systems expand access to pedagogically grounded learning, knowledge management safeguards institutional knowledge from loss due to personnel turnover, and business intelligence transforms these combined data and knowledge flows into evidence for strategic decision-making) with the success of this integration determined not by technological sophistication alone, but by the alignment of institutional strategy, human resource digital competency, and leadership commitment, and has clear implications for how education authorities design digital governance regulations, capacity-building investments, and data privacy policies at the system level; Given that these conclusions are based on a conceptual synthesis of a limited sample of six articles from a single database source, these findings should be viewed as a conceptual reference, not an empirically validated model, and further research is needed to empirically test, refine, and adapt this framework across different types of educational institutions, and (where possible) through multi-database searches beyond Google Scholar.

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