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DIGITAL LEARNING GOVERNANCE IN PRIMARY SCHOOLS: TPACK-BASED CURRICULUM INTEGRATION AND PRINCIPAL E-LEADERSHIP

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ABSTRACT

The integration of Information and Communication Technology (ICT) in primary education requires more than the provision of digital devices; it demands a systematic governance model that connects instructional design, curriculum integration, teacher competence, leadership, and evaluation. This study aims to review and synthesize literature on ICT-based learning governance in primary schools (SD/MI), with specific attention to four review items: learning design and evaluation, TPACK-based curriculum integration, the changing role of teachers, and determinant factors affecting implementation, particularly principal e-leadership and digital learning barriers. This study employed a structured narrative literature review supported by a PRISMA-inspired selection process. The selected literature was analyzed thematically by grouping the findings into governance, actor roles, and determinant factors. The results show that effective ICT-based learning governance in primary schools requires structured instructional design through models such as ADDIE, continuous evaluation through frameworks such as CIPP, and curriculum integration guided by TPACK. The findings also indicate that teachers need to shift from being knowledge transmitters to learning designers and facilitators who can align digital tools with pedagogical strategies and subject content. Furthermore, principal e-leadership emerges as a key determinant in building vision, providing infrastructure, supporting teacher training, and supervising digital learning practices. However, implementation is still challenged by digital divides, limited teacher competence, technical burdens, and pedagogical resistance. This study concludes that the success of digital learning in primary schools depends on the integration of TPACK-oriented teacher development, systematic learning governance, and strong principal e-leadership.

Keywords: Primary School, ICT Governance, TPACK, Principal E-Leadership, Curriculum Integration.

INTRODUCTION

Digital transformation has become one of the most significant issues in contemporary education. The integration of Information and Communication Technology (ICT) is no longer understood merely as the provision of digital devices, internet access, or learning platforms, but as a systemic transformation that affects curriculum design, teacher competence, school leadership, assessment practices, and learning governance. UNESCO (2023) emphasizes that the use of technology in education must be examined through the lenses of relevance, equity, scalability, and sustainability. This view suggests that technology should not be adopted only because it is modern or innovative, but because it has clear pedagogical value and can support inclusive and meaningful learning. Similarly, OECD (2023) argues that digital education requires

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an effective digital education ecosystem in which policy, infrastructure, data governance, learning resources, teacher capacity, and institutional management are interconnected.

In the context of primary education, especially Sekolah Dasar/Madrasah Ibtidaiyah (SD/MI), the governance of ICT-based learning becomes even more crucial. Primary school students are young learners who require concrete learning experiences, structured guidance, age-appropriate digital interaction, and continuous pedagogical support. Therefore, ICT integration in primary schools cannot be treated in the same way as technology use in higher education or adult learning. Digital tools must be carefully selected and integrated into learning activities to support foundational literacy, numeracy, character education, and students' cognitive development. Without proper governance, technology may become an additional burden for teachers and students rather than a meaningful learning support. From the perspective of Islamic values, the urgency of this internal transformation aligns with the words of Allah in QS. Ar-Ra'd verse 11:

إِنَّ ٱللَّهَ لَا يُغَيِّرُ مَا بِقَوْمٍ حَتَّىٰ يُغَيِّرُوا۟ مَا بِأَنفُسِهِمْ

"... Indeed, Allah does not change the condition of a people until they change the condition of themselves..."

This verse provides a philosophical foundation: educational technological innovation will not bring about real change without being preceded by the willingness of institutions and individual teachers to change their pedagogical mindsets.

Previous studies have shown that the availability of infrastructure does not automatically determine the success of ICT integration. Hew and Brush (2007) identify several barriers to technology integration in K–12 education, including limited resources, institutional constraints, subject culture, teacher attitudes and beliefs, lack of knowledge and skills, and assessment-related issues. This argument is reinforced by Ertmer's (1999) distinction between first-order and second-order barriers. First-order barriers are external obstacles such as access, time, training, and technical support. In contrast, second-order barriers are internal factors such as teacher beliefs, pedagogical habits, and resistance to change. These studies indicate that ICT integration should be understood as a governance issue, not merely a technical issue.

From a pedagogical perspective, the Technological Pedagogical Content Knowledge (TPACK) framework provides an important theoretical basis for understanding how teachers integrate technology into teaching. Mishra and Koehler (2006) argue that effective technology integration requires the dynamic interaction among technological, pedagogical, and content

knowledge. In primary schools, this means teachers should not use digital media solely for presentation or entertainment. Rather, they need to connect digital tools with appropriate teaching strategies and subject content to make abstract concepts more concrete and accessible for young learners. Thus, TPACK is relevant for analyzing how curriculum integration can be strengthened through ICT-based learning.

However, teacher competence alone is not sufficient to ensure successful ICT-based learning. Digital transformation in schools also requires leadership that can build vision, coordinate resources, support teachers, and monitor implementation. In this context, principal e-leadership becomes a key determinant. Avolio, Kahai, and Dodge (2001) explain that e-leadership refers to leadership processes mediated by advanced information technology and organizational change. For primary schools and madrasahs, e-leadership means that the principal is expected not only to provide digital infrastructure, but also to guide teachers, develop digital learning policies, facilitate professional development, and create a school culture that supports innovation.

In Indonesia, the relevance of ICT-based learning governance is also connected to the broader agenda of educational transformation and curriculum reform. The implementation of Merdeka Belajar encourages schools to develop more flexible, contextual, and student-centered learning. Angga and Iskandar (2022) emphasize that principals play a strategic role in implementing Merdeka Belajar at the primary school level, serving as policy drivers, motivators, and facilitators of change. In the digital era, this role has become more complex because principals must ensure that technology use supports curriculum goals, teacher readiness, and students' learning needs. Therefore, ICT-based learning governance in SD/MI should integrate pedagogical design, teacher competence, leadership, infrastructure, and evaluation.

Although many studies have discussed ICT integration, digital learning, TPACK, and school leadership separately, there is still a need for a more integrated review that connects these concepts within the specific context of primary school governance. Much of the existing discussion focuses on technology adoption, teachers' digital competence, or leadership in general, but few studies synthesize how ICT-based learning governance can be constructed through TPACK-based curriculum integration and principal e-leadership. This gap is important because primary schools require a governance model that is pedagogically appropriate,

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institutionally manageable, and responsive to the developmental characteristics of young learners.

Based on this background, this study aims to review and synthesize literature on ICT-based learning governance in primary schools, with specific attention to three main issues. First, it examines how ICT-based learning governance can be designed, implemented, and evaluated in SD/MI contexts. Second, it analyzes how TPACK-based curriculum integration shapes teachers' roles in digital learning. Third, it identifies determinant factors that support or hinder ICT-based learning governance, particularly principal e-leadership, teacher readiness, digital infrastructure, and pedagogical resistance. Through this review, the study seeks to contribute to the development of a conceptual framework for digital learning governance in primary education.

METHODOLOGY

This study employed a structured narrative literature review supported by a PRISMA-inspired selection flow to ensure transparency in the identification, screening, eligibility assessment, and inclusion of sources. A structured narrative review was considered appropriate because the study aimed not to measure effect size, but to map, critique, and synthesize conceptual and empirical findings related to ICT-based learning governance in primary schools. The review was guided by several analytical frameworks: Technological Pedagogical Content Knowledge (TPACK) as the main framework for examining technology integration in teaching and curriculum; ADDIE as an instructional design model for analyzing learning design governance; CIPP as an evaluative framework for examining digital learning quality assurance; and e-leadership as a lens for analyzing the determinant role of school principals in digital transformation.

The literature search was conducted through Google Scholar, SINTA-indexed journals, official documents, and reference tracking. The keywords used included “ICT-based learning governance,” “digital learning in primary school,” “TPACK integration,” “technology integration in elementary school,” “principal e-leadership,” “digital leadership in school,” “learning design governance,” and “digital curriculum integration.” The search focused on publications from 2019 to 2026 to maintain the relevance of the findings to recent developments in digital learning, while several foundational works published before 2019 were retained

because they provided essential theoretical bases, such as TPACK, ADDIE, CIPP, e-leadership, and first- and second-order barriers to technology integration (Ferrari, 2015; Snyder, 2019).

A total of 185 records were initially identified, consisting of 142 records from Google Scholar, 31 official documents/reports/books, and 12 additional sources obtained through reference tracking. After removing 21 duplicate records and 12 records with incomplete metadata, inaccessible full text, or publication years outside the inclusion range, 152 records were screened based on their titles and abstracts. At this stage, 91 records were excluded because they were not directly related to primary education, ICT-based learning governance, TPACK-based curriculum integration, or principal e-leadership. Subsequently, 61 full-text reports were sought for retrieval, of which 6 could not be accessed. A total of 55 full-text sources were assessed for eligibility. After applying the inclusion and exclusion criteria, 28 sources were excluded because they did not focus on primary school contexts, discussed only technical application without governance or pedagogical analysis, lacked relevance to TPACK or leadership, or overlapped substantially with other included studies. Finally, 27 sources were included in the qualitative synthesis, consisting of 22 scientific articles and 5 official documents, books, or key references (Braun & Clarke, 2006).

The inclusion criteria consisted of: (1) publications related to ICT-based learning, digital learning governance, TPACK, curriculum integration, principal e-leadership, or digital transformation in schools; (2) studies focused on primary school, elementary school, SD/MI, or relevant K-12 contexts; (3) peer-reviewed journal articles, academic proceedings, books, official documents, or institutional reports; (4) sources published between 2019 and 2026, except for foundational theoretical references; and (5) full-text availability. Meanwhile, sources were excluded if they were not related to primary education, only discussed technical use of digital applications without pedagogical or governance relevance, lacked sufficient methodological or conceptual clarity, or were non-academic sources such as blogs, news articles, and opinion pieces.

The selected sources were analyzed using thematic synthesis. The data were reduced, coded, and grouped into three major themes: ICT-based learning governance, TPACK-based curriculum integration and teacher roles, and determinant factors influencing implementation, particularly principal e-leadership and barriers to digital transformation. The synthesis process enabled the study to construct a conceptual understanding of how digital learning governance

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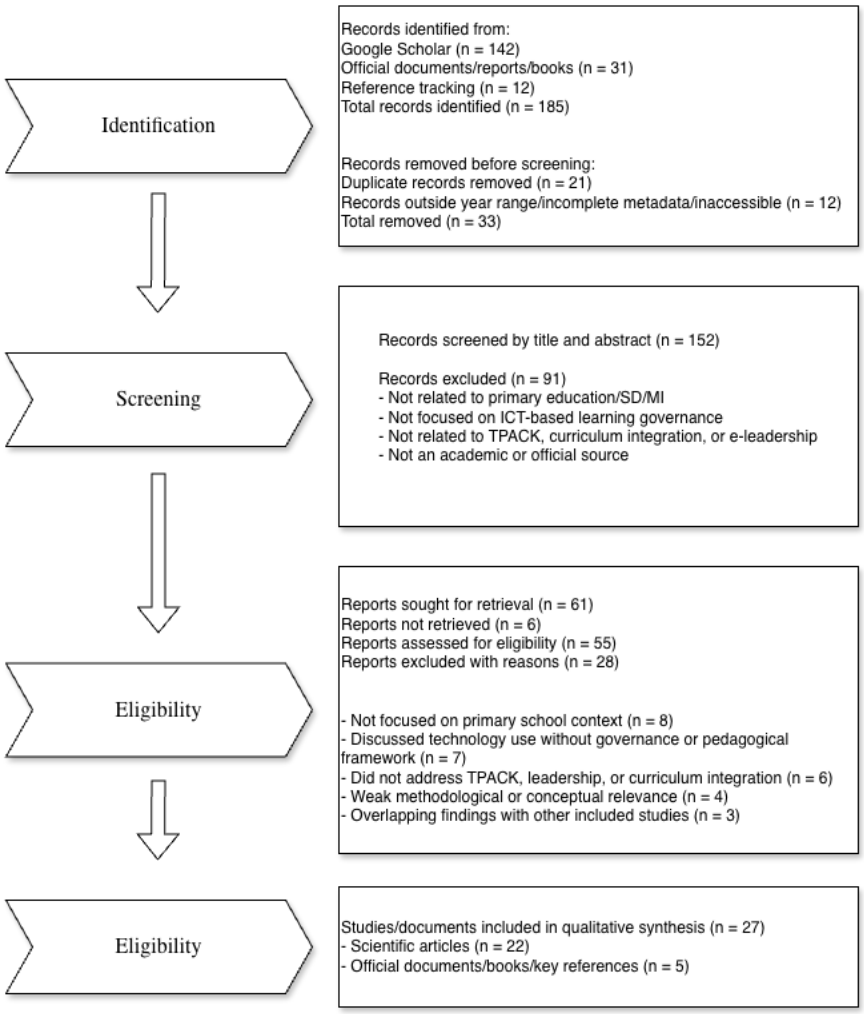
in primary schools can be designed, implemented, and evaluated. It was strengthened through teacher competence and school leadership.

The flow of literature identification and selection is presented in Figure 1 using an adapted PRISMA 2020 flow diagram.

Figure 1. PRISMA Flow Diagram of Literature Selection Process



RESULT AND DISCUSSION

ICT-Based Learning Governance

1. Learning Design and TPACK Integration

The results of the literature synthesis indicate that ICT-based learning governance in primary schools requires a systematic instructional design framework rather than merely providing digital devices or learning platforms. This finding is consistent with Branch (2009), who explains that the ADDIE model (analysis, design, development, implementation, and evaluation) provides a structured framework for designing instruction. In the context of primary

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education, ADDIE can be interpreted not only as an instructional design model but also as a governance instrument, as it helps schools systematically regulate learning needs analysis, digital content development, implementation procedures, and evaluation mechanisms.

At the curriculum level, the integration of ICT should be embedded in lesson plans, teaching modules, learning activities, and assessment strategies. This aligns with the TPACK framework proposed by Mishra and Koehler (2006), which argues that effective technology integration requires the integration of technological, pedagogical, and content knowledge. Therefore, ICT integration in primary schools should not be understood as the use of technology solely for presentation or entertainment purposes. Rather, digital media should be selected based on their relevance to learning objectives, students' cognitive development, and the characteristics of subject matter. For example, visual simulations may help students understand abstract scientific concepts, while interactive literacy platforms can support reading comprehension and vocabulary development.

This finding is also supported by Hew and Brush (2007), who emphasize that successful technology integration in K–12 education is influenced by multiple factors, including resources, institutional support, teacher attitudes, knowledge and skills, and assessment culture. Thus, ICT-based learning governance must ensure that clear institutional policies, teacher mentoring, and academic supervision accompany the integration of ICT into the curriculum. From a governance perspective, the principal needs to ensure the alignment between learning objectives, digital activities, assessment evidence, and student learning outcomes.

To provide a structured overview of the findings, Table 1 presents a synthesis of the literature mapped into three main dimensions: Governance, the Role of Actors, and Determinant Factors. This mapping highlights the specific context of primary education and the critical role of e-leadership.

Table 1. Literature Synthesis

Dimension	Focus / Sub-theme	Frequently Discussed Indicators	Key References
Governance	Design & Curriculum	ADDIE model adaptation for thematic curriculum; TPACK alignment in lesson plans (RPP/Modul Ajar).	(Mishra & Koehler, 2006; Branch, 2009)
	Implementation	Synchronous–asynchronous protocols for young learners; parental involvement; micro-policies on digital ethics.	(Graham, 2006; Hew & Brush, 2007)

	Evaluation	Digital assessment SOPs; CIPP model application; data-driven feedback for foundational competencies.	(Long & Siemens, 2011; American Educational Research Association, 2014)
Actor	Teacher's Role & Competence	Designers of thematic digital activities: shift from knowledge source to facilitators; TPACK mastery.	(Redecker, 2017; Mishra & Koehler, 2006)
	Teacher Support Policies	Alleviating administrative burdens; providing financial rewards; mandating targeted training.	(Hanim et al., 2020)
Determinants	Enablers: Principal E-Leadership	Transformational leadership driving organizational change; multicultural instructional leadership; 4 key roles (educator, manager, supervisor, motivator).	(Avolio et al., 2001; Windasari et al., 2022; Nurrochman et al., 2023; Maulana et al., 2026)
	Barriers: Internal & External	Digital divide; pedagogical resistance (second-order barriers); technical burdens affecting primary teachers.	(Ertmer, 1999; Van Dijk, 2020; Kesuma et al., 2025)

2. Learning Implementation for Young Learners

The synthesis shows that implementing ICT-based learning in primary schools needs to account for the developmental characteristics of young learners. Digital learning for primary school students cannot simply adopt the model used in secondary or higher education because young learners need clearer instructions, shorter learning sequences, concrete examples, and stronger teacher guidance. This supports Graham's (2006) view that blended learning requires the thoughtful combination of face-to-face and technology-mediated learning experiences. In primary education, this combination should be carefully managed so that digital activities do not replace teacher scaffolding, but strengthen student engagement and understanding.

The literature also indicates that synchronous and asynchronous learning should be governed through clear school-level protocols. Synchronous learning is more appropriate for explanation, guidance, interaction, and immediate clarification, while asynchronous learning is better suited to practice, reflection, and independent assignments. However, for primary school students, asynchronous activities require simple instructions, parental support, and age-appropriate digital platforms. This is in line with the argument of Hew and Brush (2007), who state that institutional support and teacher knowledge are decisive factors in successful

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technology integration. Therefore, schools need to formulate micro-policies on screen time, digital communication ethics, parental involvement, and minimum standards for digital learning activities.

3. Learning Evaluation

The results also show that evaluation is a crucial component of ICT-based learning governance. Evaluation should not only measure students' final learning outcomes but also examine whether the digital learning system has been properly planned, implemented, and improved. The CIPP model developed by Stufflebeam provides a relevant evaluative framework because it examines context, input, process, and product. In primary school governance, context evaluation can identify students' needs and school readiness; input evaluation can assess the availability of infrastructure, teacher competence, and digital resources; process evaluation can monitor the implementation of ICT-based learning; and product evaluation can examine student outcomes and program effectiveness.

Digital assessment should also be carefully designed to measure foundational competencies rather than merely record students' ability to operate digital tools. Long and Siemens (2011) emphasize the importance of learning analytics for understanding learning processes through digital traces. However, in primary education, data-driven assessment should be interpreted pedagogically and ethically. Digital quizzes, e-portfolios, LMS records, and computer-based tests should be used as feedback instruments to improve learning, not merely as administrative evidence. Therefore, ICT-based governance requires clear standard operating procedures for digital assessment, data privacy, feedback mechanisms, and follow-up interventions.

4. The Role of Primary School Teachers in Digital Learning

The findings indicate that the teacher's role in ICT-based learning shifts from being the primary source of knowledge to serving as a designer, facilitator, evaluator, and learning guide. This role transformation is consistent with Redecker's (2017) DigCompEdu framework, which emphasizes that educators need digital competence not only to use technology but also to design learning, manage digital resources, facilitate student engagement, assess learning, and empower learners. In primary schools, this competence is especially important because teachers must translate digital resources into meaningful learning experiences that support children's cognitive, social, and emotional development.

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The TPACK framework further explains that teacher competence in digital learning is not limited to technological skills. Mishra and Koehler (2006) argue that meaningful technology integration occurs when teachers connect technological knowledge with pedagogical strategies and content characteristics. Therefore, teacher professional development should not focus only on technical training, such as how to use applications or learning platforms. Instead, training should help teachers design digital activities, select appropriate media, develop interactive assessments, and align technology use with curriculum goals.

This finding is reinforced by Ertmer's (1999) distinction between first-order and second-order barriers. First-order barriers include access, infrastructure, time, and technical support, while second-order barriers include teacher beliefs, pedagogical habits, and resistance to change. In the context of primary schools, second-order barriers are often more difficult to overcome because they relate to teachers' confidence, teaching culture, and perceptions of technology. Therefore, school governance should provide continuous mentoring, collaborative lesson design, peer learning communities, and reflective supervision to help teachers gradually develop pedagogically meaningful digital practices.

Supporting and Inhibiting Factors: The Crucial Role of E-Leadership

1. Supporting Factors (Principal E-Leadership)

The synthesis reveals that principal e-leadership is a central determinant in ICT-based learning governance. E-leadership refers to leadership practices mediated by advanced information technology and organizational change. Avolio, Kahai, and Dodge (2001) explain that e-leadership involves the interaction between leadership processes, digital technology, and organizational structures. In primary schools, this means that principals are responsible not only for procuring technology but also for developing a digital vision, coordinating teachers, managing resources, monitoring implementation, and fostering a culture of innovation.

The role of principal e-leadership is also related to instructional leadership. Principals need to ensure that digital transformation supports learning quality, not merely administrative modernization. This finding is consistent with studies on school leadership, which show that principals play important roles as educators, managers, supervisors, and motivators in digital transformation. In the context of primary schools and madrasah ibtidaiyah, e-leadership should be reflected in concrete actions, such as facilitating TPACK-based teacher training, providing

digital infrastructure, developing school-level digital learning policies, supervising ICT-based instruction, and encouraging collaboration among teachers, students, and parents.

2. *Inhibiting Factors*

The literature synthesis also identifies several inhibiting factors, including the digital divide, limited teacher competence, technical burdens, and resistance to pedagogical change. Van Dijk (2020) argues that the digital divide is not limited to physical access to technology, but also includes differences in skills, usage, and outcomes. This perspective is important for primary schools because unequal access to devices, internet connection, and parental support may affect students' participation in digital learning.

In addition, Hew and Brush (2007) identify several barriers to technology integration in K–12 settings, including limited resources, institutional constraints, subject culture, teacher attitudes and beliefs, knowledge and skills, and assessment-related issues. These barriers show that ICT-based learning governance must address both structural and cultural dimensions. Schools need to provide infrastructure and technical support, but they must also develop teachers' pedagogical readiness and willingness to change. In this regard, Ertmer's (1999) concept of first-order and second-order barriers remains relevant. Infrastructure problems may be solved through funding and policy support, but teacher beliefs and instructional habits require long-term professional development, collegial support, and reflective leadership.

Overall, the findings suggest that ICT-based learning governance in primary schools should be understood as an integrated system consisting of instructional design, curriculum integration, teacher competence, evaluation, leadership, and institutional support. Technology alone does not guarantee learning improvement. Its effectiveness depends on whether schools can govern digital learning through clear planning, TPACK-based teacher development, continuous evaluation, and strong principal e-leadership. Therefore, the main contribution of this review is the formulation of a governance-oriented perspective that places ICT integration within a broader framework of curriculum management, pedagogical transformation, and school leadership.

CONCLUSION

Effective ICT-based learning governance in primary schools cannot be reduced to the availability of infrastructure alone; rather, it is a complex synergy among mature instructional

design, TPACK-based curriculum integration, and ongoing evaluation. This literature review concludes that the ideal governance model must integrate systematic frameworks such as ADDIE and CIPP to ensure quality and facilitate the transformation of teachers' roles. The success of these systems depends heavily on the institution's ability to optimize key supporting factors, primarily principal e-leadership and continuous training, while proactively mitigating structural barriers such as digital divides and cultural resistance. Theoretically, these findings enrich the discourse on educational management by asserting that technology integration requires a specific pedagogical framework suited to primary education. The practical implication is that primary schools (SD/MI) should shift their focus towards the development of a Standard Operating Procedure (SOP) for governance and a roadmap for TPACK teacher competency development. Based on this study, it is recommended for future researchers to conduct empirical studies to test the effectiveness of principal e-leadership in a variety of different school cultural contexts. For education practitioners, it is recommended to prioritize ongoing coaching programs for teachers that focus on TPACK, rather than just technical training on applications.

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