The Influence of Principal Digital Leadership on Teacher Performance through Innovative School Climate toward Sustainable Education

Rosmiati[1]

[1]Program Doktor Ilmu Manajemen, Universitas Halu Oleo, Kendari, Sulawesi Tenggara, Indonesia

Keywords

teacher performance; innovative school climate; sustainable education; school leadership; educational Transformation

Correspondence Email:
rosmiatioss93@gmail.com

Abstract

Educational institutions worldwide are undergoing rapid Transformation driven by technological advancement, globalization, the integration of artificial intelligence, and rising societal expectations regarding educational quality. Within this context, school principals are increasingly required to enact digital leadership that strengthens teacher performance and supports the long-term development of education. This study examines how principal digital leadership influences teacher performance through the mediating role of innovative school climate, with sustainable education as the overarching orientation. Adopting an explanatory conceptual approach grounded in contemporary educational-leadership theory and a structured review of quantitative empirical studies published between 2020 and 2026, the article develops an integrated analytical model and a set of testable hypotheses. The synthesis indicates that principal digital leadership contributes substantially to teacher effectiveness by promoting technological adaptation, collaborative professional learning, instructional innovation, and organizational flexibility. Innovative school climate functions as a strategic mediatingvariable that channels and amplifies the effect of leadership practices on teacher performance. Schools characterized by collaboration, openness to innovation, digital communication, and continuous learning appear more capable of achieving sustainable educational transformation. The findings further suggest that sustainable education cannot be secured through investment in technological infrastructure alone, but rather through visionary leadership that integrates innovation, inclusivity, institutional resilience, and long-term adaptability. Theoretically, the study integrates digital-leadership theory, organizational-climate theory, and sustainable-education perspectives into a coherent framework; practically, it offers strategic recommendations for policymakers, educational administrators, and school leaders seeking to improve teacher performance and strengthen sustainable educational ecosystems in the digital era.

1. Introduction

Education systems across the globe are being reshaped by a convergence of forces that includes accelerating technological change, deepening globalization, the rapid diffusion of artificial intelligence, and increasingly demanding expectations about the quality and relevance of learning. These pressures have altered not only how teaching and learning are organized but also the competencies that school leaders are expected to demonstrate. The conventional managerial repertoire of the principal centred on administration, supervision, and compliance has proven insufficient for guiding schools through digital disruption, prompting growing scholarly interest in the construct of digital leadership as a distinct and consequential leadership orientation [1], [2].

Digital leadership extends earlier conceptions of electronic leadership, in which leaders mediate organizational processes and relationships through information and communication technologies [3]. In the school setting, it denotes the capacity of the principal to articulate a technology-rich vision, cultivate a digital-age learning culture, model ethical and professional use of technology, and drive systemic improvement so that the institution can respond adaptively to a fast-changing environment [4], [1]. Because teachers are the primary agents through which educational quality is realized, a central question is whether and how the digital leadership of principals translates into stronger teacher performance.

Teacher performance understood as the effective planning, delivery, assessment, and continuous improvement of instruction has long been identified as one of the most proximate school-level determinants of student learning [5], [6]. A substantial and growing body of quantitative evidence indicates that principals who lead digitally can raise teacher performance by encouraging technology integration, professional learning, and instructional innovation [7], [8]. Yet leadership rarely affects teacher outcomes in a purely direct manner; its influence is frequently transmitted through the organizational conditions that leaders help to create [9]. This recognition directs attention to the climate of the school as a critical intervening mechanism.

Among the climate dimensions most relevant to a period of digital transformation is the innovative school climate: the shared perception that the organization values experimentation, collaboration, openness to new ideas, digital communication, and continuous learning [10], [11]. A climate that legitimizes innovation provides teachers with the psychological safety and collective support required to adopt new practices, suggesting that innovative school climate may mediate the relationship between principal digital leadership and teacher performance. Despite the plausibility of this mechanism, the literature remains fragmented: studies tend to examine either the direct leadership–performance link or the climate–innovation link in isolation, and few integrate these strands within an explicit orientation toward sustainable education.

Sustainable education refers to the capacity of educational systems to renew themselves and to maintain quality, equity, and relevance over time, in alignment with the fourth Sustainable Development Goal and broader frameworks for education for sustainable development [12], [13]. Sustainable leadership scholarship cautions that improvements which depend on transient enthusiasm or on infrastructure alone seldom endure; durability instead requires leadership that distributes capacity, builds resilience, and embeds learning into the institution [14]. Viewed through this lens, the value of principal digital leadership lies not merely in short-term performance gains but in its potential to establish the climate and capabilities that allow educational quality to be sustained.

Against this background, the present study pursues three objectives. First, it develops an integrated analytical model in which innovative school climate mediates the relationship between principal digital leadership and teacher performance, with sustainable education as the overarching orientation. Second, it synthesizes recent quantitative empirical evidence (2020–2026) to justify the model and to formulate a coherent set of testable hypotheses. Third, it proposes an operational and analytical design through which the model can be empirically validated. The study contributes theoretically by integrating digital-leadership theory, organizational-climate theory, and sustainable-education perspectives within a single framework, and practically by offering strategic guidance to policymakers, administrators, and school leaders operating in the digital era.

1.1. Literature Review and Hypothesis Development

1. Principal Digital Leadership

Digital leadership in education is best understood as an evolution rather than a replacement of established

leadership theory. Building on the notion of e-leadership, in which social influence is enacted through digital media to change attitudes, behaviour, and performance [3], digital leadership in schools describes a principal's ability to harness technology strategically to transform the organization into an adaptive, technology-enabled learning environment [1], [2]. Widely used professional standards conceptualize this capacity along several interrelated dimensions, including the articulation of a shared technological vision, the cultivation of a digital-age learning culture, excellence and ethics in professional practice, systemic institutional improvement, and the promotion of responsible digital citizenship [4].

Empirical work conducted during and after the pandemic confirms that these dimensions are not merely aspirational. Principals who exercise digital leadership have been shown to facilitate teachers' technology integration, reflective practice, and professional engagement, often by reducing uncertainty and supplying the resources and modelling that adoption requires [7], [8]. Digital leadership is therefore positioned in this study as the key antecedent that sets in motion the organizational and individual processes examined below.

1.1 Teacher Performance

Teacher performance is conceptualized as the degree to which teachers fulfil their professional responsibilities across the instructional cycle planning and designing learning, enacting effective pedagogy, assessing and providing feedback, and engaging in continuous professional development and collegial collaboration [5], [15]. Because it sits closest to the student, teacher performance is widely treated as the most influential school-controllable determinant of learning outcomes, and as the principal channel through which leadership effects reach the classroom [6].

In a digitally transforming environment, teacher performance increasingly encompasses the capacity to integrate technology meaningfully into pedagogy, to adapt to new instructional tools, and to innovate in response to changing learner needs. This expanded conception explains why leadership oriented toward digital transformation is hypothesized to bear directly on performance, and why the surrounding climate is expected to shape how readily teachers act on new possibilities.

1.2 Innovative School Climate

Organizational climate refers to the relatively enduring, shared perceptions that members hold about the character of their work environment [16]. An innovative school climate is the variant of this construct in which members perceive the organization as encouraging experimentation, tolerating reasonable risk, rewarding new ideas, supporting collaboration, and sustaining open and increasingly digital communication [11], [10]. Such a climate functions as the immediate social context within which teachers decide whether to attempt, sustain, or abandon innovative practice.

Recent quantitative studies provide consistent support for the motivational and behavioural significance of this climate. An innovation-oriented climate has been found to drive teachers' innovative work behaviour, frequently operating through intervening psychological resources such as self-efficacy [11], and the collective innovativeness fostered by a supportive climate has been shown to mediate the relationship between climate and important teacher outcomes [10]. These findings establish innovative school climate as a theoretically defensible mediator linking leadership to performance.

1.3 Sustainable Education

Sustainable education denotes more than the inclusion of sustainability topics in the curriculum; it describes an educational system capable of renewing itself and maintaining quality, equity, inclusivity, and relevance over the long term [12], [13]. It is closely associated with the fourth Sustainable Development Goal and with frameworks for education for sustainable development that emphasize lifelong learning and institutional adaptability. Sustainable leadership theory adds that durable improvement depends on leadership which builds capacity, distributes responsibility, and embeds learning into the organization rather than relying on short-lived initiatives or infrastructure alone [14].

Within the digital era, scholarship increasingly links leadership, innovation, and sustainability, arguing that digitally capable leadership can advance sustainable development when it is coupled with an innovation-supportive organizational culture [17], [18]. In this study, sustainable education functions as the overarching orientation that gives long-term meaning to the proposed leadership–climate–performance mechanism.

1.4 Digital Leadership and Teacher Performance

A direct relationship between principal digital leadership and teacher performance is well supported. By furnishing a clear technological vision, allocating resources, modelling effective use of digital tools, and reducing the uncertainty associated with change, digitally oriented principals lower the barriers to adoption and motivate teachers to perform at higher levels [1], [8]. Evidence further indicates that the influence of digital leadership extends to reflective and engaged professional practice, both of which are core components of contemporary teacher performance [7]. Accordingly, the following hypothesis is proposed:

H1. Principal digital leadership has a positive and significant effect on teacher performance.

1.5 Digital Leadership and Innovative School Climate

Leaders are widely regarded as the principal architects of organizational climate, shaping shared perceptions through the priorities they signal, the behaviour they model, and the structures they establish [16], [9]. A principal who leads digitally is therefore expected to foster an innovative climate by legitimizing experimentation, enabling digital communication and collaboration, and rewarding the adoption of new practices. Studies of leadership and innovation climate consistently report that supportive, forward-looking leadership strengthens the conditions under which innovation is perceived to be valued and safe [11], [17]. This reasoning yields:

H2. Principal digital leadership has a positive and significant effect on innovative school climate.

1.6 Innovative School Climate and Teacher Performance

An innovative climate supplies the social and psychological conditions that enable teachers to translate intention into action. When experimentation is supported and failure is not punished, teachers are more willing to adopt new pedagogies and technologies, sustaining higher performance [10], [11]. Empirical evidence links innovation-oriented climates to teachers' innovative work behaviour and to favourable affective and professional outcomes that underpin effective practice [11], [10]. Hence:

H3. Innovative school climate has a positive and significant effect on teacher performance.

1.7 The Mediating Role of Innovative School Climate

Taken together, H1 to H3 imply an indirect pathway in which principal digital leadership influences teacher performance by first shaping the innovative climate of the school. This mediational logic is consistent with the long-standing finding that school leadership affects classroom outcomes largely through the organizational conditions leaders create rather than through direct action upon teaching itself [9], [6]. Recent studies that position innovation climate or collective innovativeness as mediators of leadership and climate effects reinforce the expectation that innovative school climate carries a meaningful portion of the leadership effect [11], [10]. Therefore:

H4. Innovative school climate mediates the relationship between principal digital leadership and teacher performance.

1.8 Orientation toward Sustainable Education

The final element of the framework situates the leadership–climate–performance mechanism within the pursuit of sustainable education. Sustainable leadership theory holds that improvements endure only when leadership builds enduring capacity and embeds learning into the institution [14], while emerging scholarship links digitally capable, innovation-supportive leadership to sustainable development outcomes [17], [18]. An innovative climate that continuously elevates teacher performance is expected to strengthen the institutional resilience, adaptability, and renewal capacity on which sustainable education depends. This leads to the integrative proposition:

H5. Principal digital leadership, innovative school climate, and teacher performance jointly contribute to the advancement of sustainable education.

Conceptual Framework

Synthesizing the hypotheses above, the study advances an integrated explanatory model. Principal digital leadership is positioned as the exogenous construct. It is theorized to exert a direct effect on teacher

performance (H1) and an effect on innovative school climate (H2). Innovative school climate, in turn, is theorized to influence teacher performance (H3) and to mediate the leadership–performance relationship (H4). Teacher performance, together with the climate that sustains it and the leadership that initiates it, is oriented toward sustainable education as the long-term systemic outcome (H5).

Schematically, the model may be expressed as: Principal Digital Leadership → Innovative School Climate → Teacher Performance → Sustainable Education, with an additional direct path from Principal Digital Leadership to Teacher Performance. The path diagram should be inserted here as Fig. 1, with arrows labelled H1–H5 to correspond with the hypotheses developed in Section 2.

Fig. 1 Conceptual framework of the study (insert path diagram Sin the camera-ready version)

2. Method

2.1 Research Design

This article adopts an explanatory conceptual design supported by a structured review of the recent empirical literature. The aim of the present stage is to construct and theoretically justify the analytical model rather than to report primary data; the synthesis therefore functions as the evidentiary basis for the hypotheses, and a corresponding empirical design is proposed for subsequent validation.

The literature review followed a transparent and reproducible procedure informed by widely used reporting principles for systematic reviews. Searches were directed at peer-reviewed studies published between 2020 and 2026 in major databases including Scopus, Web of Science, ERIC, and Google Scholar, using combinations of the terms digital leadership, technology leadership, teacher performance, innovative school climate, innovation climate, and sustainable education. Studies were retained when they reported quantitative relationships among the focal constructs in educational or closely related organizational settings, and were excluded when they lacked methodological transparency or relevance. The retained studies were then synthesized thematically to derive the directional relationships expressed in H1–H5.

2.2 Proposed Empirical Validation

To enable empirical testing, the study proposes a quantitative explanatory survey design. The target population comprises teachers in the relevant educational jurisdiction, with respondents selected through probability sampling (for example, proportionate stratified random sampling) and a sample size adequate for structural analysis. The four constructs would be operationalized using validated multi-item Likert-type scales: principal digital leadership through dimensions such as visionary leadership, digital-age learning culture, professional practice, and systemic improvement; teacher performance through planning, instruction, assessment, and professional development; innovative school climate through collaboration, openness to innovation, digital communication, and continuous learning; and sustainable education through indicators of institutional resilience, inclusivity, and long-term adaptability.

Instrument quality would be established through content validity, convergent and discriminant validity, and internal-consistency reliability. The hypothesized relationships, including the mediating effect specified in H4, would be examined using partial least squares structural equation modelling (PLS-SEM), which is well suited to complex predictive models and mediation analysis [19]. Indirect effects would be evaluated using bootstrapping procedures consistent with contemporary recommendations for assessing mediation [20]. This proposed design is presented for future research; the contributions reported here are conceptual and synthetic.

3. Results and Discussion

The synthesis of the 2020–2026 literature offers convergent support for each path in the model. With respect to H1, multiple quantitative studies report that principal digital leadership is

positively associated with teacher performance and with adjacent outcomes such as technology integration, reflective practice, and professional engagement [7], [8], [1]. The consistency of these results across diverse national contexts strengthens confidence in a genuine, rather than context-specific, leadership effect.

Regarding H2 and H3, the evidence indicates that leadership shapes the innovative climate of an organization and that such a climate, in turn, elevates teachers' innovative behaviour and effectiveness [11], [10]. The recurrent appearance of innovation climate and collective innovativeness as mediators in recent models lends direct support to H4: the influence of leadership on teacher outcomes appears to be transmitted substantially through the organizational conditions that leaders create rather than through unmediated personal influence [9], [10]. This pattern reframes the principal's task from directly managing teaching toward deliberately engineering a climate in which effective and innovative teaching becomes the norm.

In relation to H5, the literature linking digital leadership, innovation, and sustainability suggests that the proposed mechanism has implications beyond immediate performance. Leadership that institutionalizes innovation and continuous learning builds the adaptive capacity that sustainable education requires, whereas reliance on infrastructure investment alone is unlikely to produce durable change [14], [17], [18]. The synthesis thus supports the view that sustainable education is an emergent property of well-led, innovation-rich schools rather than a direct purchase of technology.

Theoretically, the integrated model addresses a fragmentation in the existing literature by uniting digital-leadership theory, organizational-climate theory, and sustainable-education perspectives. It specifies not only that digital leadership matters, but the organizational mechanism through which it matters and the long-term systemic purpose toward which it is directed. This contributes a more complete causal narrative than the direct-effect studies that currently dominate the field.

Implications

Theoretically, the study offers an integrative framework that can guide future empirical work, providing a clear set of constructs, paths, and hypotheses for testing across educational systems. By foregrounding innovative school climate as a mediator and sustainable education as an orienting outcome, it extends leadership research beyond proximal performance toward systemic durability.

Practically, the framework implies that efforts to improve teacher performance in the digital era should invest in the leadership capacity of principals, not only in devices and platforms. Policymakers may prioritize the development of principals' digital-leadership competencies through targeted professional learning and supportive standards. Educational administrators may design structures and incentives that cultivate collaboration, openness to innovation, and continuous learning. School leaders themselves may concentrate on building an innovative climate legitimizing experimentation, enabling digital communication, and distributing leadership so that improvements in teaching are sustained rather than transient.

Limitations and Future Research

Two limitations should be acknowledged. First, the contribution reported here is conceptual and synthetic; although the model is grounded in recent quantitative evidence, it has not yet been tested with primary data. Second, the synthesis is bounded by the search criteria and the period reviewed, and may not capture every relevant contribution. Future research should empirically validate the model using the proposed design, examine potential moderators such as school level, resource context, and teachers' digital readiness, and consider longitudinal designs capable of assessing the sustainability of effects over time.

4. Conclusion

This study has developed and theoretically justified an integrated model in which principal digital leadership strengthens teacher performance both directly and through the mediating role of innovative school climate, with sustainable education as the overarching orientation. Synthesizing quantitative evidence published between 2020 and 2026, the analysis indicates that digitally capable principals raise teacher performance most effectively when they cultivate a climate of collaboration, openness, digital communication, and continuous learning, and that such conditions underpin the resilience and adaptability on which sustainable education depends. Sustainable education, the study concludes, is achieved less through technological infrastructure than through visionary leadership that integrates innovation, inclusivity, and long-term

institutional renewal. The proposed framework and validation design provide a foundation for subsequent empirical research and offer actionable guidance for policymakers, administrators, and school leaders committed to strengthening sustainable educational ecosystems in the digital era.

5. References

[1] F. Navaridas-Nalda, M. Clavel-San Emeterio, R. Fernández-Ortiz, and M. Arias-Oliva, "The strategic influence of school principal leadership in the digital transformation of schools," Computers in Human Behavior, vol. 112, p. 106481, 2020, doi: 10.1016/j.chb.2020.106481.

[2] M. M. Magesa and J. Jonathan, "Conceptualizing digital leadership characteristics for successful digital transformation: The case of Tanzania," Information Technology for Development, vol. 28, no. 4, pp. 777–796, 2022, doi: 10.1080/02681102.2021.1991872.

[3] B. J. Avolio, S. Kahai, and G. E. Dodge, "E-leadership: Implications for theory, research, and practice," The Leadership Quarterly, vol. 11, no. 4, pp. 615–668, 2000, doi: 10.1016/S1048-9843(00)00062-X.

[4] International Society for Technology in Education (ISTE), ISTE Standards for Education Leaders. Arlington, VA, USA: ISTE, 2018.

[5] P. Hallinger, "Leadership for learning: Lessons from 40 years of empirical research," Journal of Educational Administration, vol. 49, no. 2, pp. 125–142, 2011, doi: 10.1108/09578231111116699.

[6] K. Leithwood, A. Harris, and D. Hopkins, "Seven strong claims about successful school leadership revisited," School Leadership & Management, vol. 40, no. 1, pp. 5–22, 2020, doi: 10.1080/13632434.2019.1596077.

[7] R. Agustina, W. Kamdi, S. Hadi, and D. Nurhadi, "Influence of the principal's digital leadership on the reflective practices of vocational teachers mediated by trust, self-efficacy, and work engagement," International Journal of Learning, Teaching and Educational Research, vol. 19, no. 11, pp. 24–40, 2020, doi: 10.26803/ijlter.19.11.2.

[8] F. Amar and D. Eleyan, "Effect of principal's technology leadership on teacher's technology integration," International Journal of Instruction, vol. 15, no. 1, pp. 781–798, 2022, doi: 10.29333/iji.2022.15145a.

[9] P. Hallinger and R. H. Heck, "Exploring the principal's contribution to school effectiveness: 1980–1995," School Effectiveness and School Improvement, vol. 9, no. 2, pp. 157–191, 1998, doi: 10.1080/0924345980090203.

[10] B. Hu, K. H. Park, and Z. Xu, "The mediating effect of teachers' collective innovativeness between school climate and job satisfaction," European Journal of Educational Research, vol. 13, no. 4, pp. 1573–1585, 2024, doi: 10.12973/eu-jer.13.4.1573.

[11] S. Mokhlis and A. H. A. Abdullah, "School innovation climate as a driver of teachers' innovative work behavior: The mediating role of self-efficacy," International Journal of Evaluation and Research in Education (IJERE), vol. 14, no. 5, pp. 3735–3743, 2025, doi: 10.11591/ijere.v14i5.32757.

[12] S. Sterling, Sustainable Education: Re-visioning Learning and Change. Totnes, UK: Green Books, 2001.

[13] UNESCO, Education for Sustainable Development: A Roadmap. Paris, France: United Nations Educational, Scientific and Cultural Organization, 2020.

[14] A. Hargreaves and D. Fink, Sustainable Leadership. San Francisco, CA, USA: Jossey-Bass, 2006.

[15] M. Tschannen-Moran and A. Woolfolk Hoy, "Teacher efficacy: Capturing an elusive construct," Teaching and Teacher Education, vol. 17, no. 7, pp. 783–805, 2001, doi: 10.1016/S0742-051X(01)00036-1.

[16] W. K. Hoy and C. G. Miskel, Educational Administration: Theory, Research, and Practice, 9th ed. New York, NY, USA: McGraw-Hill, 2013.

[17] M. Zada, S. Zada, B. K. Dhar, C. Ping, and S. Sarkar, "Digital leadership and sustainable development: Enhancing firm sustainability through green innovation and top management innovativeness," Sustainable Development, vol. 33, no. 5, pp. 6704–6716, 2025, doi: 10.1002/sd.3488.

[18] A. Rof, A. Bikfalvi, and P. Marquès, "Digital transformation for business model innovation in higher education: Overcoming the tensions," Sustainability, vol. 12, no. 12, p. 4980, 2020, doi: 10.3390/su12124980.

[19] J. F. Hair, G. T. M. Hult, C. M. Ringle, and M. Sarstedt, A Primer on Partial Least Squares Structural

Equation Modeling (PLS-SEM), 3rd ed. Thousand Oaks, CA, USA: Sage, 2022.

[20] K. J. Preacher and A. F. Hayes, "Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models," Behavior Research Methods, vol. 40, no. 3, pp. 879–891, 2008, doi: 10.3758/BRM.40.3.879.