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Principal Leadership Strategies in Managing the Implementation of Education Management Information Systems in Nature Schools

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ABSTRACT

Digital transformation in education positions school principals as strategic actors in managing the implementation of the Education Management Information System (EMIS); however, empirical studies remain concentrated on formal schools and have not adequately explored alternative school contexts. This study aims to analyze principals' leadership strategies in managing EMIS implementation in nature schools, alternative educational institutions with distinct philosophical, pedagogical, and cultural characteristics. The study employed a qualitative approach with a multiple case study design at two nature schools, Naufal Zahra School and Arrasyid School. Data were collected through semi-structured interviews with two principals as key informants and four supporting informants (teachers and system operators), participant observation, and documentary analysis. Data analysis followed the Miles, Huberman, and Saldaña interactive model encompassing data condensation, thematic display, and conclusion drawing and verification, supported by source, method, and cross-case triangulation. The findings identify five mutually reinforcing leadership strategies: needs-diagnostic planning, phased socialization and implementation, differentiated training combined with empowering operators as internal technical agents, institutional digital culture building, and adaptive management of implementation barriers. These strategies improved administrative effectiveness, accelerated data-driven decision-making, and strengthened school–parent communication while maintaining coherence with the humanistic values of nature schools. This study contributes to educational leadership theory by demonstrating that successful EMIS implementation in alternative institutions rests on contextual, transformational, and adaptive leadership strategies attuned to organizational culture.

Informasi Artikel

Kata Kunci:
kepemimpinan kepala sekolah, sistem informasi manajemen pendidikan, sekolah alam, transformasi digital, studi kasus kualitatif

ABSTRACT

Transformasi digital pendidikan menempatkan kepala sekolah sebagai aktor strategis dalam pengelolaan implementasi Sistem Informasi Manajemen Pendidikan (SIM Pendidikan), namun kajian empiris masih terkonsentrasi pada sekolah formal dan belum memadai dalam mengeksplorasi konteks sekolah alternatif. Penelitian ini bertujuan menganalisis strategi kepemimpinan kepala sekolah dalam mengelola implementasi SIM Pendidikan di sekolah alam, lembaga pendidikan yang memiliki keunikan filosofis, pedagogis, dan kultural. Penelitian menggunakan pendekatan kualitatif dengan desain studi kasus berganda (*multiple case study design*) pada dua sekolah alam, yaitu Sekolah Naufal Zahra dan Sekolah Arrasyid. Data dikumpulkan melalui wawancara semi-terstruktur dengan dua kepala sekolah sebagai informan kunci serta empat informan pendukung (guru dan operator SIM), observasi partisipatif, dan studi dokumentasi. Analisis data menerapkan model interaktif Miles, Huberman, dan Saldana melalui kondensasi data, penyajian tematik, serta penarikan dan verifikasi kesimpulan, dengan triangulasi sumber, metode, dan lintas kasus untuk menjaga keabsahan temuan. Hasil penelitian mengidentifikasi lima strategi kepemimpinan yang saling memperkuat: perencanaan berbasis diagnosis kebutuhan kelembagaan, sosialisasi dan implementasi bertahap, pelatihan terdiferensiasi disertai pemberdayaan operator sebagai agen teknis internal, pembangunan budaya digital kelembagaan, serta pengelolaan hambatan secara adaptif. Kelima strategi tersebut terbukti meningkatkan efektivitas administrasi, mempercepat pengambilan keputusan berbasis data, dan memperkuat komunikasi sekolah–orang tua, sekaligus menjaga koherensi dengan nilai humanistik sekolah alam. Penelitian ini berkontribusi pada pengembangan teori kepemimpinan pendidikan dengan menunjukkan bahwa keberhasilan implementasi SIM Pendidikan di lembaga alternatif bertumpu pada strategi kepemimpinan yang kontekstual, transformasional, dan adaptif terhadap kultur organisasi.

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1. Introduction

Digital transformation in education has positioned information technology as an important pillar in the governance of contemporary educational institutions. The acceleration of technology adoption after the COVID-19 pandemic has encouraged schools to integrate Education Management Information Systems (EMIS) as instruments for managing academic administration, learning evaluation, institutional communication, and data-based decision-making. [1] defines MIS as a technology-based system that collects, processes, stores, and distributes information to support the coordination, control, and analysis functions of an organization. In the school context, these functions are directly related to the managerial capacity of leaders in managing information as a strategic institutional resource.

The success of EMIS implementation is not determined solely by the quality of the technology adopted, but also by leadership capacity in managing the human, process, and organizational culture dimensions that accompany it. [1], [2] emphasize that principal leadership is the second most important school-level factor after teacher quality in determining the success of educational organizational transformation. In a systematic review, [3] found that school leadership functions as a key mediator between technology availability and the effectiveness of its use: principals who understand the strategic value of technology are better able to build staff capacity and create conditions conducive to digital innovation. This finding is strengthened by [4], who demonstrated a significant relationship between principals' leadership styles and the success of digital transformation in educational institutions.

Theoretically, this role is most relevantly explained through the transformational leadership framework [5], which identifies four dimensions of effective leadership: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. In the context of EMIS implementation, these four dimensions are manifested in building a shared digital vision, encouraging collective commitment, stimulating pedagogical innovation, and providing personal support during the technology adaptation process. [6], [7] complement this framework with the concept of the implementation dip, which views resistance and temporary declines in performance as normal phases in the organizational change curve, thereby requiring adaptive rather than repressive leadership. [8], in the Indonesian context, emphasizes that professional principals must master managerial competencies that include needs-based planning, resource management, and participatory change leadership.

At the national level, several recent studies have documented the positive impact of MIS implementation on school performance. [9] found that the use of MIS had a significant effect on the performance of public elementary schools in Surabaya, particularly in administrative efficiency. [10] showed that administrative digitalization increased the work efficiency of educational personnel, while [11] and [12] confirmed the contribution of MIS integration to the effectiveness of institutional management and communication. Conversely, [13] warned that limited MIS management can hinder the acceleration of digital transformation and reduce the quality of educational services. This pattern of findings consistently positions leadership as a determinant variable and indicates that MIS success is a function of managerial strategy, not merely the availability of devices.

Nevertheless, these studies still largely focus on the contexts of formal schools, madrasahs, or higher education institutions that are relatively homogeneous in terms of curriculum structure and organizational culture. The context of nature schools as an alternative education model that prioritizes humanistic, ecological, and experiential learning approaches has not received adequate attention. Nature schools operate with flexible curricula, narrative portfolio-based evaluation, and collaborative and participatory organizational cultures. These characteristics create different demands for EMIS: the adopted system must accommodate varied assessment forms, narrative student development reports, and intensive communication between schools and parents. These demands are significantly more complex than those of conventional formal schools, thereby creating specific leadership challenges that have not been widely explored empirically.

[14] underlines that every educational institution has unique cultural and organizational conditions that determine how leaders navigate the challenges of digital transformation, while [15] emphasizes the importance of aligning technological vision with organizational values so that change can be accepted organically. [16] and [17] add that the sustainability of educational digital transformation depends on leadership commitment to managing change consistently and adaptively. This line of argument shows that successful EMIS implementation in nature schools cannot be assumed to be a replication of practices in formal schools, but requires leadership strategies shaped by the institution's own pedagogical and cultural context.

Based on the literature review, three research gaps underlie this study. First, empirical studies that explore principals' leadership strategies in depth in alternative school contexts remain scarce. Second, previous studies tend to highlight the technical aspects of system use without elaborating the concrete forms of principals' managerial strategies as determinants of success. Third, there is no analytical framework that systematically maps how the dimensions of transformational leadership and change management operate in the institutional practices of nature schools. On this basis, this study aims to analyze principals' leadership strategies in managing EMIS implementation in nature schools, guided by three research questions: (1) how do principals plan EMIS implementation; (2) how do principals manage the implementation and adaptation of EMIS; and (3) what strategies do principals apply to manage barriers to EMIS implementation?

This study offers twofold contributions. Theoretically, it expands the application of transformational leadership [18] and change management [7] frameworks to alternative education contexts that have been underrepresented in educational leadership literature. Practically, the findings can serve as a reference for principals, educational foundation managers, and policymakers in designing EMIS implementation strategies that are adaptive to the cultural and pedagogical characteristics of alternative educational institutions.

2. Research Method

Research Approach and Design

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This study used a qualitative approach with a multiple case study design. The qualitative approach was selected because the aim of the study was to understand the meaning, leadership process, and dynamics of EMIS implementation contextually and in depth, rather than to measure variables quantitatively [19]. The multiple case study design was used because the study examined principals' strategies in two institutions with similar characteristics but different operational contexts, thereby enabling comparative analysis that strengthens the external validity of the findings [20]. [21] states that case studies are relevant when research focuses on leadership processes, managerial decision-making, and organizational change dynamics in real contexts. This design enabled the exploration of concrete forms of principals' strategies in planning, implementing, and evaluating EMIS implementation authentically in nature schools.

Research Location and Time

The study was conducted at two nature schools that had actively implemented EMIS, namely Naufal Zahra School and Arrasyid School. The locations were selected purposively based on four criteria: (1) the schools had integrated digital technology into academic management, communication, and administration for at least two years; (2) the principals played an active role in leading the digital transformation process; (3) the schools operated as alternative nature-based education models with organizational cultures different from formal schools; and (4) the schools were willing to participate fully, including providing access to institutional documents. The use of two locations enabled cross-case triangulation that strengthened the credibility and transferability of the findings [22]. The study was conducted over three months, from February to April 2026, through three structured phases of data collection: field orientation (February), intensive data collection (March), and data validation (April).

Research Subjects and Informant Selection Techniques

The research subjects consisted of six informants selected through a combination of purposive sampling and snowball sampling. The principals were assigned as key informants because they had the greatest authority and involvement in formulating and implementing EMIS implementation strategies. Supporting informants were selected based on principals' recommendations to ensure their direct involvement and relevance to the research focus. The inclusion criteria included: (1) active involvement in EMIS management or use; (2) understanding of the implementation process and principals' strategies; (3) at least one year of experience in the school environment studied; and (4) willingness to provide in-depth and open information. The informant profile is presented in Table 1.

Table 1. Research Informant Profile

Code	Role in the Study	Position	Institution	Selection Technique
KS-NZ-01	Key Informant	Principal	Naufal Zahra School	Purposive
G-NZ-02	Supporting Informant	Teacher	Naufal Zahra School	Snowball
OP-NZ-03	Supporting Informant	EMIS Operator	Naufal Zahra School	Snowball
KS-AR-04	Key Informant	Principal	Arrasyid School	Purposive
G-AR-05	Supporting Informant	Teacher	Arrasyid School	Snowball
OP-AR-06	Supporting Informant	EMIS Operator	Arrasyid School	Snowball

Source: Research data (2026)

Data Collection Techniques

Data were collected through three complementary techniques to generate a comprehensive understanding. First, semi-structured interviews served as the main technique for exploring principals' strategies, experiences, and views in depth. The interview guide was developed based on three analytical domains: (a) EMIS implementation planning strategies, including needs diagnosis, plan preparation, and target setting; (b) implementation and adaptation management strategies, including mentoring, training, and resource empowerment; and (c) strategies for managing barriers and evaluating implementation. The semi-structured format allowed the researcher to explore strategic dimensions that emerged from informants' experiences [16]. Interviews were conducted face to face, recorded with informants' consent, and transcribed verbatim to maintain data accuracy. Interviews with principals lasted 60-90 minutes, while interviews with supporting informants lasted 30-45 minutes.

Second, participant observation was conducted to directly observe EMIS management activities led or facilitated by the principals. The observation focused on EMIS training sessions, technical coordination meetings, operator assistance to teachers, administrative data management activities, and digital communication patterns between schools and parents. Field notes were prepared systematically using a structured format that included description, interpretation, and researcher reflection. Observations were conducted repeatedly at each location for at least eight meetings to ensure an in-depth understanding of EMIS implementation patterns in institutional routines [17].

Third, document studies were used to complement primary data through the analysis of institutional artifacts, including School Work Plans (RKS) containing digitalization programs, EMIS use evaluation reports, system technical manuals, training archives, digital attendance and assessment recaps, and school-parent communication documents. Document analysis provided objective triangulative data that did not depend on informants' perceptions [23]. The combination of these three techniques was based on the principle that a comprehensive understanding of leadership strategies can only be achieved through data triangulation across sources and methods.

Data Trustworthiness

Data trustworthiness was ensured through four validation

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strategies applied simultaneously. First, source triangulation was conducted by comparing data from the perspectives of principals, teachers, and operators to ensure consistency and completeness of information. Second, method triangulation was conducted by verifying interview findings through observation and documentation data, so that each claim regarding leadership strategy was supported by at least two different data sources. Third, member checking was conducted by confirming the interpretation of interview data with principals to ensure the accuracy of the meanings captured by the researcher. Fourth, cross-case triangulation was conducted by systematically comparing strategic patterns at Naufal Zahra School and Arrasyid School to identify the consistency of findings across contexts [19]. The simultaneous application of these four strategies produced a level of data credibility and trustworthiness consistent with qualitative research standards.

Data Analysis Techniques

Data analysis used the interactive model of [24], which consists of three simultaneous and iterative stages. First, data condensation was conducted by coding all interview, observation, and documentation data through a two-level coding system. First-cycle coding used descriptive coding to describe observed phenomena factually, while second-cycle coding used pattern coding to identify recurring patterns and themes. The coding process was carried out carefully by repeatedly referring to the raw data to maintain interpretive consistency. Second, data display was conducted in the form of structured thematic narratives that organized findings based on the dimensions of principals' strategies, supported by cross-case matrices to identify similarities and differences between the two schools. Third, conclusion drawing and verification were conducted gradually based on patterns, causal relationships, and theoretical propositions emerging from the data. Each conclusion was verified through reference back to the raw data and confirmation with relevant leadership theories. The analysis process was iterative throughout the study so that interpretation remained grounded and contextual.

Research Ethics Procedures

All research procedures were conducted in accordance with qualitative research ethics standards. Each informant was given a written informed consent form explaining the research objectives, the informant's right to withdraw without consequence, and guarantees of identity confidentiality. Informant codes (KS-NZ-01 and so forth) were used as a data anonymization mechanism to protect participants' privacy. Interview recordings were used only for transcription and research analysis purposes. Access to institutional documents was obtained through official permission from the principals and educational foundations of each institution.

3. Results and Discussion

The thematic analysis of 44 data units from six informants produced eleven codes (K-01 to K-11), which were then condensed into five main themes. These five themes represent principals' leadership strategies in managing EMIS implementation in nature schools, which took place multidimensionally and mutually reinforced one another. A summary of the themes is presented in Table 2.

Table 2. Summary of Principal Leadership Strategy Themes

Theme	Theme Name	Data Code	Informants Involved	Number of Quotations
T1	Needs-Diagnostic Planning Strategy	K-01, K-10	KS-NZ-01, KS-AR-04	6
T2	Training and Operator Empowerment Strategy	K-05, K-08	KS-NZ-01, G-NZ-02, OP-NZ-03, KS-AR-04, G-AR-05	12
T3	Institutional Digital Culture Building Strategy	K-03, K-07	KS-NZ-01, G-NZ-02, OP-NZ-03, G-AR-05	9
T4	Measurable Benefits of the EMIS Implementation Strategy	K-02, K-09	All informants	11
T5	Barrier Management and Continuous Evaluation Strategy	K-04, K-06	All informants	6

Source: Research data analysis results (2026); total of 44 data units from 6 informants

Theme 1: Needs-Diagnostic Implementation Planning Strategy

The first theme reveals that principals in both locations began EMIS implementation by diagnosing concrete managerial problems. The Principal of Naufal Zahra School described the background of this strategic decision as follows:

> *"Initially, it was because data management was still manual. Many data were scattered, and the reporting process took a long time." (KS-NZ-01)*

This specific and measurable diagnosis of problems reflects the dimension of intellectual stimulation in transformational leadership [18], namely the leader's capacity to encourage critical problem identification and data-based solution formulation. The Principal of Arrasyid School reinforced this pattern by setting specific implementation goals, namely "to improve administrative efficiency and facilitate communication among the school, teachers, students, and parents" (KS-AR-04). Such measurable goal formulation indicates the principal's managerial capacity to align technology adoption with the institution's strategic needs [8]. KS-AR-04's statement that "digitalization has become a current school need" further shows a leadership vision that is proactive toward external environmental dynamics.

Observation and documentation data strengthened this finding. Implementation planning in both schools was carried out through the preparation of a phased program consisting of socialization, training, and system application according to organizational readiness. This incremental approach is consistent

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with the principles of change management [7], which state that effective innovation considers organizational readiness capacity at each implementation phase. The School Work Plan (RKS) documents in both institutions showed that the digitalization program was designed with measurable achievement targets per semester, an indicator of systematic strategic planning. This pattern also indicates a shift from reactive decision-making to anticipatory decision-making, which characterizes adaptive leadership in digital transformation [16].

Theme 2: Differentiated Training Strategy and Empowerment of Operators as Internal Technical Agents

The second theme identifies human resource capacity development as the core of implementation management. Interview data showed that, at the initial stage, some teachers had difficulty adapting to the new system. This transition experience was described by a teacher at Naufal Zahra School:

> *"At first, I was quite confused because all administration had previously been done manually, but after the training I began to get used to it." (G-NZ-02)*

The gap in digital competence among users was also acknowledged by the Principal of Arrasyid School, who stated that "not all educators have the same digital skills" (KS-AR-04). The principals' strategic response to this condition took the form of routine training programs differentiated by ability level and continuous technical assistance. Conceptually, this differentiation strategy embodies the dimension of individualized consideration in transformational leadership [18]: leaders provide attention and support tailored to the specific needs of each staff member, rather than applying a uniform approach that may leave groups of users with low competence behind.

The most distinctive finding of this study is the principals' strategy of empowering school operators as organized internal technical agents. Principals deliberately positioned operators not merely as technical administrative staff, but as strategic implementation partners responsible for assisting teachers. This pattern was documented in the statement of the Arrasyid School Operator:

> *"We communicate regularly about data updates and problems in using the system." (OP-AR-06)*

The Naufal Zahra School Operator described the scope of this strategic function: "I manage school data, ensure that the system runs well, and assist teachers and principals in using EMIS" (OP-NZ-03), while the Arrasyid School Teacher confirmed: "The school operator often helps when teachers experience difficulties" (G-AR-05). This operator empowerment strategy is consistent with [3], who states that effective principals in technology management identify, train, and empower staff as technology leaders within the school. This practice represents a distribution of technical leadership that enhances implementation sustainability without creating dependence on one individual. Furthermore, this strategy goes beyond the technical approaches reported by [9] and [10] by adding a relational dimension in which operators function as cultural bridges between technology and educational practitioners.

Theme 3: Institutional Digital Culture Building Strategy

The third theme reveals that principals proactively built a digital culture as a long-term strategy supporting implementation sustainability. The Principal of Naufal Zahra School articulated a vision that went beyond merely technical aspects:

> *"I hope digital transformation is not only about technology, but also about changing the work culture to become more effective and open to innovation." (KS-NZ-01)*

This leadership vision, which places organizational culture above technology, is consistent with [7], which argues that sustainable educational transformation requires cultural change, not merely technical change. [4] adds that principals oriented toward digital culture building are better able to create organizational ecosystems that are adaptive to technological change. [15] views cultural change as a key indicator of genuine institutional leadership success.

Manifestations of work culture change were consistently documented across all informants. The Principal of Naufal Zahra School reported that "administration has become more organized, and teachers are also beginning to get used to using technology" (KS-NZ-01), and that "parents can now monitor their children's development through the digital system" (KS-NZ-01). In terms of operational efficiency, the Naufal Zahra School Operator stated: "Administrative work used to take a long time. Now it is faster and more organized" (OP-NZ-03). The Arrasyid School Teacher reported a pedagogical impact: "Administrative work is faster, so teachers can focus more on learning" (G-AR-05). The convergence of experiences across roles shows that principal leadership did not merely change the system, but also changed the mindset and work patterns of all members of the school community [6]. An important note is that this cultural change occurred without eroding the humanistic identity of nature schools, indicating that principals successfully managed the tension between technological modernization and preservation of institutional values.

Theme 4: Measurable Benefits of the EMIS Implementation Strategy

The fourth theme documents the concrete benefits generated by principals' strategies in managing EMIS implementation. The Principal of Arrasyid School described the most strategic benefit by stating that EMIS "helps accelerate access to information and facilitates data-based decision-making" (KS-AR-04). The acceleration of data-based decision-making is a direct manifestation of the value of an effective EMIS. [1] emphasizes that management information systems function to transform data into meaningful information that supports accurate, timely, and evidence-based managerial decision-making.

These benefits were felt consistently across all user levels: teachers reported ease in managing attendance, assessment, and learning reports ("EMIS helps in managing materials, attendance, and learning evaluation", G-AR-05); operators reported efficiency in data management ("it is quite effective because all data are stored digitally and are easier to find", OP-NZ-03); and the parent community experienced improved quality of institutional communication. This pattern confirms the findings of [9], [10], and [11] regarding the positive impact of MIS on institutional performance.

The new contribution of this study lies in identifying the social-relational dimension of MIS benefits in the context of

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nature schools. Digital systems function not only as instruments of administrative efficiency, but also as means of maintaining community connectedness: parents can monitor their children's development in real time, teachers can prepare narrative student development reports aligned with the portfolio approach of nature schools, and principals can coordinate institutional activities based on accurate data. Thus, in the context of alternative schools, MIS effectiveness has relational and community dimensions that are generally overlooked in previous studies of formal schools. This finding expands the literature by showing that EMIS success can be evaluated not only through efficiency indicators, but also through its capacity to support the social relations of the educational community.

Theme 5: Barrier Management and Continuous Evaluation Strategy

The fifth theme identifies implementation barriers and principals' response strategies for managing them adaptively. Three main categories of barriers were identified from field data: limited digital competence among users, technological infrastructure constraints, and cultural resistance to changes in work systems. The Naufal Zahra School Operator reported a technical barrier: "Usually the problems are the internet connection and some users forgetting how to use the system" (OP-NZ-03). The Arrasyid School Teacher added: "Sometimes when the system has an error or the internet is unstable, the learning process is disrupted" (G-AR-05). From a leadership perspective, the Principal of Arrasyid School identified a structural barrier in the form of disparities in educators' digital competence.

Principals in both locations responded to these barriers through layered adaptive strategies. First, they ensured the availability of internal technical assistance through operators who were ready to help throughout working hours. Second, they advocated the strengthening of technological infrastructure to foundations and external stakeholders. Third, they created open feedback mechanisms so that system-use problems could be reported and addressed quickly. Fourth, they built internal digital learning communities that facilitated collaboration among users in sharing solutions to technical problems.

These layered adaptive strategies reflect principals' understanding of the concept of implementation dip [7]: barriers are viewed as a normal phase of organizational learning, not as failure, and are therefore addressed through capacity strengthening rather than program reduction. [14] emphasizes that principals who successfully navigate the challenges of digital transformation are those who can turn barriers into organizational learning opportunities that strengthen institutional capacity sustainably. Similarly, [2] emphasizes that effective principals are those who build the collective capacity of organizations to respond to and recover from each barrier constructively. Viewed comparatively across cases, the response pattern at Naufal Zahra School tended to emphasize collective involvement of educators in problem-solving discussions, whereas the pattern at Arrasyid School was more prominent in its technical assistance structure through operators. These differences show that principals' strategies, although derived from the same principles, are manifested in practices shaped by the configuration of resources and internal culture of each institution.

Integrative Discussion: Configuration of Leadership Strategies in the Nature School Context

The synthesis of the five themes reveals that principals' leadership strategies in managing EMIS implementation in nature schools form a multidimensional configuration that interacts synergistically. Needs-diagnostic planning becomes the starting point that sets the strategic direction; differentiated training and operator empowerment provide the required technical and relational capacities; digital culture building ensures the sustainability of change; mapping benefits provides empirical legitimacy that strengthens collective commitment; and adaptive barrier management ensures implementation resilience amid field dynamics. This configuration supports [6], which argues that effective school leadership operates through an integrated combination of transformational and instructional strategies, rather than through the application of a single dimension.

The distinctive characteristic of leadership in nature schools is the principal's ability to manage the cultural tension between the drive for technological modernization and commitment to institutional humanistic values. This tension is not resolved through a compromise that weakens one side, but through an integration strategy that positions technology as a means, not an end, for strengthening the pedagogical mission of nature schools. This pattern confirms [15] regarding the importance of aligning leadership with organizational culture, while also expanding it by showing how such alignment is practiced in alternative education contexts. Furthermore, this capacity goes beyond conventional transformational leadership frameworks that are generally formulated in formal organizational contexts, and points toward what can be identified as culturally anchored transformational leadership: transformational leadership rooted in institutional culture.

4. Conclusion

This study concludes that principals play a determinant role in the successful management of EMIS implementation in nature schools, and that this success derives from a configuration of five mutually reinforcing leadership strategies: (1) implementation planning based on problem diagnosis and institutional needs analysis; (2) phased socialization and implementation that considers the readiness capacity of human resources; (3) differentiated training accompanied by the empowerment of operators as internal technical agents; (4) institutional digital culture building that aligns technology with the humanistic values of nature schools; and (5) adaptive barrier management through continuous assistance, infrastructure advocacy, and responsive evaluation. EMIS implementation managed through these five strategies has been shown to improve administrative efficiency, accelerate data-based decision-making, facilitate learning management, and significantly strengthen school-parent communication.

Theoretically, this study provides two main contributions. First, it expands the application of the transformational leadership framework [18] into the context of alternative schools by showing how the four dimensions of transformational leadership - idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration - operate concretely in EMIS management practices. Second, this study offers the concept of culturally anchored transformational

leadership as a theoretical elaboration that accommodates the characteristics of educational leadership in alternative institutions with distinctive cultural identities. This study also confirms Fullan's (2007) change management proposition that the success of educational digital transformation depends on leaders' capacity to manage the implementation dip constructively.

Practically, this study recommends four points. First, principals need to develop digital leadership competence as part of a structured program of continuous professional development. Second, EMIS implementation in nature schools should be designed by considering the uniqueness of institutional culture and pedagogy, rather than copying systems developed for formal schools. Third, the empowerment of school operators as internal technical agents needs to be formally institutionalized in the organizational structure and clear job descriptions. Fourth, educational policymakers need to strengthen digital infrastructure development programs and principals' digital competence as systemic prerequisites for the successful implementation of EMIS.

The limitation of this study lies in its coverage of two nature school locations, which limits the generalizability of the findings. Future studies are recommended to use a broader comparative approach or mixed methods involving more alternative schools across various geographical and cultural contexts to test the robustness of the five-strategy configuration identified in this study, while also developing a more generalizable model of principal leadership in EMIS management.

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