

Artificial Intelligence in School Management. A Systematic Review

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Abstract

This article addresses a significant gap in the literature by synthesizing peer-reviewed evidence on artificial intelligence (AI) applications in school management, focusing on administrative decision-making, resource allocation, operational support, and educational leadership. The review follows PRISMA guidelines and draws on approximately forty peer-reviewed studies published between 2018 and 2026, retrieved from SpringerLink, Sage Journals, ScienceDirect, ERIC, and Google Scholar. To contextualize AI-enabled administrative functions, the analysis also incorporates research from organizational studies, management information systems, business process management, and cybersecurity. Particular attention is given to explainable AI and stewardship, including formal modeling approaches for administrative processes and techniques that enhance the transparency and accountability of algorithmic decision-making. The review further examines financial management, student data protection, cybersecurity, interoperability, federated learning, and the integration of large language models into school information and ERP systems. Three key themes emerge. First, AI can improve administrative efficiency, reduce workload, strengthen data-informed decision-making, and optimize organizational processes. Second, successful implementation depends on robust governance frameworks, ethical guidelines, AI literacy among staff and leaders, effective data protection and cybersecurity measures, interoperability planning, and adequate digital infrastructure. Third, core dimensions of educational leadership—including professional judgment, relational trust, contextual understanding, creativity, and ethical accountability—remain indispensable and should be preserved as AI adoption expands. Based on these findings, the article proposes three research hypotheses concerning the relationship between AI-driven automation and administrative workload, the role of AI governance frameworks in shaping stakeholder outcomes, and the moderating effect of organizational support on the relationship between AI integration and institutional performance. The review also identifies methodological limitations in the existing evidence base, which remains dominated by conceptual and qualitative studies. Overall, AI offers substantial potential to transform school management, but its effectiveness depends on sustained

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investment in governance, technical safeguards, AI literacy, transparency, and equity-oriented implementation practices.

Keywords:

Artificial intelligence in education, school management, educational leadership, administrative automation, decision support systems, AI ethics.

Introduction

School leaders in the twenty-first century operate in an increasingly complex environment. Principals, district administrators, and school management teams are simultaneously expected to drive instructional improvement, manage increasingly diverse student populations, navigate evolving legislative and regulatory requirements, satisfy stakeholder accountability demands, and maintain operational efficiency within constrained financial resources. Administrative tasks — scheduling, attendance monitoring, budget management, reporting, staff appraisal, resource allocation, parent and community communication — consume enormous proportions of school leaders' time and cognitive bandwidth, often at the direct expense of instructional leadership, professional development, and the relational work that animates healthy school cultures.

Into this context, artificial intelligence has arrived not as a speculative futuristic prospect, but as an increasingly present technological reality. Machine learning algorithms, natural language processing systems, predictive analytics platforms, computer vision tools, and decision-support architectures are already being piloted and deployed across educational settings worldwide. Vendors market AI-powered school management systems that claim to automate routine administrative tasks, generate real-time performance dashboards, optimize staff scheduling, predict student attendance and dropout risk, and provide evidence-based recommendations to school leaders. National and regional education authorities in several countries have begun developing AI policy frameworks for schools. At the same time, critical scholars have raised urgent questions about algorithmic bias, data privacy, the displacement of human professional judgment, and the risk that AI adoption in schools may deepen rather than mitigate

existing educational inequities. Across organizational contexts more broadly, AI adoption in management information systems (MIS) and management research has accelerated, yet reviews identify persistent gaps in understanding key adoption factors, topic evolution, and the socio-technical relationship between artificial and human intelligence (Islami & Mulolli, 2024, p.4; Liu et al., 2024, p.3; Stoykova & Shakev, 2023, p.9). These developments raise questions about how to design, deploy, and govern AI so that it remains explainable, context-sensitive, and aligned with human educational and organizational goals. Explainability represents a central concern across these domains. In compulsory education, prediction systems that estimate pupils' future attendance rely on private data and can affect access to schooling and grades, thereby risking disadvantage for underperforming students if their operation remains opaque (Kammüller & Satija, 2023, p.8). In adjacent domains, deep AI networks trained on large benchmark datasets are being repurposed for tasks such as waste classification, where object contamination and deformation challenge generalizability and highlight the need for domain-informed augmentation and explanation of model behavior; kernel-weight analyses of architectures such as ResNet, ConvNeXt, and vision transformers show diminishing contributions from deeper layers, motivating leaner architectures that balance accuracy with explainability (Arashpour, 2023) — a tension that maps directly onto the trade-off between predictive power and interpretability that recurs throughout the school-management literature. In educational leadership specifically, analyses of Principal Ethical AI Leadership (PEAIL) portray a conceptually rich but empirically preliminary field, in which advocacy for values such as fairness and inclusion outpaces systematic evidence about how leaders handle day-to-day ethical dilemmas around AI (Ho, 2026). This scholarship further notes an under-representation of principals' own voices, uneven contextual diversity, and a narrow methodological repertoire, all of which constrain the development of robust, context-sensitive guidance for school leaders navigating AI-related decisions. Formal modeling and systematic review methodologies have been proposed to address different facets of these challenges. In the case of pupils' attendance prediction, the Isabelle Infrastructure Framework

(III_f) has been instantiated to represent attendance infrastructures as Kripke structures, with actors, locations, labeled private data, and a black-box function that maps data tuples to attendance predictions, alongside explicit actions such as ‘put’ and ‘eval’ governed by local policies (Kammüller & Satija, 2023, p.8). This formalization supports model checking and attack-tree-based reasoning about how attendance decisions are produced and how counterfactual modifications to disadvantage status or location can change outcomes, thereby offering a principled route to explanation of opaque decision procedures. In MIS, systematic literature reviews using rigorously defined research questions and search strategies have similarly been advanced to identify AI capabilities, platforms, business value, and organizational challenges, emphasizing transparency, replicability, and comprehensive coverage of available studies (Stoykova & Shakev, 2023, p.14). The scope of this article is deliberately bounded: it is concerned not with AI as a tool for teaching and learning, but with AI as an instrument of school organization, management, operational support, and leadership stewardship. The guiding question is: what does the current evidence base — spanning education-specific research, ethical-leadership scholarship, and adjacent organizational, management-information-systems, business-process-management, and cybersecurity literatures — tell us about how AI can be integrated into school management and support processes, and what are the conditions, benefits, risks, explainability requirements, and implications of such integration for educational leadership?

1. Background and Conceptual Foundations

1.1. Dimensions of AI in Educational Contexts

Within modern schooling systems, AI-driven tools represent a new phase in this evolution by offering data-driven personalization and automation within large-scale settings. Operationalizations of AI in K–12 contexts include predictive analytics that forecast academic performance or behavioral risk, adaptive learning environments, intelligent tutoring systems that personalize instruction and feedback, and generative models such as ChatGPT. Research on AI in education

conceptualizes these applications as a heterogeneous umbrella of machine-learning and data-driven systems embedded in everyday school practice, extending the longstanding project of managing diversity and individual needs within mass education. Systematic reviews of Principal Ethical AI Leadership use this operational definition to examine how school leaders confront equity, inclusion, and accountability issues arising from the deployment of such systems (Ho, 2026). Insights from the adjacent literature on AI applied to business process management indicate that machine learning and natural language processing can be employed to monitor and predict process trajectories while also surfacing practical problems such as label ambiguity and limited generalization — issues directly relevant when school systems deploy predictive analytics and adaptive tutoring tools (Fettke & Di Francescomarino, 2025, p.69). Label ambiguity, noisy event acquisition, and weak generalization often limit reliability and can make explanations brittle in practice, with similar data issues potentially eroding fairness and producing opaque recommendations when adaptive tutors or risk models are deployed across diverse student populations. Business process management research also explores techniques for improving event-log quality and semantically enriching process descriptions, measures that may suggest practical ways to strengthen prediction and explainability when analogous analytics are introduced in educational systems (Fettke & Di Francescomarino, 2025, p.73). A complementary strand centers on AI literacy and curriculum design. Contemporary analyses propose that integrating AI into education proceeds along two intertwined pathways: preparing students to participate in AI-shaped societies and economies, and deploying AI itself to support and personalize learning environments. The first pathway involves deliberately embedding topics such as coding, machine learning, data science, robotics, and neural networks across educational stages, beginning with foundational exposure in early schooling and advancing into higher education. The second entails engaging learners directly with AI tools and platforms, including large language models, AI-powered textbooks, and other modalities that personalize content and interaction. Historical experience with curriculum reform informs current calls for comprehensive competency

frameworks that move beyond technical skills to include critical thinking, problem solving, and reflection on ethical issues such as data privacy, algorithmic bias, and broader societal impacts. Efforts such as the Council of Europe's proposed “compass for AI in education,” intended to translate human rights and democratic standards into concrete guidance for responsible, human-centric AI use in education, exemplify this institutionalization of AI-related competencies within a long tradition of policy frameworks steering educational change (Reimers et al., 2025).

1.2. Defining AI in School Management

Artificial intelligence, for this review, refers to computational systems that perform tasks traditionally requiring human intelligence, including pattern recognition, prediction, natural language understanding, and decision support. The primary AI technologies identified in the literature as relevant to school management include machine learning (ML) algorithms for prediction and classification; predictive analytics platforms for attendance, performance, and resource forecasting; natural language processing (NLP) for communication, document processing, and reporting; computer vision systems for attendance automation and security monitoring; knowledge-based decision support systems; and AI-driven business intelligence and analytics dashboards. School management and organizational support processes encompasses the full range of administrative, operational, governance, and leadership activities that sustain the functioning of educational organizations. This includes, but is not limited to, student information management; staff scheduling and human resource administration; attendance monitoring and reporting; budget planning and resource allocation; communication and community engagement; decision support for principals and senior leaders; school self-evaluation and performance monitoring; compliance and regulatory reporting; and strategic planning. Conceptualizations of AI in school management emerge most clearly when examined through principals' concrete uses of data-driven systems, automation tools, and generative applications in day-to-day leadership. Studies on Principal Ethical AI Leadership (PEAIL)

describe AI as embedded in the same data infrastructures that underpin teaching, assessment, and organizational dashboards, positioning AI not as an isolated tool but as part of broader analytic platforms guiding school-level decisions. Within this perspective, AI in school management is defined operationally by the socio-technical arrangements through which principals process information, allocate resources, and exercise ethical agency in digitally mediated environments (Ho, 2026). Empirical and advocacy-oriented work portrays AI as supporting multiple managerial domains, AI-based predictive analytics and risk-management tools contribute to evidence-based decisions, particularly around forecasting and scenario analysis for school improvement; operationally, automated systems for scheduling, grading, and attendance exemplify AI applications that increase efficiency and free leaders to concentrate on higher-level strategic goals; in professional development, AI applications identify teachers' learning needs and deliver personalized coaching through virtual platforms, embedding staff development within continuous, data-informed cycles; and in communication and equity, multilingual messaging, stakeholder feedback collection, and student well-being support via chatbots situate AI within relational and inclusion-oriented dimensions of school management (Ho, 2026). PEAIL scholarship refines this definition by emphasizing AI as both an object and a context of ethical stewardship. PEAIL is described as a context-sensitive practice that links micro-level moral agency with macro-level socio-technical and policy frameworks, recognizing that opaque technologies, structural inequities, and external governance pressures shape principals' scope of action. Within this framing, AI in school management encompasses tools whose outcomes affect instructional and professional practices, organizational systems and governance, and equity and inclusion. Responsible use of AI to support personalization, differentiation, and student engagement is explicitly distinguished from any replacement of pedagogical judgment, defining AI as augmentative rather than substitutive in instructional decision processes. Organizational and governance uses constitute another definitional pillar. Ethical principals are described as implementing AI in administrative functions such as scheduling, reporting, and resource

allocation while ensuring that efficiency gains do not erode transparency or fairness. Acting as gatekeepers, they interpret AI-generated data through a critical lens, uphold privacy and legal compliance, and align AI deployment with school values and policy frameworks. Under this view, AI in school management refers not only to the technical systems themselves but also to the leadership practices that filter, contextualize, and constrain their influence (Ho, 2026). A complementary leadership framework elaborates AI-specific domains aligned with professional standards for educational leaders. Within this framework, AI is defined in terms of its role in data-informed decision-making, operational efficiency, and administrative transformation. Principals are expected to use AI tools to monitor key performance indicators, automate routine tasks such as scheduling, attendance reporting, and basic communications, and employ AI for compliance tracking, budgeting, and resource allocation, always with human judgment and ethical oversight (DeMatthews et al., 2026, p.3). Conceptualizing AI in this way embeds it within strategic planning and visioning, where principals cultivate a shared, people-centered vision of AI integration, maintain a human-in-the-loop approach, and align AI work with district and state policies. Other accounts describe AI as an “extended brain” that helps principals process information, track compliance and performance in real time, and make timely, data-informed decisions, provided that findings are corroborated with human stakeholders such as teachers and counselors. Generative AI systems are additionally defined by their capacity to automate emails, meeting summaries, budget tracking, and report writing, while requiring secure, institutionally governed platforms for any interaction with sensitive student data (DeMatthews et al., 2026, p.4). Across these strands, AI in school management is thus delineated as a multi-domain ensemble of analytic, automating, and generative tools whose meaning is co-constituted by ethical leadership practices, governance structures, and human-in-the-loop oversight.

1.3. Taxonomic Landscape: AI Applications in Educational Leadership

Sposato (2025), in a comprehensive taxonomy of AI applications in educational leadership, identifies multiple domains in which AI is

shaping school leadership practice. Drawing on an extensive review of literature, Sposato organizes AI applications along two axes: the level of decision-making they support (operational, tactical, or strategic), and the nature of the human–AI relationship (tool, assistant, collaborator, or autonomous agent). This taxonomy provides a useful organizing frame for the evidence synthesized in this review.

At the operational level, AI tools automate routine administrative tasks: generating reports, monitoring attendance, processing scheduling conflicts, managing communications, and tracking resource usage. These tools function primarily as instruments that extend human capacity without substantially altering the nature of decision-making. At the tactical level, AI systems support more complex decisions: analyzing student performance data, identifying at-risk students, comparing resource allocation options, and evaluating staff performance patterns. Here, the human–AI relationship begins to involve genuine collaborative reasoning, with AI surfacing patterns and options that school leaders evaluate and act upon. At the strategic level — still largely aspirational in the current literature — AI systems might support long-term school improvement planning, policy formation, and organizational learning, potentially functioning as genuine decision partners to school leaders.

1.4. The Human-AI Collaboration Imperative

Arar (2024) develops the concept of “symbiotic co-leadership,” arguing that the most productive human–AI relationships in school contexts are those in which each party contributes what it does best: AI contributes computational power, pattern recognition, scalability, and consistency; humans contribute contextual wisdom, ethical judgment, relational intelligence, and creative adaptation. This framing is echoed across the literature and constitutes the first major conceptual pillar of the field.

Dai & Rawolle (2025) argue that effective AI integration in school management requires clarity about where human judgment is irreplaceable, active co-design of AI tools with educators rather than imposition of external vendor systems, and institutional structures that ensure human oversight of AI-generated recommendations. This framework is significant because it resists both techno-utopian accounts of AI as a simple efficiency fix and dystopian accounts of AI as an

existential threat to professional autonomy, offering instead a nuanced middle ground grounded in respect for the complexity of educational leadership.

2. Theoretical Foundation of School Management through AI perspective

2.1. Educational Management Theories

Research on principal preparation for AI integration foregrounds the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and Diffusion of Innovations (DOI) as core perspectives explaining how individual perceptions, social influence, and systemic conditions shape technology use in schools. These frameworks treat adoption as both technical and socio-organizational, emphasizing perceived usefulness and ease of use, organizational support, and the relative advantage and compatibility of innovations within existing practices. Within educational leadership scholarship, these adoption theories are mobilized to argue that successful AI integration depends simultaneously on personal attitudes, school culture, and structural arrangements, making them foundational reference points for management thinking in AI-rich environments.

Leadership-focused theories complement these adoption models by specifying how principals can shape conditions for AI use. Instructional leadership, transformational leadership, distributed leadership, and social justice leadership are each invoked to conceptualize how school leaders guide technology-related change. Instructional leadership centers on improving teaching and learning, so AI tools are assessed in terms of alignment with instructional goals and teacher growth. Transformational leadership stresses vision and motivation; principals who articulate ethical AI use and model innovation can help their schools navigate adoption challenges. Distributed leadership emphasizes teamwork and shared responsibility, positioning AI initiatives as collective projects rather than individual decisions. Social justice leadership introduces an explicit equity lens, orienting AI use

toward benefits for underserved students and protection against exacerbated inequalities (DeMatthews et al., 2026, p.6).

Ethical leadership theories are reinterpreted in light of AI through the conceptualization of Principal Ethical AI Leadership (PEAIL). PEAIL is framed as socio-technical stewardship in which principals operate within multi-level ecologies that link personal virtue, organizational cultures, and external governance environments (Ho, 2026). Existing work shows that ethical leadership in this context involves cultivating trust, modeling principled behavior, and sustaining open dialogue, with these relational qualities treated as preconditions for addressing AI-related dilemmas around surveillance, automation, and equity. Outcome-oriented syntheses group the effects of PEAIL into domains such as instructional and professional practices, organizational systems and governance, and equity and inclusion, illustrating how ethical leadership norms translate into concrete decisions about personalization, administrative automation, and the protection of vulnerable students (Ho, 2026).

Methodologically oriented reviews of PEAIL expose important gaps in how these theories are operationalized. Across 62 studies on AI and ethical leadership, conceptual and qualitative designs dominate, including nine conceptual pieces, seven commentaries, and 15–16 qualitative studies, with relatively few investigations directly examining how school leaders make ethical decisions about AI tools. Quantitative work largely addresses technology acceptance and attitudes rather than ethical judgment, while theoretical engagement spans 23 frameworks, of which Decision-Making Theory and Transformational Leadership Theory appear only a handful of times each. Critically oriented perspectives such as Critical Race Theory and Intersectional Feminist Theory occur rarely, signaling that systemic equity analyses remain marginal within current educational management theorizing around AI (Ho, 2026). Synthesis across this body of work yields a constrained but coherent picture of educational management theories under digital disruption: technology adoption models explain individual and organizational readiness for AI, traditional leadership theories provide lenses on instructional, transformational, distributed, and justice-oriented practices, and PEAIL

recasts ethical leadership as context-sensitive stewardship in AI-integrated schools (DeMatthews et al., 2026, p.5; Ho, 2026). At the same time, empirical fragility, over-reliance on advocacy-oriented writings, and limited use of rigorous systematic review standards indicate that these theoretical strands require further refinement and robust validation before they can fully guide educational management in AI-rich systems (Ho, 2026).

2.2. AI-Related Theoretical Frameworks

AI-related theorizing in education currently develops unevenly across conceptual domains, with several strands explicitly identified as underdeveloped or fragmented. A systematic synthesis of artificial intelligence in education (AIEd) reviews reports that only 7.84% of included work engages directly with AIEd theories, despite their critical role in guiding the design, implementation, and evaluation of AI systems for teaching and learning. This relative scarcity is linked to difficulties in integrating abstract theoretical insights into real-world educational settings and to a wider gap between technological capabilities and educational theories that specify how, why, and under what conditions AI can support learning processes effectively. Existing AI-related frameworks in AIEd are often applied descriptively rather than subjected to empirical testing: Cognitive Load Theory and Self-Regulated Learning Theory are frequently invoked to justify the design of AI-based tutoring and assessment systems, yet few studies assess whether such interventions genuinely reduce cognitive load or foster self-regulation in practice. Parallel fragmentation appears where Social Agency Theory, TPACK, the Technology Acceptance Model, and Constructivism are typically used in isolation, with limited attempts to connect or integrate them into broader explanatory models of learning with AI. This siloed application constrains comprehensive accounts of how cognitive, emotional, and social factors jointly shape students' engagement with AI tools (Huang et al., 2026, p.3).

Conceptual gaps also concern the temporal relationship between technological innovation and theory-building. While AI techniques and applications evolve rapidly, frameworks tailored specifically to AIEd lag behind. Most studies continue to rely on established learning theories rather than generating AI-informed conceptual models that

capture issues such as AI-enhanced feedback, human–AI co-agency, or the dynamics of overreliance and critical engagement in AI-infused environments. As a result, the field calls explicitly for theories extended using evidence from learning analytics and human–AI collaboration, with a view to explaining how AI can scaffold student thinking, support teachers' metacognitive reflection, and sustain creativity and critical thinking (Huang et al., 2026, p.12). Beyond individual learning theories, wider framework architectures have been proposed to structure AIED research. One synthesis introduces a three-level thematic framework distinguishing user-related themes from developer-related themes at Level 1, then differentiating AI education and literacy, AI applications, AI challenges, and AI technology development at Level 2, and finally specifying more granular constructs such as AI education courses, AI literacy, AI ethics, AI functions, AI utilization processes, AI techniques, AI programming languages, and AI operating platforms at Level 3. This hierarchical arrangement clarifies how conceptual work on AI ethics, utilization processes, and technical underpinnings can be systematically related rather than treated as isolated topics, and it connects theoretical constructs explicitly to functional categories such as prediction, detection, classification, decision-making, and automated assessment (Huang et al., 2026, p 5).

Methodological reflections on AI-related theoretical frameworks in educational leadership exhibit a comparable pattern of conceptual richness and empirical thinness. Reviews of PEAIL adopt established ethical leadership theories but then ground the resulting conceptual model in empirical patterns across 62 studies, rather than imposing predefined assumptions (Ho, 2026). This approach yields a multi-layered ecology in which individual dispositions, organizational cultures, policy environments, and societal norms jointly shape how principals address AI-mediated dilemmas, yet reviewers stress that PEAIL remains a framework “informed by theory and guided by evidence” rather than a theory rigorously validated through extensive field data (Ho, 2026). Across these strands, research shows that AI-related theoretical frameworks in education are characterized by underdeveloped dedicated AIED theories, descriptive rather than

testing-oriented uses of classic learning theories, fragmented deployment of technology adoption and pedagogical frameworks, and emerging but empirically limited models of socio-technical stewardship in leadership. Calls for future work converge on tighter coupling between theory and practice, explicit integration of cognitive, emotional, and social perspectives, and the development of AI-specific conceptual models grounded in systematic empirical assessment (Ho, 2026, p.12; Huang et al., 2026, p.7).

3. Research methodology

The research goal is to identify how AI is being implemented in school management processes and to determine the extent to which it is changing school management theory.

We used PRISMA framework. Searches were conducted in the following databases: SpringerLink, Sage Journals, ScienceDirect (Elsevier), ERIC (Education Resources Information Center), and Google Scholar. The search was conducted using Boolean keyword combinations including, but not limited to: “artificial intelligence” AND “school management”; “AI” AND “educational leadership”; “machine learning” AND “school administration”; “predictive analytics” AND “educational decision-making”; “natural language processing” AND “school organization”; “AI” AND “principal leadership”; “automation” AND “school processes”; “AI ethics” AND “education management”; “decision support systems” AND “educational organizations”; and “AI” AND “administrative efficiency” AND “schools.”

3.1. Eligibility Criteria

Inclusion criteria for the review were: (1) peer-reviewed articles or book chapters published in English between January 2018 and April 2026; (2) empirical, theoretical, review, or framework articles addressing the use of AI in school management, administrative processes, educational leadership, or organizational support functions in pre-university education settings; (3) articles providing sufficient methodological detail and analytical substance to enable quality assessment. Exclusion criteria were: (1) articles focused exclusively on

AI applications in classroom instruction or direct student learning without addressing managerial or organizational dimensions; (2) grey literature, conference proceedings, and non-peer-reviewed sources; (3) duplicates; (4) articles in languages other than English.

3.2. Screening and Quality Assessment

Following the initial database search, approximately 400 records were identified after deduplication. Title and abstract screening reduced this to approximately 80 potentially eligible full-text articles. Full-text review against the eligibility criteria resulted in a final corpus of approximately 26 sources for qualitative synthesis. Studies were assessed on criteria including clarity of research design, relevance of evidence to the review question, transparency of methodology, and appropriateness of conclusions relative to data. No studies were excluded solely on quality grounds, but quality assessments informed the weight given to different sources in the narrative synthesis.

Data Extraction and Synthesis

Data were extracted from each included source using a structured extraction template covering: author(s), year, country/context, study type, AI application described, educational management level addressed, benefits reported, challenges identified, ethical dimensions discussed, and key conclusions. Extracted data were analyzed thematically, following the six-phase thematic analysis process described by Braun and Clarke (2006): familiarization, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Three overarching themes — benefits, implementation challenges and equity implications, and the human dimension of leadership — and multiple sub-themes were identified, which structure the findings reported in Sections 5 through 8 of this article. Where the supplementary explainability, governance, and organizational sources offered evidence that extended rather than duplicated the core corpus — for example on financial and resource management, student data management and cybersecurity, interoperability, and the analysis of correlations between AI adoption and school performance — these were integrated as additional sub-

themes within the same thematic structure, with all attributions traced to their original sources to ensure fidelity to the underlying evidence.

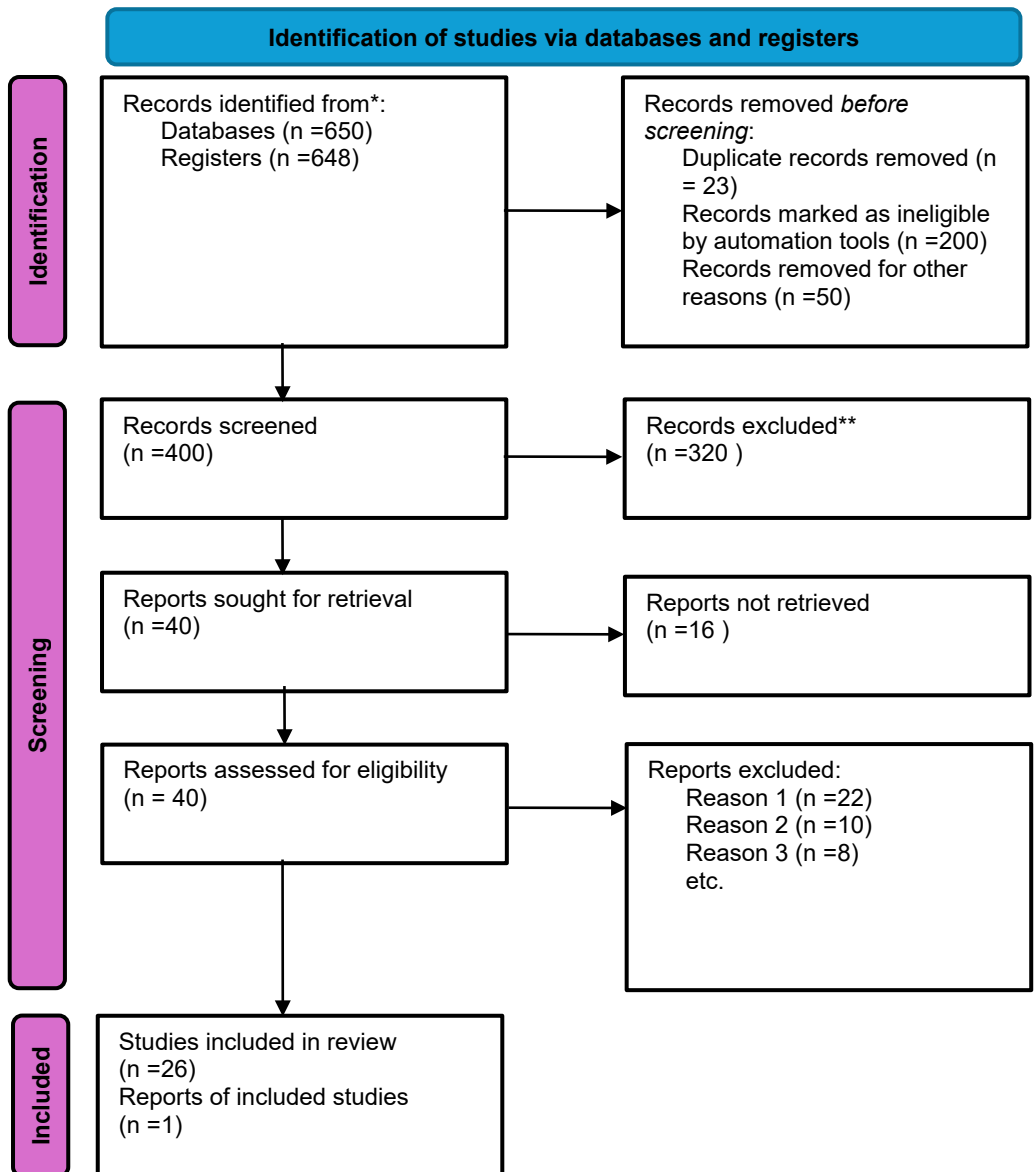


Figure 1. PRISMA flow

3.3. Research Hypotheses for Future Empirical Investigation

We formulated three research hypotheses to guide future empirical inquiry. These hypotheses are grounded in the patterns identified in the literature, respond to the most significant gaps in current knowledge, and are designed to be testable through rigorous empirical research designs. The convergent evidence base assembled for this expanded review — spanning roughly forty primary and secondary sources across systematic review, explainability/ethics, and bibliometric/organizational management literatures — reinforces rather than revises these hypotheses: the gains documented for AI in school management are real but conditional, the human elements of leadership remain foundational, and governance quality is decisive.

H1. AI Integration and Administrative Workload Reduction

The implementation of AI-driven automation and predictive analytics in school management will significantly reduce administrative workload for principals, thereby increasing the time and cognitive resources available for instructional leadership, and thereby improving overall school effectiveness as measured by teacher professional satisfaction, principal leadership quality ratings, and student outcome indicators.

This hypothesis is grounded in the consistently documented finding that AI tools reduce administrative burden in school management settings (Kafa, 2025, p.3; Machkour & Khdar, 2025, p.8; Reimers et al., 2025), combined with the extensive literature on the relationship between principals' instructional leadership time and school effectiveness. Future research should test this hypothesis through longitudinal quasi-experimental designs comparing schools that have implemented AI management tools with matched comparison schools, measuring outcomes across multiple dimensions including principal time allocation, leadership quality perceptions, and student performance indicators.

H2. Governance Frameworks and Stakeholder Outcomes

Schools that adopt structured AI leadership frameworks — explicitly addressing ethics, equity, community engagement, and operational governance — will demonstrate higher stakeholder satisfaction, better

decision-making quality, and more equitable student outcomes compared to schools that adopt AI in management processes in an ad-hoc, unstructured manner.

This hypothesis is grounded in the consistent emphasis in the literature on governance, ethics, and structured implementation as determinants of AI integration quality (DeMatthews et al., 2026, p.7; Dai & Rawolle, 2024, p.1474; Arar, 2024, p.3). It implies that the quality of AI governance is as important as the sophistication of the AI technology in determining outcomes — a hypothesis that runs counter to the vendor-driven narrative that technology quality is the primary determinant of AI integration success. Future research should compare schools with structured AI governance frameworks against those without, using mixed-methods designs that capture both quantitative outcome indicators and qualitative stakeholder experience data.

H3. Organizational Support Factors as Moderators

Organizational support factors — including staff AI literacy, adequate digital infrastructure, clear ethical guidelines, and sustained professional development — positively moderate the relationship between AI integration in school management support processes and key performance indicators such as resource optimization efficiency, principal decision quality, and teacher collaboration, such that AI integration produces stronger positive outcomes in schools with stronger organizational support conditions.

This hypothesis is grounded in multiple strands of evidence in the reviewed literature (Kafa, 2025, p.4; Reimers et al., 2025; Wang, 2021, p.11; Arar, 2024, p.4) and reflects the theoretical insight that AI tools are not sufficient conditions for improved outcomes: they are necessary but not sufficient, with sufficiency contingent on organizational conditions that enable effective human-AI collaboration. Future research should test this moderation hypothesis through survey-based studies in large school samples, using structural equation modeling or multilevel regression to estimate the moderating effects of support conditions on the AI integration-outcomes relationship.

4. Analysis and interpretation of the research data

4.1. Correlation Between AI Adoption and School Performance

Empirical work directly quantifying statistical correlations between AI adoption and school performance remains scarce in current research on

educational leadership and AI. Reviews of Principal Ethical AI Leadership (PEAIL) report that only a small subset of the 62 identified studies examines how school leaders actually use AI tools in practice, and fewer still trace these uses systematically to learning outcomes or organizational performance indicators. Within this corpus, most quantitative designs concentrate on technology acceptance or attitudes rather than measurable effects on achievement, equity, or school improvement metrics, which constrains any effort to compute or generalize correlations between AI uptake and performance.

Available analyses instead describe AI-related outcomes qualitatively across several levels. At the micro level, ethical leadership around AI is reported to bolster teacher and student confidence in AI-mediated processes, in part by reducing fears of bias and data misuse. Organizationally, ethical deliberation is associated with stronger norms of technology use and a more coherent moral-professional culture. At policy and societal scales, ethical leadership linked to AI integration is said to enhance legitimacy and accountability, positioning schools as trustworthy actors within national digital education agendas. These outcome descriptions, however, are seldom operationalized through standardized performance indicators or statistical models that would enable calculation of effect sizes or correlation coefficients.

Within substantive accounts of AI use in schools, PEAIL reviews describe principals employing adaptive learning platforms, AI tutors, generative tools, and predictive analytics for strategic planning, with reported benefits including support for evidence-based decisions, risk management, and automation of tasks such as scheduling, grading, and attendance that free time for strategic goals. Separate work on AI-enabled educational management highlights automated attendance, course scheduling, and intelligent assessment systems that can provide more comprehensive analyses of students' learning processes, habits, and problem-solving than point-in-time examinations, potentially informing long-term development (Feng & Li, 2024, p.50). Yet these accounts primarily document functional opportunities and perceived advantages; they do not provide paired quantitative measures of AI adoption intensity and corresponding changes in test scores,

progression rates, or other outcome measures needed to establish statistical correlations.

Overall, current evidence portrays a field in which AI adoption in schools is expanding and is normatively linked to improved decision-making, efficiency, and potentially more nuanced assessment, while rigorous quantitative demonstrations of correlations with school performance are largely absent. Reviews consistently recommend longitudinal, comparative, and mixed-methods research incorporating systematic indicators, equity measures, stakeholder trust metrics, and learning outcomes, so that relationships between AI integration and school performance can be assessed empirically rather than inferred.

4.2.Benefits of AI in school management

4.2.1Administrative Efficiency and Workload Reduction

The most consistently documented benefit of AI in school management across the literature is improved administrative efficiency. Studies from multiple national contexts report that AI-powered tools can significantly reduce the time school leaders and administrative staff spend on routine, repetitive, and low-complexity tasks, thereby freeing cognitive and temporal resources for higher-order leadership activities. Machkour & Khdar (2025) synthesize evidence from multiple empirical studies to conclude that AI-driven administrative tools reduce average time spent on routine tasks by substantial margins. The authors cite evidence of automated report generation, intelligent scheduling systems, and AI-powered communication platforms as examples of tools that streamline management workflows. Critically, the authors note that these efficiency gains are not automatic: they depend on adequate system design, staff training, and integration with existing administrative infrastructures.

Reimers and colleagues (2025) present case evidence from diverse national contexts across Latin America, Africa, and Southeast Asia, documenting how schools in under-resourced settings have used AI tools to manage enrollment data, generate compliance reports, and automate communication with parents. Notably, the authors identify that administrative efficiency gains are particularly significant in

schools where administrative staffing is thin and principals are directly responsible for tasks that, in wealthier contexts, are handled by dedicated administrative teams. This finding complicates simplistic narratives of AI as primarily a luxury of well-resourced contexts and suggests that AI tools, if designed and deployed thoughtfully, could have substantial equity implications.

Kafa (2025) surveyed school leaders about their perceptions and experiences of using an AI tool for management tasks. The findings reveal that a majority of participating principals perceived the AI tool as useful for reducing routine administrative burden, with particular appreciation expressed for features that automated scheduling, generated standardized reports, and supported attendance monitoring. Importantly, Kafa (2025) notes that perceptions of usefulness were significantly moderated by principals' AI literacy and their confidence in interpreting AI-generated outputs, underscoring the dependency of efficiency gains on human capacity to engage with AI productively.

A complementary leadership framework specifies how this efficiency potential should be operationalized. Guidance for principals describes domain-level expectations that AI should streamline communications, scheduling, compliance tracking, budgeting, resource allocation, and attendance reporting so that staff can redirect time toward instruction and relationship building. Within this framing, automation is not positioned as an end in itself but as a means to protect staff work time and align operations with school improvement goals and district priorities, with explicit attention to data accuracy, fairness, and legal compliance (DeMatthews et al., 2026, p.8). One set of practices focuses on data-informed decision-making supported by automated dashboards and monitoring tools: principals are advised to use AI systems to track key performance indicators in strategic plans and to identify trends in areas such as attendance or discipline, while always applying human judgment to interpret patterns and confirm risk flags with teachers and counselors before intervening. AI is further characterized as an “extended brain” that assists school leaders in processing large volumes of information and making timely decisions, provided that findings are corroborated through stakeholder feedback and strong oversight (DeMatthews et al., 2026, p.8). These recommendations underscore a

human-in-the-loop paradigm in which automated analytics remain subordinate to professional judgment and community values.

Another cluster of contributions elaborates concrete administrative tasks amenable to automation. Suggested uses include AI-generated basic emails, meeting summaries, budget tracking, and the rapid creation of master schedules that consider teacher availability, student needs, and compliance requirements. Generative systems are also presented as tools for preparing reports, analyzing student data, setting up professional development schedules, and tracking regulatory compliance (DeMatthews et al., 2026, p.10). At a broader operational level, school leaders are encouraged to automate routine scheduling, attendance reporting, and basic communications, and to embed AI into transactional functions linked to resource stewardship and operations management, explicitly tied to professional standards that call for actionable data systems, strategic staffing, and technology use to improve operations while maintaining privacy, security, and legal conformity (DeMatthews et al., 2026, p.11).

Evidence from higher-level analyses of education systems provides a complementary view. It describes automated management as a major opportunity domain, alongside personalized learning, global resource sharing, and teacher professional development support. In this account, AI systems perform time-consuming tasks such as course scheduling, student attendance, and grade evaluation, using technologies including facial recognition for attendance and natural language processing for automatic grading; these tools are reported to reduce teachers' administrative workload and enable greater focus on instruction and individualized tutoring. Intelligent assessment systems are said to move beyond point-in-time examinations by continuously analyzing students' learning processes, habits, and problem-solving patterns to deliver more comprehensive and accurate evaluations that can inform long-term development (Feng & Li, 2024, p.49). To structure empirical work on automation impacts, general methodological guidance such as the PICO framework — specifying population, intervention, comparator, and outcome as core components of focused questions — can be adapted to support rigorous evaluation of AI-based administrative interventions relative to traditional processes (Parambil et al., 2024, p.5). Beyond

schooling, systematic reviews of AI in management information systems emphasize organizational-level automation supported by decision support, transaction processing, and enterprise resource planning systems, and call for detailed classifications of AI capabilities such as predictive analytics and intelligent process automation; these classifications highlight that automation often integrates machine learning, computer vision, and cognitive automation, suggesting that school-focused frameworks for administrative AI can be informed by broader MIS perspectives while remaining anchored in human-centered leadership and ethical oversight (Stoykova & Shakev, 2023, p.12; DeMatthews et al., 2026, p.8).

4.2.2.Data-Driven Decision Support

A second major domain of documented AI benefit in school management concerns decision support. AI systems — particularly those incorporating machine learning, predictive analytics, and business intelligence dashboards — can process and synthesize large volumes of educational data to provide school leaders with timely, evidence-grounded insights that would be difficult or impossible to generate manually.

Wang (2021) examines the intersection of AI and data-informed decision-making in educational leadership. Drawing on a detailed case analysis, Wang identifies several ways in which AI systems can enhance the quality of decisions by school leaders: by surfacing non-obvious patterns in student performance data, by enabling rapid comparison of outcomes across demographic subgroups, and by generating probabilistic forecasts of future trends. Crucially, however, Wang's analysis is framed as a “cautionary tale”: the author documents how an overconfident reliance on AI-generated data can distort decision-making, particularly when leaders lack the statistical literacy to interrogate AI outputs critically or when the underlying data contain systematic biases. Wang's article makes a powerful case that AI enhances decision quality only when it is combined with human analytical skill, contextual knowledge, and healthy epistemic skepticism.

DeMatthews et al (2026) present a six-domain framework for AI integration in school leadership that explicitly includes “data-informed

decision-making” as one of its core domains. The authors argue that AI can support more equitable decision-making by making patterns of differential treatment, resource distribution, and outcome disparities visible to leaders who might otherwise be unaware of them. They note, however, that this potential is contingent on data quality, representational equity in training datasets, and the interpretive capacity of school leaders.

4.2.3.Process optimization in school

Beyond efficiency and decision support, the literature identifies a third category of AI benefit, the optimization of specific operational processes within school management. These include student attendance monitoring, staff scheduling, resource allocation, performance monitoring, and community communication.

Computer vision and machine learning-based attendance systems — using face recognition, deep learning algorithms, and AI cameras — have been documented in multiple studies as enabling more accurate, efficient, and less administratively burdensome monitoring of student attendance. Convolutional neural networks (CNNs) have been applied to automate classroom attendance marking, reducing both the administrative load on teachers and the error rates associated with manual attendance systems. Predictive models have been used to forecast attendance patterns, enabling proactive intervention for students at risk of chronic absenteeism.

In the area of scheduling, AI systems have been used to generate optimal timetables that minimize conflicts, maximize resource utilization, and accommodate complex constraints across large schools. In resource allocation, machine learning-based forecasting models have supported more accurate budgeting and planning by predicting enrollment trends, maintenance needs, and staffing requirements. In communication, natural language processing tools have enabled automated generation of parent newsletters, personalized progress communications, and multilingual translation of school documents, reducing the administrative burden associated with community engagement while potentially improving the quality and accessibility of communication.

4.2.4. Financial and resource management

Financial and resource management in AI-enabled school administration aligns closely with broader patterns of AI-supported decision-making and operational efficiency observed across sectors. Guidance for principals positions AI as a means to assist with budgeting, compliance tracking, and resource allocation, while retaining human oversight and clear alignment with school improvement goals and district priorities (DeMatthews et al., 2026, p.7). Within this framing, automating transactional tasks is intended to protect staff time for instruction and relationships, not to replace professional judgment in financial decisions.

Evidence from manufacturing and logistics illustrates how AI augments financial stewardship by integrating large data streams for cost control and risk reduction. In Industry 4.0 environments, AI systems integrate data from information technology, smart sensors, and interconnected devices to support operational efficiency, supply chain coordination, and adaptation to changing environments. Automation of warehouse robotics, visual inspection, fault detection, and predictive maintenance reduces costs associated with unanticipated interruptions and operational errors, with financial benefits arising from improved reliability and lower disruption-related expenses. Within supply chain management, AI-based analysis of historical and real-time data supports forecasting, resource planning, and optimization of coordination, yielding more efficient allocations of inventory, transport, and production capacity, and generating cost savings and greater responsiveness to market fluctuations. Generative AI expands this financial and resource lens by enabling scenario analysis around political, social, or economic changes: such systems can model possible disruptions in demand or supplier availability, supporting risk assessment and the design of more efficient distribution strategies and logistics routes in light of external factors such as weather patterns and environmental constraints, as well as internal needs including cost reduction and management of peak demand. These applications show how AI-enabled scenario planning can inform budgetary contingencies and investment decisions linked to infrastructure, transportation, and

inventory buffers in complex organizational settings (Aguado-García et al., 2026, p.27-32).

Comparative organizational analyses in management information systems further underline how AI capabilities relate to financial performance. Classifications of AI in management highlight decision support systems, analytical and statistical models, optimization techniques, and cost–benefit analysis as central elements of “production optimization and analytics” and “business economics and transition to economy 4.0,” where decision-making, value creation, cost engineering, and budget control are key cluster components. Within these clusters, analytical models, stochastic systems, and uncertainty analysis contribute to multi-criteria evaluations of profitability, risk, and investment strategies (Padovano & Cardamone, 2024, p.10). Such structures parallel school-level needs to evaluate AI investments, weigh operational savings against licensing and training costs, and monitor financial impacts over time.

Human resource management cases focused on compensation, performance management, and benefits provide additional insight into AI-supported financial stewardship in people-intensive organizations. Scenario-based analyses of compensation management and benefits management stress that pay structures, incentives, and benefits enhancements must adhere to industry standards, best practices, and regulatory constraints while allocating resources efficiently and following transparent implementation timelines. Performance management and professional development applications similarly emphasize that system implementation requires careful resource allocation for training managers and employees, and must align with core organizational objectives such as precision, innovation, and strategic capacity (Aguinis et al., 2024, p. 5). These HR-oriented examples underscore that AI-informed financial and resource decisions need to integrate contextual factors, regulatory compliance, and long-term talent development goals rather than focusing solely on short-term cost reductions.

Taken together, these strands suggest that AI-enabled financial and resource management combines automated analytics, predictive modeling, and scenario generation with context-sensitive leadership

practices. In educational settings, this entails using AI tools for budgeting, compliance, and resource allocation only within frameworks that safeguard transparency, fairness, and alignment with institutional missions (DeMatthews et al., 2026, p.12). Practical experience from higher education suggests that districts should budget explicitly for training, policy revision, and shared accountability structures so that administrators, teachers, and students receive support and the onus for misuse is distributed rather than placed solely on learners (Lim et al., 2023, p.7). While such investments may appear costly initially, evidence implies that clear governance, equitable access strategies, and sustained upskilling can reduce the downstream administrative burden created by patchwork bans or uneven deployments.

4.2.5. Student Data Management as an application domain

Student data management constitutes a fourth application domain in which AI offers school leaders genuine operational benefits, while simultaneously introducing the privacy, security, and ethical risks examined. AI systems support administrative integration of large, sensitive data streams: managing enrollment records, tracking compliance with attendance and reporting obligations, and feeding analytics dashboards that inform leadership decisions. Within e-learning and institutional platforms, technical interventions target the secure management of students' digital traces, including improving the accuracy and security of attendance systems by combining face recognition with location detection on mobile devices, developing anonymous authentication schemes that validate learners while minimizing latency, and integrating multi-modal biometric techniques into learning management systems to maintain identity assurance across sessions. Additional work develops privacy-preserving algorithms for learning analytics datasets in order to balance student privacy protection with the analytical usefulness of the resulting information (Parambil et al., 2024, p.3). Complementary efforts use blockchain to manage educational records and digital diplomas and to enhance transparency around how learning analytics data are treated, for example through visual icons that communicate data practices to stakeholders (Parambil et al., 2024, p.4).

From a management perspective, the operational value of these tools — more accurate attendance records, more secure and efficient handling of enrollment and assessment data, and richer analytics for leadership decision-making — is real, but it is inseparable from the governance, consent, and security obligations discussed later in this review. As such, student data management functions simultaneously as a benefit domain and as one of the most consequential sites of ethical risk in AI-enabled school management.

4.2.6. School Leadership support and strategic capacity

The literature also documents emerging evidence that AI can support the strategic and leadership dimensions of school management, not just the operational and administrative. AI-powered analytics dashboards can provide principals with real-time visibility into school performance indicators — attendance rates, grade distributions, disciplinary incidents, staff wellbeing signals — that support more responsive and evidence-informed leadership.

DeMatthews et al (2026) articulate a vision in which AI serves as a “strategic partner” for school leaders, augmenting their capacity to identify improvement priorities, monitor implementation fidelity, and evaluate the impact of leadership decisions. The authors acknowledge that this vision is largely aspirational given the current state of AI development and deployment in schools, but they argue that it represents a legitimate and important direction for both research and practice. Similarly, Sposato (2025) envisions AI systems that can support “adaptive strategic planning” in schools — systems that learn from historical decision patterns, model the likely consequences of different strategic choices, and provide leaders with scenario-based decision support.

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Table 1 Summary of Documented AI Benefits in School Management

Domain	AI Application(s)	Documented Benefit(s)	Key Sources / Evidence Strength
Administrative Efficiency	Automated reporting, scheduling, communication	Reduced routine workload; time savings for school leaders	Machkour & Khdar 2025, p.8; Kafa, 2025, p.3; Reimers et al., 2025, p.11
Decision Support	Predictive analytics, BI dashboards, ML pattern recognition	Evidence-grounded decisions; early identification of at-risk students	Wang, 2021, p.8; DeMatthews et al. 2026, p.14;
Attendance Monitoring / Process Optimization	Face recognition, CNNs, deep learning, predictive models	Accuracy, efficiency, proactive absenteeism intervention	Machkour & Khdar 2025, p.9, p.9); Reimers et al. , 2025, p.6
Resource Allocation & Scheduling	Forecasting models, ML-based planning tools	Optimized budgeting, enrollment planning, maintenance scheduling, optimal timetabling	Machkour & Khdar, 2025, p.7; Reimers et al., 2025, p.11
Financial & Resource Management (Broader)	Industry 4.0 analytics, scenario modeling, HR/compensation tools	Cost control, risk reduction, predictive maintenance, equitable resource decisions	Aguado-García et al., 2026, p.8; Padovano & Cardamone, 2024, p.11; Aguinis et al. 2024, p.7

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Student Data Management	Biometric attendance, anonymous authentication, privacy-preserving analytics, blockchain records	Secure, accurate records; richer leadership analytics	Parambil et al. 2024, p.5; Ahmad, et al, 2022, p.8
Community Communication	NLP, automated messaging, multilingual tools	Improved parent engagement; reduced administrative burden	Reimers et al., 2025, p.7
Strategic Leadership	Analytics platforms, scenario modeling, adaptive planning	Improved strategic capacity; evidence-based improvement planning	DeMatthews et al., 2026, p.9; Dai & Rawalle, 2024, p.1472
Organizational (Cross-Sector)	HR recruitment, logistics forecasting, ERP/MIS automation	Productivity gains, better hiring, service delivery	Stoykova & Shakev, 2023, p.11; Aguado-García et al. 2026, p.9

4.2.7.Implementation Challenges, Ethical Concerns, and Equity Implications

a. Data quality, privacy, and security

Across the literature, concerns about data quality, privacy, and security emerge as among the most consistently identified challenges to AI integration in school management. AI systems are only as good as the data they are trained on and operate with; in many school contexts, data are incomplete, inconsistently recorded, siloed across incompatible systems, or reflective of historical biases. Data quality limitations can undermine the reliability of AI-generated predictions and recommendations, and in some cases may generate systematically misleading outputs.

Privacy concerns are particularly acute in school settings, where data subjects are often minors, where data contain sensitive information about student learning needs, behavioral histories, family circumstances, and health status, and where the consequences of data misuse can be severe. Regulatory frameworks such as FERPA in the United States, GDPR in the European Union, and analogous legislation in other jurisdictions impose significant requirements on how student data may be collected, processed, stored, and shared. AI systems that process student data must comply with these frameworks, and the compliance burden is non-trivial, particularly for smaller schools and districts with limited legal and technical expertise.

Wang (2021) documents cases in which school leaders were presented with AI-generated analytics that obscured, rather than revealed, the limitations and uncertainties in underlying data, leading to overconfident decision-making. This finding underscores the importance of what Wang calls “data literacy” and “AI literacy” for school leaders: the capacity to understand not just what AI systems output, but how those outputs are generated, what assumptions they embed, and where they may be unreliable.

Principal Ethical AI Leadership (PEAIL) scholarship positions school leaders as socio-technical stewards whose responsibilities include anticipating and mitigating risks related to data privacy, algorithmic bias, and informed consent, as well as setting clear policies and ensuring compliance with legal and social standards. Within this framing, data protection is integral to safeguarding vulnerable students and reinforcing justice in AI-enabled schooling, not a purely legal or technical add-on (Ho, 2026). Advocacy-oriented analyses of PEAIL specify data privacy and security as a core domain of ethical action: authors argue that principals must establish robust data protection protocols, including anonymization and consent management, in order to meet legal and ethical obligations for both students and staff. Commentators caution against surveillance-based AI systems and call for greater transparency regarding algorithmic design and data sourcing, while also insisting that all AI tools be subject to ongoing ethical scrutiny and compliance checks under principal oversight (Ho, 2026). Further practice-oriented recommendations propose

institutionalizing governance routines such as data-protection protocols, data-minimization workflows, algorithmic impact assessments, audit logs, and regular “ethics rounds” that review high-stakes uses of AI, together with explicit codification of non-delegable decisions and documented professional judgments when AI outputs are overridden (Ho, 2026).

Evidence indicates that principals, teachers, and students encounter persistent challenges in data ethics and security, particularly around the handling of sensitive student information collected by AI systems. Such data remains vulnerable to misuse, and schools frequently lack robust mechanisms to ensure informed consent when deploying AI tools. Advocacy-oriented work contends that inadequate oversight and opaque AI processes expose school leaders to significant ethical risk during technology adoption, especially where monitoring practices like facial recognition and intensive analytics become normalized and threaten the ethical integrity of school environments (Ho, 2026). Cybersecurity analyses focused on educational settings catalogue a broad spectrum of technical threats that directly affect student data management. Documented risks include data breaches, unauthorized access to biometric and location data, hacking, phishing, malware, denial-of-service and distributed denial-of-service attacks, information gathering, cross-site scripting, SQL injection, and malicious PDF distribution. Table-based summaries further identify privacy threats in cloud storage and data sharing, identity theft, fraud, and unauthorized access in online learning, as well as unauthorized screen recording of course videos and exam fraud via impersonation (Parambil et al., 2024, p.4).

Studies call for robust security architectures that balance efficiency with privacy through encrypted storage, secure authentication, and scalable network designs, while also warning that explainable deep neural network approaches for threat detection can impose additional computational and infrastructural burdens. Ethical use of biometric data in student authentication receives particular attention, with authors stressing the need for explicit consent, data usage transparency, and long-term security evaluation of blockchain or biometric systems to avoid inadvertent exposure or misuse (Parambil et al., 2024, p.8).

Synthesis of cybersecurity recommendations for managers of educational systems and designers of AI-driven protection tools underscores several actionable priorities: comprehensive training programs for educators, students, and staff should ensure effective and informed use of AI-based cybersecurity tools; robust ethical guidelines must respect student privacy, comply with legal frameworks, and provide transparent communication about AI uses in security; interdisciplinary collaboration between AI experts, cybersecurity professionals, and educators is advised to develop tailored solutions for education, with machine learning algorithms such as random forests and deep neural networks employed to improve real-time threat detection accuracy and reduce false positives; and advanced data-privacy techniques — including data anonymization, differential privacy, and zero-knowledge proofs — are recommended to secure sensitive student information while still enabling personalized learning experiences, with enhancements in model interpretability through explainable AI identified as vital for building trust and accountability (Parambil et al., 2024, p.9).

In distance education contexts, comprehensive risk management plans are proposed to address vulnerabilities in e-learning, smart education infrastructures, and cloud-based education portals. Security concept models for distance learning emphasize coordinated assurance processes, user-focused measures, and organizational procedures that can be implemented at multiple security levels. At the same time, analyses of AI-related ethical challenges in schools emphasize that principals often lack clear frameworks to govern data-intensive AI tools, and may depend heavily on vendors whose priorities do not necessarily align with educational or ethical values. This dependence, combined with opaque AI decision processes, complicates accountability when harmful or biased outcomes emerge from student data processing (Ho, 2026, p.14; Parambil et al., 2024, p.7). From a management perspective, student data handling is thus not only a technical cybersecurity problem but also a domain where ethical leadership, informed consent, transparency, and equitable governance must be integrated with advanced authentication, encryption, analytics,

and monitoring technologies in order to safeguard learners while enabling legitimate educational uses of AI.

b. Algorithmic bias, discrimination, and accountability

A second cluster of challenges concerns the potential for AI systems used in school management to embed, perpetuate, or amplify discriminatory patterns. Algorithmic bias — the systematic tendency of AI systems to produce outputs that disadvantage particular groups — can arise from biased training data, from design choices that embed historically unequal patterns as normative, from the selection of variables that serve as proxies for protected characteristics, or from the interaction of multiple individually defensible design choices that combine to produce discriminatory effects.

In school management contexts, the risk of algorithmic bias is particularly salient in three areas: student classification and tracking systems that use AI to assign students to programs or interventions; staff evaluation and performance management systems that use AI-generated metrics to assess teacher effectiveness; and predictive systems that identify at-risk students for targeted support. In each of these areas, if the AI system is trained on historical data that reflects discriminatory patterns — for example, if students from particular racial, ethnic, or socioeconomic backgrounds were historically over-represented in disciplinary data — the system may reproduce and legitimize those patterns through ostensibly objective algorithmic outputs.

DeMatthews et al (2026) devote substantial attention to what they call “ethical and equitable AI leadership,” arguing that school leaders have a professional and moral responsibility to critically interrogate the fairness implications of any AI tool they adopt or permit to be used in their schools. The authors advocate for regular algorithmic audits, diverse and representative data governance processes, transparency requirements for AI vendors, and clear lines of human accountability for decisions made with AI assistance. They propose a six-domain framework — encompassing ethics, equity, operations, curriculum, community, and leadership development — that positions ethical accountability not as a constraint on AI adoption but as its essential foundation.

Analyses of AI in online and higher education security contexts explicitly flag “Bias, Fairness, and Equity” as a central ethical category, reporting that AI algorithms carry significant potential for bias and discrimination, with consequent risks of unequal treatment of students. Authors discussed within this literature describe how AI systems can reflect or amplify existing societal biases, thereby generating unfair outcomes when deployed in educational settings; these findings frame bias not as an abstract possibility but as a concrete mechanism through which algorithmic decision-making can undermine equity. Concerns about fairness arise alongside related demands for transparency and accountability: institutional responsibility in the deployment of AI technologies requires clearly articulated policies that specify how systems will be used and what impacts they may have on student autonomy and academic integrity, alongside transparency in AI decision-making processes and human oversight to correct errors or biases, so that students, parents, and educators can understand AI-driven outcomes and have channels to question or challenge them (Parambil et al., 2024, p.9). In this view, fairness is inseparable from visibility into algorithmic operations and from accountable human governance structures.

PEAIL scholarship translates these fairness issues into leadership practice. Within the equity and inclusion outcome domain, PEAIL is described as ensuring that AI tools are used to promote equity rather than reinforce exclusion. When guided ethically, AI can improve access for multilingual learners, support diverse learning needs, and foster inclusive communication, but leaders remain responsible for anticipating and mitigating risks related to data privacy, algorithmic bias, and informed consent. Ethical leadership involves setting clear policies, raising awareness, and ensuring compliance with legal and social norms, with explicit attention to protecting vulnerable students and reinforcing justice in AI-enabled schooling (Ho, 2026). Broader management analyses of AI reinforce the idea that biased training data can drive discriminatory outcomes: systems can perpetuate pre-existing biases in their training datasets, for instance in hiring contexts where gender or racial prejudices embedded in historical data lead to discriminatory recommendations. Automation bias is highlighted as a particular danger — decision-makers may over-trust AI outputs because of their perceived objectivity, relying too heavily on

algorithmic recommendations without adequate scrutiny. This overreliance can yield unethical outcomes, diffuse accountability, and erode human oversight. To address these challenges, authors call for frameworks that prioritize transparency, accountability, equity, and privacy in AI governance, explicitly linking fairness concerns to the need for interpretability and clear lines of responsibility (Islami & Mulolli, 2024, p.5).

Research on ethical AI leadership in education underscores that such stewardship operates in multi-level ecologies. PEAIL is situated within an outer governance environment marked by opaque technologies and structural inequities that can outstrip the reach of individual ethics. Within this setting, ethical leadership is reconceptualized as socio-technical stewardship that connects micro-level moral agency with macro-level policy and infrastructural conditions. Outcome syntheses show that principals who act as gatekeepers interpret AI-generated data critically, align AI use with school values and policy frameworks, and resist blind reliance on algorithms in decisions about funding, staffing, and resource allocation. Under these conditions, AI-supported efficiencies are prevented from compromising transparency or fairness, and equity goals such as inclusion and justice are advanced rather than undermined (Ho, 2026). Evidence across these strands indicates that addressing bias and fairness in AI requires not only technical mitigation of discriminatory patterns but also robust ethical leadership, institutional accountability, and policy mechanisms that foreground equity in AI design and use.

c.Resistance, trust, and professional culture

The literature identifies a third set of implementation challenges related to the human and cultural dimensions of AI adoption in schools. Teacher and administrator resistance to AI tools is documented in multiple studies, arising from concerns about job displacement, surveillance, deskilling, loss of professional autonomy, and distrust of opaque algorithmic systems. This resistance is not irrational: it reflects legitimate professional concerns about the implications of AI adoption for the nature of educational work.

Arar (2024) argues that resistance to AI in school management is often a symptom of deeper organizational dynamics — cultures of distrust, inadequate change management, insufficient consultation with staff,

and a perceived imposition of technological change from above. Arar's human-machine symbiosis framework emphasizes that successful AI integration requires not just technical implementation but cultural and relational work: building shared understandings of the purposes and limitations of AI, creating space for critical dialogue about AI adoption, and ensuring that staff feel that their expertise and professional judgment are valued rather than threatened.

Kafa (2025) reports that among the school leaders surveyed in Cyprus, willingness to use AI tools was significantly associated with prior positive experience with technology, institutional support structures, and confidence in the tool's reliability. These findings align with the broader technology adoption literature in suggesting that perceived usefulness, perceived ease of use, and trust are key determinants of AI tool adoption, and that all three can be enhanced through appropriate training, support, and communication.

Infrastructure, digital divide, and contextual Equity

A fourth domain of implementation challenges concerns the infrastructural and contextual conditions required for effective AI deployment in school management. AI tools require reliable digital infrastructure — broadband connectivity, up-to-date hardware, interoperable software systems, and technical support — that is unevenly distributed across and within educational systems globally. Schools in under-resourced communities, rural settings, and lower-income countries often lack the basic technological prerequisites for AI adoption, raising serious concerns about whether AI may deepen rather than mitigate existing educational inequities.

Reimers and colleagues (2025) document this challenge explicitly in their analysis of AI and school management in the Global South. While acknowledging the potential for AI to address specific management challenges in under-resourced settings, the authors note that realizing this potential requires substantial prior investment in digital infrastructure, technical capacity, and supportive policy frameworks. Without these investments, AI adoption risks benefiting primarily the most advantaged schools and systems, widening digital and resource divides.

The equity implications of AI adoption in school management extend beyond infrastructure to include questions of representational equity in AI development processes. AI systems designed primarily by engineers in high-income, English-speaking contexts may be poorly suited to the administrative realities, cultural norms, regulatory environments, and language needs of schools in other contexts. The absence of diverse voices in AI design and governance is a systemic problem that requires deliberate corrective action through inclusive design processes, community consultation, and diversification of the AI development pipeline.

Policy gaps and governance deficits

The literature consistently identifies the absence of adequate policy frameworks for AI in school management as a significant systemic challenge. Despite the rapid pace of AI adoption in education, many school systems lack explicit policies addressing data governance, algorithmic accountability, AI procurement standards, staff AI literacy requirements, and ethical frameworks for AI use. This policy vacuum creates risks: schools may adopt AI tools without adequate due diligence, vendor interests may shape AI adoption decisions in the absence of public regulatory frameworks, and accountability for AI-related harms may be diffuse and unenforceable.

Multiple authors call for the development of robust policy frameworks at national and district levels that set clear standards for AI adoption in schools, require transparency from AI vendors, protect student and staff data, establish accountability mechanisms, and ensure equitable access. DeMatthews et al (2026) propose that these policy frameworks be co-developed with school leaders, teachers, students, families, and community members rather than designed exclusively by technologists and bureaucrats, emphasizing the importance of democratic participation in AI governance.

d. Policy Alignment and Interoperability with Broader Educational Ecosystems

Policy alignment around AI in schooling unfolds within multi-level ecologies where individual principals operate inside an outer governance environment composed of vendor infrastructures, market dominance, algorithmic opacity, and cross-jurisdictional regulations. This external layer establishes many of the moral and procedural

boundaries within which national and regional policies, school cultures, and resource conditions function, so that familiar levers such as AI readiness, policy clarity, and local resource availability are always conditioned by broader corporate and regulatory structures (Ho, 2026). Within this setting, policy instruments such as guidelines, accountability mechanisms, and role definitions shape how principals engage with AI, influencing both their authority and their responsibility for AI-related decisions. Clear policy direction can legitimize ethical expectations, formalize standards for responsible AI use, and embed ethics and AI literacy into leadership development programs, thereby equipping principals with conceptual tools to navigate technological change in ways that remain sensitive to transnational governance debates and platform power (Ho, 2026).

Ethical AI leadership frameworks conceptualize principals as socio-technical stewards rather than heroic moral managers. In this view, alignment between AI and policy is not a simple matter of compliance but involves mediating between school-level values and constraints imposed by vendor infrastructures, opaque algorithms, and global normative commitments to fairness, inclusion, and human dignity. Ethical challenges linked to privacy, equity, professional autonomy, and transparency arise at the intersection of local standards and global infrastructures; policies that ignore this intersection risk placing unrealistic burdens on individual principals without addressing structural drivers of bias, surveillance, or governance gaps. Leadership strategies therefore emphasize strengthening oversight, protecting data, fostering inclusion, and sustaining human-centered culture as forms of mediation between normative commitments and structural limitations (Ho, 2026, p.14). Beyond school governance, policy debates on AI intersect with wider educational ecosystems concerned with lifelong learning and workforce adaptability. Analyses of government–industry partnership models describe policy-driven collaboration, platform-based partnerships, research-driven collaboration, industry–university partnerships, and regional governance frameworks as mechanisms for coordinating technology-enabled learning and reskilling initiatives, relying on clearly defined roles, strategic integration of technology, and broad stakeholder involvement. Recent bibliometric mapping of AI research in management-related domains indicates that ethics, decision making, and governance feature prominently among author keywords,

lending empirical weight to arguments for integrated governance approaches, while also revealing uneven coverage across indexing databases that may suggest variable visibility of policy-oriented work (Patra et al., 2024, p.14). Technology-enabled learning solutions, such as large-scale online platforms, demonstrate advantages in scalability, flexibility, customization, and real-time updating of content, provided that policies coordinate curriculum development, incentives, and learning infrastructure in ways that sustain continuous learning cultures, situating AI-related policies in schooling within larger ecosystems of digital learning governance where cross-sectoral collaboration and shared platforms are central (Reimers et al., 2025).

Interoperability in AI-intensive ecosystems depends first on the technical capacity of diverse applications and infrastructures to exchange data and services across heterogeneous hardware, software, and networking environments. A large-scale scientometric analysis of Industry 4.0 and 5.0 scholarship identifies “interoperability and system integration” as a distinct thematic cluster, associated with software applications and middleware, explicit interoperability mechanisms, computer architecture and hardware/software paradigms, semantic modeling, ontology-driven engineering, OPC UA, web services, closed-loop control systems, open systems and open-source software, asset administration shells, data issues, and IT/OT convergence and synchronization. This cluster structure shows that interoperability is not a single interface problem but a composite of middleware, semantic, architectural, and data-integration concerns that must be coherently addressed when connecting AI components with surrounding systems (Padovano & Cardamone, 2024, p.11). Keyword-embedding studies in industrial engineering employ Sentence-BERT to derive dense semantic representations of tens of thousands of keywords and then apply hierarchical clustering and t-SNE visualization, with document keywords functioning as elementary constituents of a “knowledge landscape” in which cosine similarity guides cluster formation and spatial proximity denotes semantic relatedness. Such methods allow researchers to organize semantically similar topics into high-level subject areas and to examine how concepts such as interoperability, cloud computing, edge analytics, and AI capabilities co-occur across publications, offering an additional layer of interoperability at the level of conceptual vocabularies (Padovano & Cardamone, 2024, p.12).

Platform choices for AI integration further condition interoperability and data governance. A systematic review of AI in management information systems reports that most examined applications run on cloud-based or on-premises platforms, with only a small number targeting edge devices or hybrid architectures. Edge AI combined with federated learning is identified as a promising direction because local training on edge devices, followed by aggregation of model updates rather than raw data, can improve privacy, security, and resilience to cloud outages. The same review stresses that platform selection has direct implications for compliance with data protection regimes such as GDPR, since organizations must implement appropriate technical and organizational measures to secure personal data generated on edge devices and may employ AI to automate data protection tasks and detect breaches in real time (Stoykova & Shakev, 2023, p.16). Automation-focused analyses of AI deployment in enterprise resource planning and business management software extend these platform considerations to generative models and large language models: major ERP and CRM vendors are described as integrating LLMs and GPT-based services into their suites, with debates centering on cost-effectiveness versus competitive advantage, the trade-offs between relying on pre-trained external APIs and developing proprietary models, and heightened concerns about data privacy, bias, and information security in sensitive sectors. Despite these concerns, documented use cases range from qualitative data analytics and customer feedback insight extraction to knowledge-base structuring, accessibility support, language preservation initiatives, and educational customer support and personalized learning. Across these domains, LLMs and GPTs are characterized as augmenting rather than replacing human intelligence and critical thinking, implying interoperability requirements that preserve human interpretive control within larger socio-technical systems (Stoykova & Shakev, 2023, p.13).

Cybersecurity research in online and higher education settings adds a further interoperability dimension for AI-based protection layers. Studies catalogue threats such as cheating in online examinations, privacy breaches, vulnerabilities in cloud-based infrastructures, and administrative compliance challenges, and examine AI and traditional solutions including keystroke dynamics, “Deep Speaker” authentication, multifactor biometrics, and predictive models for threat detection. Findings underscore the need for integrated security

architectures that combine AI-driven anomaly detection, encryption, authentication, and privacy-preserving analytics so that educational platforms, learning management systems, and administrative tools can interoperate securely without undermining data confidentiality or ethical norms. Recommendations emphasize comprehensive training, robust ethical guidelines, interdisciplinary collaboration, explainable AI techniques, continuous monitoring, and exploration of emerging technologies such as graph neural networks and blockchain as components of a resilient, interoperable cybersecurity infrastructure for education (Parambil et al., 2024, p.6). At the level of policy and system design, a systems-thinking perspective on AI in education describes education as a living, adaptive, multi-goal environment where curriculum, teacher training, assessment, governance, finance, and student support interact dynamically. Introducing AI-powered tools, including adaptive platforms, is argued to require alignment of these interacting subsystems so that data flows, institutional cultures, and resource structures adapt in concert rather than in isolation; interoperability is therefore framed not only as a technical integration of platforms and protocols, but as the capacity of AI initiatives to harmonize with existing institutional goals, feedback loops, and multi-directional influences, avoiding external impositions disconnected from prevailing educational realities (Reimers et al., 2025). Practical evidence from dental education suggests that uptake of AI for assessment remains uneven: many educators report limited use, low confidence, and insufficient institutional support, while ethical worries and potential misuse remain salient — findings that suggest interoperability must encompass governance, training, and support pathways as well as technical standards, so that educational systems can integrate AI tools without undermining pedagogical aims (Leung et al., 2026, p.4).

Table 2 Challenges and Mitigation Strategies

Challenge	Nature of Risk	Proposed Mitigation	Key Sources
Data quality, privacy & security	Unreliable AI outputs; breach of student/staff privacy; biometric and cybersecurity threats (breaches, phishing,	Data audits; GDPR/FERPA compliance; encrypted storage, secure	Wang, 2021, p.9; Machkour & Khdar, 2025, p.9; Parambil et al.,

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	malware, DoS, SQL injection)	authentication; anonymization, differential privacy, zero-knowledge proofs; transparent data governance and audit logs	2024, p.14; Ho, 2026, p.15
Algorithmic bias	Discriminatory classification; reproduction of inequity in tracking, staff evaluation, and at-risk prediction; automation bias / over-trust in outputs	Algorithmic audits; equity-centered design; diverse data governance; interpretability and clear lines of responsibility	DeMatthews et al., 2026, p.12; Arar, 2024, p.6; Islami & Mulolli, 2024, p.6; Parambil et al., 2024, p.12
Resistance and distrust	Non-adoption; adversarial dynamics; cultural conflict; concerns about deskilling and surveillance	Change management; participatory design; AI literacy programs; transparent communication	Kafa (2025), p.4; Arar, 2024, p.6
Digital divide / infrastructure	Inequitable access; deepening resource gaps; representational inequity in AI design	Infrastructure investment; inclusive policy; Global South engagement; diversified AI development pipeline	Reimers et al., 2025, p.5
Policy gaps & governance deficits	Unregulated vendor power; accountability vacuum; opaque multi-level governance ecologies	National AI-in-education policy; democratic governance frameworks; ethics rounds and non-	DeMatthews et al., 2026, p.11; Ho, 2026, p.10

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		delegable decision protocols	
Interoperability gaps	Fragmented platforms; semantic/middleware mismatches; weak compliance on edge/cloud architectures	Semantic modeling and middleware standards; edge AI with federated learning; platform-conditioned GDPR compliance	Padovano & Cardamone, 2024, p.12; Stoykova & Shakev, 2023, p.7
Over-reliance on AI	Erosion of professional judgment; deskilling; epistemological overconfidence	Cultivate AI literacy; maintain human oversight; reflective practice; documented override procedures	Wang, 2021, p.9; Dai& Rawolleg, 202), p.1473; Ho, 2026, p.11

5.The Human Dimension: Leadership, Ethics, and Human-AI Symbiosis

5.1. What AI Cannot Do in Educational Leadership

One of the most intellectually significant contributions of the recent literature on AI in school management is its sustained attention to the boundaries of AI capability in educational leadership contexts. While acknowledging the efficiency and decision-support benefits documented in the preceding sections, multiple scholars emphasize with considerable force that there are dimensions of school leadership that AI cannot replicate, and that protecting and cultivating these dimensions must be a central priority of any responsible AI integration strategy. Arar (2024) argues that the “human” in educational leadership encompasses at least four irreducible capacities: moral imagination — the ability to envision what is good and just in complex situations without algorithmic guidance; relational intelligence — the capacity to build trust, navigate conflict, and sustain authentic professional relationships with students, teachers, families, and communities; contextual wisdom — deep familiarity with the particular history, culture, and community that gives meaning to events and decisions in a

specific school; and creative adaptation — the ability to respond inventively to unprecedented situations for which no historical pattern exists in training data. None of these capacities is reducible to pattern recognition, prediction, or optimization, and all are essential to effective school leadership.

Wang (2021) makes a complementary argument through the lens of epistemological humility, contending that school leaders who become overly dependent on AI-generated analytics risk losing the capacity for the kind of situated, holistic, and relational knowing that constitutes genuine expertise in educational leadership. When a principal's decision-making becomes dominated by what the dashboard says, the rich texture of professional judgment — informed by direct observation, relational knowledge, historical memory, and ethical commitment — may be gradually eroded. Wang's cautionary tale is not an argument against AI in schools, but a powerful case for approaching AI integration with deliberate attention to the preservation of professional wisdom.

5.2. Frameworks for Ethical AI Leadership in Schools

In response to both the genuine potential and the genuine risks of AI in school management, several scholars have proposed frameworks for what they variously call “ethical AI leadership,” “responsible AI integration,” or “human-centered AI governance” in educational organizations. These frameworks converge on a set of core principles that can guide school leaders, district administrators, and policymakers in navigating AI adoption responsibly.

DeMatthews et al (2026) propose the most comprehensive framework to date in the educational leadership literature. Their six-domain framework addresses: (1) Ethics — commitment to transparency, accountability, and the protection of human dignity in AI decision-making; (2) Equity — active interrogation of whether AI tools advance or undermine equitable outcomes for all students; (3) Operations — thoughtful integration of AI into administrative and management workflows; (4) Curriculum — attention to the implications of AI for what and how students learn; (5) Community — inclusive engagement with families and communities in AI governance processes; and (6) Leadership Development — building school leaders' capacity to

navigate AI-integrated environments with wisdom, courage, and ethical commitment. The framework is notable for its insistence that ethics and equity are not add-ons to AI governance but its foundational pillars.

Dai & Rawolle (2024) contribute a complementary framework focused specifically on the human-AI relationship in administrative decision-making. They propose a four-quadrant model distinguishing between types of decisions on the basis of complexity and stakes, arguing that the appropriate role of AI varies systematically across these quadrants. For routine, low-stakes decisions, AI automation is appropriate and beneficial; for complex, high-stakes decisions — particularly those involving individual students, staff members, or community relationships — human judgment must remain primary, with AI serving at most an advisory role. The framework offers practical guidance for school leaders navigating the question of which decisions to delegate to AI and which to preserve as fundamentally human responsibilities.

A further contribution to this body of frameworks comes from work on Principal Ethical AI Leadership (PEAIL), which repositions school principals from heroic individual moral managers toward stewards of socio-technical systems (Ho, 2026). On this view, ethical AI leadership is operationalized not only through individual values but through concrete governance routines: institutionalized algorithmic audits, recurring “ethics rounds” in which AI-supported decisions affecting students or staff are collectively reviewed, and explicit registers of “non-delegable decisions” — categories of decision that must always retain a documented human-in-the-loop checkpoint regardless of AI recommendation confidence. Complementary formal tools, such as the Isabelle Infrastructure Framework (Kammüller & Satija, 2023, p.9), offer methods for representing data flows, actors, locations, and otherwise opaque algorithmic functions as inspectable state structures amenable to counterfactual analysis, thereby giving ethical AI leadership frameworks a concrete technical complement: governance principles are only as effective as the inspectability of the systems they govern.

5.3. AI Literacy as a Leadership Competency

A theme that emerges with increasing insistence across the literature is the importance of AI literacy as a core competency for contemporary

school leaders. AI literacy in this context does not refer to technical programming ability, but to the conceptual, critical, and practical knowledge that enables leaders to understand what AI systems do, how they generate their outputs, what assumptions and limitations they embody, how to evaluate their outputs critically, and how to make ethically informed decisions about AI adoption and governance.

Sposato (2025) argues that AI literacy should be treated as a professional development priority for educational leaders, analogous to the emphasis on data literacy that became central to educational leadership preparation in the early twenty-first century. Just as school leaders are expected to be able to read and critically interpret student performance data, they should be expected to be able to read and critically interpret AI-generated analytics. This requires investment in both pre-service and in-service professional learning programs that build leaders' AI literacy in educationally relevant and practically grounded ways.

Kafa's (2025) empirical findings from Cyprus suggest that AI literacy is not merely a nice-to-have but a determinant of whether AI tools actually deliver their promised benefits. Principals who lacked confidence in understanding and interpreting AI outputs tended either to over-rely on AI recommendations without critical evaluation or to reject AI tools entirely. Both responses are suboptimal and both reflect the inadequacy of professional preparation for AI-integrated leadership, with clear implications for educational leadership preparation programs, professional development providers, and school systems designing AI integration strategies.

5.4.Human-AI Collaboration, Explainability, and the Symbiosis Phase

Human-AI collaboration in educational leadership can be framed not as a simple extension of earlier, purely human-centered phases of ethical leadership, but as a qualitative reconfiguration of ethical practice in which algorithmic systems actively participate in assessment, prediction, and decision-making. Ho (2026) describes this configuration as a “Human-AI Symbiosis and Ethical Governance Phase” that redistributes agency between human principals and non-human systems within hybrid socio-technical environments. AI in

school management in this phase comprises discriminative models such as predictive analytics for attendance, behavior, and achievement; adaptive learning platforms and intelligent tutoring systems that automate feedback; and generative models such as large-language systems producing text, images, or code. Each of these architectures exhibits distinct profiles of transparency, traceability, and accountability, so collaborative governance requires differentiated forms of oversight rather than a single uniform policy.

Within this framing, PEAIL operates as a cross-cutting lens connecting personal virtue and professional judgment with systemic accountability, cultural pluralism, and technological mediation. Collaboration with AI is not merely tool use but an ongoing negotiation in which leaders interpret, negotiate, and at times resist pressures created by digital platforms, vendor infrastructures, and regulatory structures. The influencing factors span individual, organizational, policy, and socio-cultural levels, and are bounded by an overarching governance environment comprising market dominance, algorithmic opacity, cross-jurisdictional regulation, and global normative commitments to fairness, inclusion, and human dignity — boundary conditions that shape the possibilities and constraints of human-AI collaboration in everyday leadership.

Within this ecology, principals encounter recurring ethical challenges precisely at the points where humans and AI systems intersect: data privacy and surveillance, algorithmic bias, unequal access, professional autonomy, and transparency all arise as dilemmas in which algorithmic outputs and school-level values must be jointly navigated. Strategic responses cast human-AI collaboration as mediated through explicit leadership practices — strengthening human oversight, protecting data, fostering inclusion, sustaining human-centered school cultures, ensuring transparent procedures, building AI literacy and ethical awareness, and working to bridge digital divides, all refracted through ongoing negotiations with vendors and compliance regimes. When such strategies are enacted, AI-supported decision processes become genuinely collaborative in the sense that human actors retain interpretive authority and relational commitments while leveraging algorithmic capabilities.

The outcomes associated with ethically managed human-AI collaboration point toward potential gains in personalization, professional collaboration, and inclusive school cultures: when human oversight and value mediation are maintained, AI can enhance personalized learning and foster new forms of professional cooperation without displacing empathy, trust, and moral judgment as core leadership qualities. Reviews of this emerging collaborative order are careful to note, however, that it remains conceptually vigorous but empirically preliminary. The broader framework of socio-technical stewardship — oversight practices, human-in-the-loop decision-making, value mediation, and formal inspectability tools such as the Isabelle Infrastructure Framework — is informed by theory and guided by evidence rather than fully validated, and further in-situ and longitudinal studies are required to clarify how socio-technical stewardship can reliably convert ethical intent into sustainable, equity-oriented practice in AI-mediated schooling.

6. Discussion

6.1. Implications for Policy, Practice, Research, and Governance

6.1.1. Implications for Educational Policy

The evidence synthesized in this review has substantial implications for educational policy at system, national, and international levels. Perhaps most urgently, the review underscores the need for coherent, comprehensive, and democratically legitimate policy frameworks for AI in school management. The current situation — characterized by rapid, largely uncoordinated AI adoption driven primarily by vendor marketing in the absence of robust regulatory oversight — creates unacceptable risks for students, staff, and communities.

Policy frameworks for AI in school management should, at minimum, establish: clear requirements for transparency and explainability in AI systems used in educational settings; robust data protection and privacy standards that exceed minimum legal requirements and specifically address the vulnerabilities of students as data subjects; mandatory ethical impact assessments for AI procurement decisions; requirements for staff AI literacy training as a condition of AI adoption; community

engagement processes that give families and community members meaningful voice in AI governance; and regular independent auditing of AI systems for bias, accuracy, and equity effects.

Beyond these minimum standards, this review suggests that policy frameworks should actively invest in equity-centered AI development and deployment, ensuring that the potential benefits of AI in school management are accessible to under-resourced schools and communities rather than concentrated in privileged settings. This requires targeted infrastructure investment, subsidized access to AI tools for under-resourced schools, capacity-building programs for educators and administrators in lower-income contexts, and active engagement with the Global South in the co-design of AI tools for school management.

6.1.2.Implications for Practice

For school leaders, the review's most important practical implication is the importance of approaching AI adoption with active rather than passive engagement. Passive AI adoption — accepting vendor offerings uncritically, allowing AI systems to automate decisions without adequate oversight, or treating AI outputs as authoritative — carries significant risks of the kinds documented throughout this review. Active AI adoption, by contrast, involves: critical evaluation of AI tools before procurement; co-design of implementation processes with staff, students, and families; deliberate cultivation of AI literacy within the school community; regular critical review of AI-generated outputs against independent evidence and professional judgment; clear institutional protocols for human oversight of AI-assisted decisions; and ongoing reflection on the ethical and equity implications of AI adoption decisions.

School leaders should also resist the temptation to define AI integration success primarily in terms of efficiency gains. While efficiency is a legitimate and valuable benefit, the purpose of school management is ultimately not efficiency for its own sake but the creation of conditions in which all students can learn, grow, and flourish. AI tools that enhance efficiency while undermining equity, trust, or professional culture are not successful integrations, regardless of their efficiency metrics. Leaders should evaluate AI adoption in terms of its contribution to the

school's core educational mission, assessed holistically and in dialogue with all stakeholders.

6.1.3. Implications for Research

The research agenda implied by this review is substantial. The field is still at an early stage of empirical development: many of the studies reviewed are theoretical or framework-oriented, empirical studies are often small-scale, context-specific, and cross-sectional, and the evidence base for specific claims about AI benefits in school management is frequently thinner than the enthusiasm of the broader discourse suggests. A more robust evidence base requires: longitudinal studies that track the effects of AI integration in school management over time; large-scale comparative studies across diverse national and contextual settings; randomized or quasi-experimental designs where feasible; mixed-methods approaches that combine quantitative outcome measures with rich qualitative understanding of implementation processes and stakeholder experiences; systematic attention to equity and distributional effects; and collaborative research designs that involve school leaders, teachers, students, families, and communities as active research partners rather than passive subjects.

The three hypotheses formulated in Section 9 of this review provide a starting point for this research agenda, but they represent only a fraction of the empirical questions that remain unanswered. Particularly urgent are questions about the long-term effects of AI adoption on the professional identity and judgment of school leaders; the conditions under which AI tools enhance versus undermine equity in school management; the mechanisms through which AI literacy affects the quality of human-AI collaboration in school settings; and the governance structures that are most effective in ensuring that AI integration in schools serves democratic and educational values rather than commercial interests.

6.1.4. Priority actions for Governance and Capacity Building

Converging the technical, ethical, and policy strands of this review into actionable guidance, five priority actions emerge as a roadmap for shifting AI use in school management from ad-hoc efficiency gains toward accountable, educationally aligned practice.

- Institutionalize governance routines — embed algorithmic audits, recurring ethics rounds, and documented human-in-the-loop decision points into procurement and day-to-day administrative practice.
- Invest in workforce capacity — provide sustained professional learning and budgeted technical support so that principals, teachers, and IT staff can interpret, challenge, and override system outputs when necessary.
- Condition vendor relationships on transparency — require data portability, audit access, and algorithmic impact assessments before deployment of AI tools in high-stakes domains.
- Adopt technical mitigations where appropriate — federated training, differential privacy, and explainable-model toolchains, balancing computational costs against usability and equity of access.
- Expand theoretical and empirical work — integrate learning science, human-AI collaboration theory, and equity-focused frameworks (including critical and intersectional perspectives) so that the design and evaluation of AI tools center both cognitive mechanisms and socio-political impacts.

Progress on these priorities depends on interdisciplinary collaboration among educators, technologists, ethicists, and policymakers, and on empirical programs that trace how leadership choices shape classroom practice and student outcomes over time. When governance, technical safeguards, and capacity investments are aligned, AI can support administrative relief and richer forms of learner support while respecting privacy, inclusion, and professional judgment.

Conclusions

This expanded systematic review has synthesized the current evidence on artificial intelligence applications in school management and organizational support processes, drawing together a systematic PRISMA-based review, explainability- and ethics-focused literature, and bibliometric and organizational-management scholarship. The

picture that emerges is one of genuine and significant potential, substantial and serious risk, and a field at an early but consequential stage of development.

The potential is real. AI tools can reduce administrative burden on school leaders in ways that free time and cognitive resources for the relational and instructional dimensions of leadership that matter most for educational quality. AI analytics can surface patterns in complex educational data that support more evidence-informed, equitable, and responsive decision-making. AI-powered operational tools can optimize scheduling, resource allocation, financial and human-resource management, attendance monitoring, and community communication in ways that improve school functioning. Predictive and generative technologies promise administrative efficiencies and new modes of personalization. These benefits are not hypothetical; they are documented across multiple national contexts, organizational functions, and study types.

The risks are equally real. Algorithmic bias can reproduce and legitimize discriminatory patterns. Data privacy and cybersecurity breaches can harm vulnerable students and families. Over-reliance on AI can erode the professional judgment, relational intelligence, and contextual wisdom that are the irreducible core of educational leadership. Digital divides and interoperability gaps can concentrate AI benefits in already-privileged settings. Policy vacuums can allow vendor lock-in and commercial interests to shape AI adoption in schools without adequate democratic accountability. Across all of these domains, three persistent tensions recur: the trade-off between predictive performance and transparency, the distribution of authority between automated systems and human decision-makers, and the ethical stewardship of sensitive student data.

The resolution of this tension — between potential and risk — is not a technical but a human and political project. It requires educational leaders who approach AI with critical literacy, ethical commitment, and democratic accountability — leaders who, in the language of Principal Ethical AI Leadership, act as socio-technical stewards aligning operational uses of AI with professional norms, equity commitments, and legal obligations. It requires policymakers who design governance

frameworks that protect students and communities while enabling responsible innovation, and who condition vendor relationships on transparency, data portability, and audit access. It requires researchers who generate the rigorous, equity-centered evidence base that responsible AI integration in schools demands, moving beyond technology-acceptance studies toward designs that trace leadership decisions to classroom practices, student learning, and equity outcomes. And it requires the voices of students, teachers, families, and communities to be genuinely heard in decisions about how AI is adopted, governed, and evaluated in educational organizations.

The central argument of this review is that AI in school management is neither a solution nor a threat, but a set of tools whose effects depend entirely on the wisdom, values, and intentions of the humans who deploy them. Its value lies in augmenting, not replacing, wise human leadership committed to educational justice. Educational leaders who engage with AI thoughtfully, critically, and with an unwavering commitment to educational justice have genuine reason for optimism. Those who adopt AI passively, uncritically, or primarily in service of efficiency have reason for serious concern. The difference lies not in the technology, but in the quality of human leadership that surrounds it. This review calls for continued, rigorous, and equity-centered research; for robust and democratically legitimate policy frameworks; for governance routines that embed algorithmic audits and ethics rounds into everyday practice; and for a profession-wide commitment to developing the AI literacy, ethical reasoning capacity, and reflective practice that responsible AI integration in school management demands. The future of AI in schools will be made, not given — and it will be made by the choices that educators, leaders, researchers, and communities make now.

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