Artificial Intelligence and Analytics in Action: Rethinking School Leadership in China's K-12 Education

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ABSTRACT

This qualitative study explores how school leaders in urban Chinese K12 schools perceive, implement, and navigate artificial intelligence and educational analytics in school management. Despite strong national policy promotion of AI driven educational transformation, empirical evidence on AI leadership practices in China remains limited. Drawing on semi structured interviews with eight principals and administrators from six public and private schools in Beijing, Shanghai, and Shenzhen, the study identifies four interrelated themes: an instrumental understanding of AI, fragmented application scenarios, multifaceted implementation challenges including limited expertise, ethical and privacy concerns, insufficient policy guidance, and resource constraints, and enabling leadership strategies such as vision building, professional development, data culture cultivation, and external collaboration. Based on these findings, the study proposes a contextualized AI leadership framework for Chinese K12 schools that conceptualizes AI integration as a dynamic interaction among policy directives, leadership agency, technological resources, and organizational culture. The findings offer theoretical insights into context sensitive AI leadership and provide practical implications for school leaders and policymakers seeking to promote strategic, ethical, and sustainable AI integration in education.

Keywords: Artificial intelligence; educational analytics; Chinese K-12 education; school leadership

INTRODUCTION

Artificial intelligence (AI) and educational data analytics are increasingly reshaping educational systems worldwide, influencing not only classroom instruction but also school governance, management, and leadership practices. Through applications such as intelligent evaluation, automated administration, and data-driven decision-making, AI technologies are widely promoted as catalysts for improving efficiency, personalization, and accountability in education. In China, national initiatives including the Education Informatization 2.0 Action Plan and the New Generation Artificial Intelligence Development Plan have explicitly positioned AI as a strategic driver of educational modernization. Substantial public investment in smart campus infrastructure and educational data platforms has created a favorable technological environment for large-scale adoption of AI and analytics in K–12 schools.

However, the effective integration of AI in education is not merely a technological issue but fundamentally a leadership and management challenge. School principals and administrative leaders play a pivotal role in interpreting policy mandates, selecting and deploying technologies, and negotiating organizational and ethical implications associated with data use. While national policies emphasize rapid digital transformation, the extent to which AI reshapes leadership practices depends largely on leaders' understanding, strategic vision, and organizational agency. As prior research suggests, technological infrastructure alone does not guarantee meaningful innovation; instead, leadership sense-making and decision-making processes are central to translating technological potential into educational value.

Despite strong top-down policy momentum, growing evidence points to a significant gap between infrastructure readiness and leadership capacity in China's K–12 education system. Official statistics indicate that although

over 90% of urban K–12 schools are equipped with basic informatization facilities, fewer than one quarter systematically apply AI technologies to strategic planning, data-informed leadership, or pedagogical innovation. Survey data further reveal that a majority of school principals perceive a lack of AI-related strategic vision and leadership competence as the primary barrier to smart campus development (Wang & Li, 2023). These findings suggest that leadership cognition and habitual management practices have emerged as critical bottlenecks constraining the realization of policy dividends, even in technologically advanced regions.

Existing academic literature provides limited insight into this leadership dimension. Research on AI in education has largely concentrated on technical capabilities, classroom-level applications, or student learning outcomes, while institutional leadership and governance issues remain underexplored—particularly in non-Western contexts. Although recent theoretical work has begun to conceptualize AI leadership through frameworks such as digital leadership, dual leadership, and human–AI collaboration, these models are predominantly developed in Western educational systems and often assume decentralized governance structures and high organizational autonomy. Their applicability to China's centralized, policy-driven K–12 system therefore remains uncertain.

Against this backdrop, there is a pressing need to move beyond infrastructural indicators and adoption rates to examine how school leaders in China actually perceive, interpret, and enact AI and analytics in their daily leadership practices. Understanding leadership sense-making, strategic dilemmas, and contextual constraints is essential for explaining why AI adoption remains largely instrumental and fragmented, despite favorable policy and technological conditions. Addressing this gap requires qualitative, context-sensitive inquiry that foregrounds leaders' lived experiences and organizational realities.

Accordingly, this study adopts a qualitative multiple-case study approach to explore AI-supported school leadership in urban Chinese K–12 schools. It addresses the following research questions:

(1) How do Chinese school leaders understand AI and educational analytics, and how are these technologies applied in day-to-day school management?

(2) What challenges and opportunities do school leaders perceive in implementing AI within school management systems?

(3) What leadership practices and policy conditions can support effective, ethical, and sustainable AI integration in the Chinese context?

This study contributes to the literature in three main ways. Empirically, it provides qualitative evidence on how AI and educational analytics are understood and enacted by school leaders in China's K–12 system, a context that remains underexplored in existing research. Theoretically, it extends prevailing AI leadership frameworks by proposing a contextualized model that foregrounds leadership agency as a mediating force between policy directives and school-level practices within a centralized governance environment. Practically, the study identifies key leadership strategies and systemic constraints shaping AI integration, offering actionable insights for policymakers and school leaders seeking to move beyond instrumental and fragmented adoption toward more strategic, ethical, and sustainable uses of AI in education.

LITERATURE REVIEW

AI and Analytics in Educational Leadership

Artificial Intelligence in Education (AIED) has increasingly influenced not only teaching and learning but also school leadership and organizational decision-making. AIED generally refers to the application of technologies such as machine learning, natural language processing, and predictive analytics to support educational management, governance, and student services (Miao et al., 2021). In leadership contexts, AI is often embedded in educational analytics, which involves the systematic collection and analysis of data to inform decision-making, resource allocation, and performance monitoring (Siemens & Baker, 2012).

Prior studies indicate that AI and analytics can enhance leadership efficiency by automating routine administrative tasks, supporting data-driven decisions, and enabling real-time monitoring of student progress

(Pedro et al., 2019). These tools potentially allow school leaders to reallocate time and attention toward instructional leadership and strategic planning. However, the integration of AI also reshapes leadership practices by introducing new demands related to data interpretation, technological competence, and ethical accountability. Consequently, scholars emphasize the importance of digital leadership and AI readiness. Digital leadership highlights leaders' capacity to integrate technology into organizational vision and culture, while AI readiness underscores technological literacy, openness to innovation, and ethical awareness (Karakose et al., 2023). School leaders are expected not only to adopt AI tools but also to critically assess their implications for equity, privacy, and professional judgment.

Despite these potentials, empirical evidence suggests that many school leaders remain cautious or insufficiently prepared to leverage AI strategically. Challenges such as limited data literacy, lack of professional training, and concerns over algorithmic transparency constrain effective use. As a result, AI in educational leadership should be understood not merely as a technical instrument but as a catalyst for redefining leadership roles, decision-making processes, and organizational values. This calls for deeper examination of how school leaders conceptualize and enact AI-supported leadership, particularly in diverse institutional contexts.

Theoretical Frameworks for AI Leadership

Several theoretical frameworks have been proposed to explain how AI and analytics can be integrated into educational leadership. A prominent approach focuses on human–AI collaboration, emphasizing that AI should support rather than replace human judgment. Karakose et al. (2023) argue that effective AI leadership depends on relational trust, ethical awareness, and leaders' ability to balance algorithmic insights with professional expertise. From this perspective, AI functions as a decision-support system that enhances leaders' cognitive capacity while preserving human agency.

Another influential framework is the concept of "dual leadership" proposed by Pietsch and Mah (2024). This model combines transformational leadership with digital instructional leadership, suggesting that school leaders must simultaneously promote a shared vision for digital transformation and provide concrete instructional support for technology use. Transformational leadership fosters motivation and openness to innovation, while digital instructional leadership ensures alignment between AI tools and pedagogical objectives. Mohan and Brooks (2023) further conceptualize AI-supported leadership as an iterative process involving continuous data collection, interpretation, and instructional action. Their model positions principals as sense-makers who translate analytics into strategic decisions that improve teaching and learning. Rather than viewing AI implementation as a one-time initiative, this framework highlights adaptability and ongoing reflection in leadership practice.

Ethical governance is a cross-cutting theme across these frameworks. International guidelines from UNESCO (2021) and Pedro et al. (2019) emphasize data privacy, bias mitigation, transparency, and accountability. Together, these theories suggest that AI leadership is a socio-technical and ethical practice rather than a purely technological one. However, most frameworks are developed in Western contexts, raising questions about their applicability in systems with different governance structures and cultural norms.

Empirical Studies and the Chinese Context

Empirical research on AI and analytics in educational leadership remains limited, particularly in K–12 settings and non-Western contexts. Existing studies tend to focus on classroom-level applications or higher education, leaving school leadership underexplored. In China, national initiatives such as Education Informatization 2.0 have accelerated the adoption of AI technologies, including automated assessment, intelligent scheduling, and learning analytics systems (Shen & Xia, 2022). These policies reflect strong governmental commitment to digital transformation in education. However, evidence suggests a notable policy–practice gap. At the school level, AI implementation is often externally driven by technology providers or administrative mandates, resulting in fragmented or superficial use. Leadership engagement with AI frequently remains operational rather than strategic. Similar patterns are observed globally, where predictive analytics are promoted but only weakly integrated into leadership decision-making processes (UNESCO, 2021).

Studies from Western contexts offer comparative insights. For example, Pietsch and Mah (2024) find that digital mindset and dual leadership competencies significantly predict AI adoption among German school leaders,

though overall implementation levels remain low. These findings underscore the central role of leadership beliefs and capacities in mediating technology use. In contrast, Chinese empirical research has largely emphasized pedagogical applications of AI, such as personalized learning and intelligent tutoring, with limited attention to leadership practices, governance, or ethical challenges. Given China's centralized policy environment and rapid technological diffusion, understanding how school leaders interpret and enact AI-supported leadership remains an important but underexplored area.

Research Gap

Based on the literature, three key research gaps are evident. First, there is a lack of empirical evidence on how school leaders in China perceive, understand, and experience AI and analytics in their leadership practices. Existing studies rarely examine leadership sense-making or decision processes. Second, dominant theoretical frameworks for AI leadership are largely Western-oriented and may not adequately capture the systemic, cultural, and institutional characteristics of Chinese K–12 education. Third, there is insufficient qualitative research that explores school leaders' lived experiences, particularly regarding strategic dilemmas, ethical concerns, and contextual constraints associated with AI adoption. To address these gaps, this study employs a qualitative multiple-case study approach focusing on urban Chinese K–12 schools. By examining leaders' interpretations and practices of AI and analytics, the study seeks to develop a contextualized understanding of AI-supported school leadership. The findings aim to contribute to the rethinking of school leadership in the AI era and to provide evidence-based recommendations for policy and practice in China.

RESEARCH METHODOLOGY

Research Design

This study adopted a qualitative multiple-case study design to explore how and why school leaders apply artificial intelligence and educational analytics in their management and leadership practices. A qualitative approach was deemed appropriate given the exploratory nature of the research questions, which seek to understand leaders' perceptions, interpretations, and decision-making processes rather than to test predefined hypotheses. Specifically, the "how" and "why" questions central to this study align well with case study methodology, which enables an in-depth examination of complex social phenomena within their real-life contexts (Yin, 2018).

The multiple-case design allows for analytic generalization through cross-case comparison, strengthening the explanatory power of the findings. By examining multiple schools, the study captures both common patterns and contextual variations in AI-supported leadership practices, thereby avoiding overreliance on a single organizational setting. This design is particularly suitable in the context of AI adoption in schools, where implementation is shaped by institutional culture, leadership vision, policy environments, and technological infrastructure. Conducting the study in natural settings further enables the identification of emergent themes and nuanced leadership practices that might be overlooked in survey-based or experimental designs. In line with Creswell and Poth (2018), this qualitative design emphasizes depth, reflexivity, and contextual understanding. Rather than treating AI as a standalone technical intervention, the study conceptualizes it as an embedded practice within school leadership systems. The multiple-case approach thus supports a holistic understanding of how AI and analytics interact with leadership roles, organizational routines, and ethical considerations. Overall, this research design provides a robust methodological foundation for rethinking school leadership in the era of AI, particularly within the distinctive institutional context of China's K–12 education system.

Participants and Sampling

The target population for this study consisted of school leaders working in K–12 schools in Beijing, Shanghai, and Shenzhen—three cities that are widely recognized as frontrunners in China's educational digital transformation. These metropolitan areas were purposefully selected due to their advanced technological infrastructure, strong policy support for AI adoption, and relatively high levels of experimentation with data-driven school management. Focusing on these cities increased the likelihood of identifying information-rich cases relevant to the research questions.

Participants included principals, vice-principals, and technology coordinators from both public and private schools. A purposive sampling strategy was employed to select leaders with direct and firsthand experience in the adoption or oversight of AI and analytics in school management (Palinkas et al., 2015). Inclusion criteria required participants to (a) hold a formal leadership role, (b) be involved in decision-making related to educational technology or data use, and (c) have experience with AI-enabled systems in their schools. Leaders without responsibility for technology-related decisions were excluded to ensure the relevance and depth of the data collected. In total, eight participants from six schools were recruited. Although the sample size was relatively small, it was considered adequate for qualitative inquiry, as thematic saturation was reached when no new substantive themes emerged from the data (Guest, Bunce, & Johnson, 2006). Ethical considerations were strictly observed throughout the study. Participants were informed of the study's purpose, assured of anonymity and confidentiality, and informed that participation was voluntary. Written informed consent was obtained prior to data collection, and ethical approval was secured in accordance with institutional research guidelines.

Data Collection and Analysis

Data were collected through semi-structured interviews, which allowed for both consistency across participants and flexibility to probe individual experiences. Each interview lasted approximately 30–45 minutes and was conducted in Mandarin to ensure participants' comfort and expressive clarity. All interviews were audio-recorded with participants' consent and transcribed verbatim for analysis. The interview protocol covered key topics, including leaders' understanding of AI, specific use cases in school management, leadership strategies, perceived benefits and challenges, and available institutional support systems. Data analysis followed Braun and Clarke's (2006) six-phase thematic analysis framework. First, the researchers familiarized themselves with the data through repeated reading of transcripts. Initial codes were then generated inductively, capturing meaningful units related to AI leadership practices. These codes were subsequently organized into potential themes, which were reviewed and refined to ensure coherence and distinctiveness. Final themes were clearly defined and named before being synthesized into an analytical narrative. NVivo (version 14) was used to facilitate systematic data management and coding.

To ensure trustworthiness and methodological rigor, the study adhered to the criteria proposed by Lincoln and Guba (1985). Credibility was enhanced through member checking, whereby interview transcripts and preliminary findings were shared with participants for verification. Peer debriefing was conducted through regular discussions among the research team to reduce individual researcher bias. An audit trail documenting analytic decisions, coding iterations, and reflective memos was maintained to ensure transparency and dependability. Finally, thick description was employed in reporting the findings by incorporating representative quotations, enabling readers to assess the linkage between raw data and analytical interpretations.

RESULTS AND DISCUSSION

Instrumental Conceptions of AI: Administrative Utility over Strategic Transformation

Across the cases, school leaders predominantly conceptualized artificial intelligence in instrumental and operational terms, viewing it primarily as a tool to enhance administrative efficiency rather than as a strategic resource for systemic school improvement. AI was most commonly associated with routine tasks such as attendance tracking, grade aggregation, and basic reporting functions. Advanced applications, including predictive analytics, adaptive management systems, or AI-supported instructional planning, were rarely mentioned and generally perceived as distant or impractical. This narrow understanding reflects limited exposure to higher-order AI functionalities as well as insufficient professional training tailored to leadership use rather than technical operation.

More importantly, this instrumental perception cannot be explained solely by knowledge deficits. Instead, it reflects a pragmatic leadership orientation shaped by performance accountability pressures within China's K–12 education system. Leaders tended to prioritize applications that produce immediate, visible, and quantifiable outcomes, such as efficiency gains and compliance with reporting requirements. As one vice-principal noted, AI was mainly used "to process part of the administrative work," while its potential role in instructional or strategic decision-making remained unexplored. This short-term operational focus constrains leaders' ability to engage with AI as a catalyst for organizational learning or long-term transformation.

From a theoretical perspective, these findings partially align with existing literature on early-stage digital leadership, where technology is initially framed as a support mechanism rather than a strategic lever. However, in the Chinese context, this instrumental logic is reinforced by centralized governance structures and evaluation systems that reward measurable outputs. Consequently, AI adoption risks becoming an extension of bureaucratic efficiency rather than a means of rethinking leadership practices, limiting its transformative capacity.

Fragmented AI Application Scenarios and the Absence of Strategic Integration

AI applications across the sampled schools were characterized by fragmentation and situational responsiveness rather than coherent strategic design. As shown in Table 1, leaders reported several isolated application scenarios, including resource optimization, student academic and behavioral monitoring, teacher performance evaluation, and, in some cases, data-driven enrollment forecasting. While these practices demonstrate a certain degree of technological engagement, they largely operate in parallel rather than as part of an integrated leadership or governance framework.

Table 1: AI Application Scenarios in School Leadership

Application Area	Typical Uses	Leadership Orientation
Resource optimization	Class scheduling, facility allocation	Operational efficiency
Student monitoring	Academic/behavioral early warning	Risk management
Teacher evaluation	Performance data aggregation	Accountability-driven
Enrollment forecasting	Demand prediction, resource planning	Administrative planning

Despite their functionality, these applications were rarely connected to pedagogical innovation, instructional improvement, or long-term strategic planning. Leaders tended to adopt AI tools reactively to address immediate administrative demands or policy requirements rather than proactively embedding them into school-wide improvement strategies. This pattern reflects limited strategic vision and organizational capacity to integrate AI across leadership domains. Analytically, such fragmentation mirrors the tension between top-down policy mandates and bottom-up implementation capacity. National initiatives such as Education Informatization 2.0 promote rapid digital adoption, yet often provide insufficient operational guidance and sustained support. Schools respond by selectively adopting tools that help meet compliance demands, resulting in a patchwork of AI uses that alleviate short-term pressures but fail to transform leadership practice in a systemic manner.

Structural, Ethical, and Capacity-Based Barriers to AI Leadership

Participants consistently reported multifaceted challenges that constrained effective AI integration in school leadership. First, inadequate AI-related skills among both leaders and teachers limited meaningful engagement with data-driven tools. Many leaders relied heavily on external vendors for technical decisions, which weakened internal capacity building and reduced leadership agency. This dependence further reinforced a passive adoption model, where schools used pre-packaged solutions without critically evaluating their educational implications. Second, ethical and data privacy concerns emerged as a major source of uncertainty. Participants expressed anxiety over unclear boundaries regarding student data access, usage, and storage, compounded by the absence of standardized protocols at the school level. These concerns often resulted in cautious or minimal use of AI, particularly in areas involving student profiling or predictive analytics.

Third, leaders highlighted the lack of coherent policy guidance and sustained resource support. While policy discourse strongly encourages AI adoption, practical standards, funding mechanisms, and professional development pathways remain fragmented. Combined with constraints related to software costs, hardware upgrades, and long-term technical maintenance, these factors create an environment where AI adoption is both encouraged and structurally constrained. Taken together, these barriers suggest that challenges in AI leadership

are not merely technical but deeply embedded in governance structures, ethical uncertainty, and capacity limitations, reinforcing the need for leadership-centered rather than technology-centered solutions.

Enabling Leadership Practices for Meaningful AI Integration

Despite these constraints, several schools demonstrated more advanced and coherent AI leadership practices. These cases shared a set of enabling leadership strategies that mediated external pressures and internal limitations. Leaders in these schools articulated a clear vision for AI integration, explicitly linking technology use to school development goals and communicating this vision to teachers and stakeholders. Rather than framing AI as an external mandate, they positioned it as a tool for collective improvement. Professional development was another critical strategy. Leaders invested in ongoing, practice-oriented training that emphasized pedagogical integration and data interpretation rather than technical operation alone. This approach helped cultivate teachers' confidence and reduced resistance to AI-supported practices. Additionally, these schools actively fostered a data-informed culture, encouraging evidence-based decision-making and reflective dialogue among staff. These findings resonate with dual leadership and human–AI collaboration theories, emphasizing leadership agency as a critical mediating factor. In the Chinese context, effective AI leadership emerges not from technological sophistication alone but from leaders' ability to align policy demands, organizational culture, and professional learning.

Toward a Contextualized AI Leadership Framework for Chinese K–12 Schools

Synthesizing these findings, this study proposes a contextualized AI leadership framework tailored to Chinese K–12 schools. Rather than a linear cause–effect model, the framework conceptualizes AI integration as a dynamic system shaped by four interrelated elements: policy directives as the external driver, leadership agency as the core mediator, technological resources as the supporting infrastructure, and organizational culture as the implementation context. The instrumental understanding of AI and fragmented application scenarios identified in this study represent surface-level manifestations of deeper systemic conditions. Enabling leadership strategies, such as vision building, professional development, and cultural cultivation, function as key intervening mechanisms that determine whether AI adoption remains superficial or becomes transformative. Crucially, leadership agency plays a central role in translating macro-level policy ambitions into meaningful micro-level practices. This framework extends existing Western-oriented AI leadership models by embedding leadership action within China's distinctive governance and accountability environment. It highlights that rethinking school leadership in the era of AI requires not only technological advancement but also contextual sensitivity, ethical reflection, and sustained leadership development.

CONCLUSION

This study examined how artificial intelligence (AI) and educational analytics are understood and enacted by school leaders within China's K–12 education system. Based on qualitative evidence from multiple cases in metropolitan contexts, the findings indicate that AI adoption in school leadership is predominantly instrumental and fragmented. Rather than functioning as a strategic driver of systemic improvement, AI is primarily used to enhance administrative efficiency, respond to accountability pressures, and address short-term organizational needs.

To explain this pattern, the study proposes a contextualized AI leadership framework tailored to Chinese K–12 schools. The framework conceptualizes AI integration as a dynamic system shaped by four interrelated elements: policy directives, leadership agency, technological resources, and organizational culture. This perspective highlights that fragmented and operational uses of AI reflect deeper structural and cultural conditions rather than purely technical limitations. Leadership agency emerges as a critical mediating force, determining whether policy-driven AI initiatives remain superficial or evolve into practices that support instructional improvement and organizational learning.

The study offers several practical implications. At the policy level, clearer and more actionable guidance is needed regarding data governance, ethical use, and leadership responsibilities, supported by sustained funding and capacity-building mechanisms. For school leaders, the findings underscore the importance of shifting from an instrumental to a strategic orientation toward AI by embedding it within school development goals. Leadership

preparation programs should prioritize AI literacy for decision-making, data interpretation, and ethical judgment. At the organizational level, cultivating a data-informed culture through ongoing professional development and strategic partnerships can further support meaningful AI integration.

Despite its contributions, this study has limitations. The focus on urban, resource-rich schools may limit the generalizability of the findings, and reliance on self-reported interview data introduces potential bias. Future research should adopt comparative and longitudinal designs, incorporate multiple data sources, and include perspectives from teachers, students, and policymakers to develop a more comprehensive understanding of AI-enabled school leadership in diverse educational contexts.

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