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REVIEW AND SYNTHESIS

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Navigating the challenges and opportunities of artificial intelligence in educational leadership: A scoping review

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Abstract

The increasing integration of Artificial Intelligence (AI) in educational settings is transforming the role of school leaders, reshaping how decisions are made, and introducing both opportunities and challenges. This paper presents the findings of a scoping review that synthesises the current literature on AI's impact on educational leadership. The review highlights that while AI has the potential to enhance decision-making through data-driven insights and automation of administrative tasks, its implementation requires careful consideration of ethical, equity, and human-centred concerns. Key findings suggest that educational leaders must develop digital literacy and AI competence to critically assess AI outputs and mitigate risks, particularly related to algorithmic bias and data privacy. The review also emphasises the necessity of continuous professional development for leaders and staff to ensure effective and ethical AI integration. In light of these findings, this paper advocates for a balanced approach where AI is used to augment, rather than replace, the human elements of leadership, and calls for future empirical research to further investigate the long-term implications of AI in diverse educational contexts.

KEYWORDS
artificial intelligence, education, leadership, school principals

Context and implications

Rationale for this study: This paper addresses the growing impact of AI on educational leadership and identify opportunities and challenges by conducting a systematic review.

Why the new finding matter: The findings highlight the importance of ethical and competent AI integration. Implications for educational professionals include prioritising the development of digital and ethical skills to address challenges such as algorithmic bias and data privacy.

Implication for teachers and policymakers: Policymakers must invest in training and ensure equitable access to technology to prevent widening the digital divide. Additionally, researchers should delve into the long-term effects of AI in diverse educational contexts.

INTRODUCTION

The rapid advancement of AI technologies has profoundly transformed the role of organisational leaders. These innovations bring both opportunities and challenges, especially in educational settings, where leaders must continuously adapt to emerging tools and practices.

AI offers organisational leaders the ability to delegate routine administrative tasks, such as scheduling and performance tracking, allowing them to focus on more strategic goals. However, leaders must carefully balance human intuition with AI-generated insights. Davenport and Kirby (2016) emphasise that advanced leadership skills are essential for maintaining trust-based relationships within an organisation, ensuring that AI-driven decisions are understood and accepted by staff members (Dai et al., 2024; Karakose, 2024). This hybrid approach—combining the capacities of AI with human oversight—is crucial for building trust and ensuring that AI is used as a tool to augment rather than replace human judgement (Kosztelnik, 2019). Leaders must also develop their ability to guide staff through this transition, ensuring that AI-driven decisions are well-received and effectively incorporated into daily operations (Chiu et al., 2023; Davenport & Kirby, 2016).

As AI continues to influence educational practices, it is critical that leaders fully comprehend both its strengths and limitations. AI can assist in automating administrative tasks and provide valuable, data-driven insights previously difficult to obtain. For example, AI systems can analyse student performance, predict learning trends, and create personalised learning pathways that allow leaders to make well-informed, evidence-based decisions, ultimately improving school outcomes (Hallinger, 2003). Nevertheless, leaders must recognise the importance of human-centred competencies such as emotional intelligence, moral reasoning, and the ability to inspire and motivate staff (Frick et al., 2013; Gazzaniga, 2011). These skills remain crucial in maintaining effective leadership and guiding educational institutions.

A significant challenge for educational leaders is ensuring that AI does not perpetuate or worsen existing inequalities, nor introduce new forms of bias. AI systems are frequently trained on historical datasets that may reflect societal biases, which can negatively influence decision-making processes (Zou & Schiebinger, 2018). Leaders must be diligent in monitoring AI systems to ensure fairness and equity, particularly in educational environments with diverse student populations. For example, algorithms could disproportionately impact students from disadvantaged backgrounds (Obermeyer et al., 2019).

Transparency is essential, and leaders must ensure that all stakeholders, including educators and parents, understand how AI systems make decisions. Effective communication of these processes is crucial to maintaining trust within the educational community (Hoy & Tschannen-Moran, 1999; Tang & Su, 2024).

As AI becomes more ingrained in educational management, fostering a symbiotic relationship between AI technologies and human leadership is paramount. While AI excels in processing vast amounts of data and offering evidence-based recommendations, human leaders are essential in applying moral judgements and ethical values—areas where AI still lacks capability (Arar et al., 2024; Buchanan & O'Connell, 2006). This complementary relationship can greatly enhance organisational performance, enabling leaders to focus on fostering relationships, promoting collaboration, and making ethical decisions that AI cannot replicate (Wang, 2021a). Distinguishing between AI's operational insights and GenAI's creative outputs enables leaders to apply the right tools for specific challenges. Thus, educational leaders must navigate this increasingly complex landscape, leveraging AI to improve efficiency while ensuring that the human touch—so crucial to leadership—remains intact.

The ongoing transformation of leadership roles in education necessitates that leaders develop not only technical expertise in AI but also strong interpersonal skills and ethical awareness. By fostering a balanced approach to AI integration, leaders can ensure that AI enhances their capacity to lead rather than diminish the importance of human oversight. This balanced strategy is essential for the effective use of AI in schools and other educational organisations, where the success of AI-driven initiatives ultimately depends on how well they are integrated into human-centred leadership frameworks (Bond et al., 2024; Gawer, 2020; Karakose, 2024). Leaders who master this balance will be better positioned to navigate the challenges of the AI age while maintaining the trust and support of their staff and communities.

To date, there is limited research examining the impact of AI on the work of educational leaders, leaving a critical gap in understanding how this emerging technology reshapes leadership roles in educational contexts (Arar et al., 2024; Cheng, 2023; Fullan et al., 2023). The study aims to identify the challenges and issues posed by AI to the role of school leaders, as well as the skills required to navigate this new context. The research focuses on how AI is reshaping school leadership roles, including decision-making, strategic planning, policy development, and problem-solving, along with interactions with students, teachers, parents, and the wider community. It addresses two key questions: the main challenges faced by school leaders due to AI advancements and the specific skills needed for the effective implementation of AI in schools.

THEORETICAL FRAMEWORK

Management in educational organisations with AI: Opportunities and challenges

The growing prominence of AI in educational contexts has prompted a re-examination of leadership frameworks within schools. In the context of this study, AI is considered a generic term encompassing several digital technologies, such as machine learning, deep learning, data mining, natural language processing, and neural networks, which create computing systems capable of performing human-like processes, including cognition, synthesis, and understanding of large data to solve complex problems (Baker & Smith, 2019). AI refers to AI systems with broad capabilities, while GenAI is designed to create content such as text, images, or audio. This distinction is relevant because each type of AI presents different implications for educational leadership.

AI compels leaders to engage in lifelong learning and to rethink traditional management frameworks to maintain competitiveness and relevance (Arar et al., 2024; Kavitha & Lohani, 2018). As AI reshapes decision-making processes, it transforms leadership's core functions. Educational leaders are not only tasked with incorporating AI into their operations but must also balance this with the essential human elements that underpin effective leadership. Their role now extends far beyond simply implementing AI technologies; they must address ethical concerns, ensure transparency, and foster collaboration between AI systems and human oversight (Benbya et al., 2020; Bond et al., 2024; Chassignol et al., 2018).

AI's ability to offer data-driven insights can significantly enhance strategic planning and operational management. Yet, AI tools are not without limitations. Kosztelnik (2019) points out that many AI systems function within a 'black box' model, wherein the decision-making processes are often opaque. This lack of transparency presents a major challenge for educational leaders, who must navigate ethical dilemmas to ensure that AI-driven decisions are fair, equitable, and just (Kosztelnik, 2019). Furthermore, Wang (2023a) warns that AI systems may introduce biases if trained on flawed datasets. Leaders must therefore remain vigilant in understanding how AI systems are developed and that the potential for these systems to produce biased outcomes could disproportionately affect marginalised students. GenAI introduces an additional layer of complexity, as it can generate outputs that may unintentionally reinforce stereotypes or inaccuracies. To mitigate these risks, leaders do not only need technical proficiency in AI but also a deep understanding of the social and ethical implications that AI poses (Tang & Su, 2024; Wang, 2023a).

While most reviewed studies treat AI broadly, a minority explicitly distinguish between AI and GenAI. This lack of distinction could influence how findings are interpreted and applied in practice. Additionally, it is important to note that the reviewed literature includes both empirical studies and theoretical or position papers, providing a comprehensive yet varied evidence base.

AI offers organisational leaders the ability to delegate routine administrative tasks, such as scheduling and performance tracking, allowing them to focus on more strategic goals. However, leaders must carefully balance human intuition with AI-generated insights. Davenport and Kirby (2016) emphasise that advanced leadership skills are essential for maintaining trust-based relationships within an organisation, ensuring that AI-driven decisions are understood and accepted by staff members (Dai et al., 2024; Karakose, 2024). This hybrid approach—combining the capacities of AI with human oversight—is crucial for building trust and ensuring that AI is used as a tool to augment rather than replace human judgement (Kosztelnik, 2019). Leaders must also develop their ability to guide staff through this transition, ensuring that AI-driven decisions are well-received and effectively incorporated into daily operations (Chiu et al., 2023; Davenport & Kirby, 2016).

The educational leader: Roles and functions in the new AI landscape

As AI continues to influence educational practices, it is critical that leaders fully comprehend both its strengths and limitations. AI can assist in automating administrative tasks and provide valuable, data-driven insights previously difficult to obtain. For example, AI systems can analyse student performance, predict learning trends, and create personalised learning pathways that allow leaders to make well-informed, evidence-based decisions, ultimately improving school outcomes (Hallinger, 2003). Nevertheless, leaders must recognise the importance of human-centred competencies such as emotional intelligence, moral reasoning, and the

ability to inspire and motivate staff (Frick et al., 2013; Gazzaniga, 2011). These skills remain crucial in maintaining effective leadership and guiding educational institutions.

A significant challenge for educational leaders is ensuring that AI does not perpetuate or worsen existing inequalities, nor introduce new forms of bias. AI systems are frequently trained on historical datasets that may reflect societal biases, which can negatively influence decision-making processes (Zou & Schiebinger, 2018). Leaders must be diligent in monitoring AI systems to ensure fairness and equity, particularly in educational environments with diverse student populations. For example, algorithms could disproportionately impact students from disadvantaged backgrounds (Obermeyer et al., 2019). Transparency is essential, and leaders must ensure that all stakeholders, including educators and parents, understand how AI systems make decisions. Effective communication of these processes is crucial to maintaining trust within the educational community (Hoy & Tschannen-Moran, 1999; Tang & Su, 2024).

As AI becomes more ingrained in educational management, fostering a symbiotic relationship between AI technologies and human leadership is paramount. While AI excels in processing vast amounts of data and offering evidence-based recommendations, human leaders are essential in applying moral judgements and ethical values—areas where AI still lacks capability (Arar et al., 2024; Buchanan & O'Connell, 2006). This complementary relationship can greatly enhance organisational performance, enabling leaders to focus on fostering relationships, promoting collaboration, and making ethical decisions that AI cannot replicate (Wang, 2021a). Distinguishing between AI's operational insights and GenAI's creative outputs enables leaders to apply the right tools for specific challenges. Thus, educational leaders must navigate this increasingly complex landscape, leveraging AI to improve efficiency while ensuring that the human touch—so crucial to leadership—remains intact.

The ongoing transformation of leadership roles in education necessitates that leaders develop not only technical expertise in AI but also strong interpersonal skills and ethical awareness. By fostering a balanced approach to AI integration, leaders can ensure that AI enhances their capacity to lead rather than diminish the importance of human oversight. This balanced strategy is essential for the effective use of AI in schools and other educational organisations, where the success of AI-driven initiatives ultimately depends on how well they are integrated into human-centred leadership frameworks (Bond et al., 2024; Gawer, 2020; Karakose, 2024). Leaders who master this balance will be better positioned to navigate the challenges of the AI age while maintaining the trust and support of their staff and communities.

Current study

The aim of the study is to identify the challenges and problems posed by AI to the role of school leaders and the skills school leaders need in this new scenario.

The implementation of AI in education is an elusive concept, leading to the adoption of a broad definition. In the context of this study, AI is considered as a generic term encompassing several digital technologies, such as machine learning, deep learning, data mining, natural language processing, and neural networks, which create computing systems capable of performing human-like processes, including cognition, synthesis, and understanding of large data to solve complex problems (Baker & Smith, 2019). The review specifically concentrates on how AI is reshaping the role of school leaders, including decision-making, policy setting, strategic planning, and problem-solving (Leithwood et al., 2020), as well as interactions with various stakeholders in the school system, such as students, teachers, parents, community members, and staff (Day et al., 2020).

The present study addresses two research questions to explore the intersection of educational leadership and AI in education:

1. What are the main challenges and problems faced by school leaders with the advancement of AI in education?
2. What are the distinctive skills and abilities required of school leaders to ensure the effective implementation of AI in schools?

METHODOLOGY

Considering the study's aim of mapping the available scientific literature on the intersection between educational leadership and AI, the present study adopted a scoping review methodology (Arksey & O'Malley, 2005; Munn et al., 2018; Tricco et al., 2018). Scoping reviews are particularly useful for rapidly reviewing evidence in emerging fields (Munn et al., 2018), as is the case with AI in Education. Given the recent advancements of AI and its implications for school principals and educational leaders, existing literature remains fragmented and underexplored. Therefore, it was pertinent to first identify the extent, range, and nature of the current scientific evidence on this topic (Arksey & O'Malley, 2005). Scoping reviews employ a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps (Tricco et al., 2018). To ensure a complete and transparent reporting process, we followed the Arksey and O'Malley (2005) methodological approach recommendations as well as the PRISMA extension for Scoping reviews reporting guidelines as recommended by Tricco et al. (2018).

Search strategy

The literature search was conducted through electronic databases as well as specialised journals. First, an extensive electronic search was carried out in three leading databases: Web of Science, Scopus, and ERIC—the latter specialising in educational research. In the Web of Science and Scopus databases, 'artificial intelligence' was used as the primary keyword, combined with secondary keywords such as 'educational leadership', 'school principal', 'AI skills', 'decision-making' and 'school management', using the Boolean operator AND. For the keyword 'school management', the search was limited to the educational research field due to the large number of retrieved records. In ERIC, the API system was used to extract the literature, with 'artificial intelligence' and 'school principal' as the selected keywords (for a detailed search string, see Appendix S1). Following the recommendations of Adams et al. (2017), grey literature from 'tier 1', including conference proceedings, editorials, comments, books, book chapters, book reviews, project reviews, and dissertations, was also included. Grey literature has the potential to capture relevant knowledge that may not be reported in academic articles (Adams et al., 2017), particularly when exploring emerging or less mature fields. To minimise linguistic bias, we did not apply any language restrictions in our search strategy (Rockliffe, 2022).

Second, a manual search was conducted in specialised journals related to the two main topics of AI and educational leadership. A total of 12 eligible records were identified and selected for further analysis. These journals included the *Journal of Educational Administration* ($n = 2$), *Computers and Education* ($n = 9$), *Applied Artificial Intelligence* ($n = 0$), *International Journal of Artificial Intelligence in Education* ($n = 0$), *Educational Technology and Society* ($n = 0$), and *Educational Management Administration and Leadership* ($n = 1$).

In total, 1514 records were identified in the search (WoS $n = 754$; Scopus $n = 332$; ERIC $n = 428$). Additionally, 12 records were added from the manual search of specialised journals, resulting in a total of 1526 records. All identified records were extracted into a spreadsheet in Excel, with at least the following information: authors, title, source, year, abstract. Duplicates were identified and removed using Excel's conditional formatting tool; however, a manual check was still necessary to ensure all duplicates were correctly addressed. After removing duplicates ($n = 329$), 1197 unique titles remained for study selection.

Study screening and inclusion/exclusion criteria

For the study selection, several criteria for inclusion/exclusion were applied in different steps (see Table 1 for the complete inclusion/exclusion criteria). Given the increasing visibility of AI in the educational sector in recent years (Arar et al., 2024; Fullan et al., 2023; Tuomi, 2018), the search was initially narrowed to include records published in the last 10 years (June 2024–2015), resulting in 1028 records.

Next, titles and abstract were screened based on inclusion/exclusion criteria in line with the purpose and scope of the study: (i) the population of interest for this review was educational leaders or school principals, (ii) the context was primary and secondary school, and (iii) the focus was on the use of AI for school management. The screening process involved reviewing the title list and abstract from the Excel spreadsheet, coding each entry as included = 1 or excluded = 0. During the title screening step, two of the authors independently reviewed the titles and excluded records related to higher education, healthcare services, industries organisation, executive education, as well as those focusing on teachers' and students' perspectives on AI use in education ($n = 886$). This process resulted in 142 records selected for abstract reading.

Abstracts were reviewed independently by two of the authors. A total of 95 records were excluded for not meeting the inclusion/exclusion criteria. Records eliminated during abstract reading included those focused on the use of AI for teaching and learning processes, AI software development, uses of decision-making systems in higher education contexts, and

TABLE 1 Inclusion/exclusion criteria.

Criterion	Inclusion criteria	Exclusion criteria
Nature	Works published in scientific databases, such as research articles, conference proceedings, editorials, comments, books, book chapters, book reviews, project reviews, and dissertations	Works published in the press (e.g. general news articles and blogs), webpages, or reports of international organisations
Publication year	Works published from 2015 to June 2014	Works published outside this range
Contexts	Works related to the use of AI in primary and secondary schools	Works related to the application of AI in higher education, healthcare services, industries organisation, management education
Population of interest	Works mainly focusing on the use of AI by school principals	Works focusing on the perspective of teachers or students
Focus	Works describing the use of AI for school management purposes	Works focusing on AI for teaching and learning, software development or professional development, project awards, AI policy development

professional education in fields such as engineering, accounting and marketing. Following this process, 47 records were selected for further eligibility assessment through full-text reading.

The full text of these selected records was searched for, yielding 42 files. Access to five records could not be retrieved (e.g. Adzhemov & Denisova, 2024; Ciccitto, 2024).

Selection of included studies

The full text of each of the 42 records was reviewed by the three authors. The texts were divided among the three authors, with each author being assigned a corresponding portion of the total. The inclusion or exclusion of each record was discussed among the three authors until consensus was reached. During this evaluation, 16 records were excluded for the following reasons: five focused on teaching and learning or on teachers and students (e.g. Kowch & Liu, 2018; Stefanos, 2024; Wang & Han, 2023), or reviewed teaching sustainable social development with AI (Aguilar-Esteva et al., 2023); two focused on technical aspects of AI use (Doyer & Bean, 2023; Muhamedyev et al., 2021); three discussed AI in education in general or data-driven policy development (Knox, 2023; Selwyn, 2022); four were awarded grants (e.g. Miller, 2023; Ruiz, 2023); and one was retracted. Ultimately, 27 articles were included in this scoping review. Figure 1 describes the full process of literature selection.

Data extraction and analysis

Once the records included in the scoping review were identified for further analysis, descriptive characteristics were extracted using a data-charting form (Levac et al., 2010). These characteristics encompassed the location of the study, indicated by the country of the corresponding author, type of publication, research aims or questions, methods, and data collection, where applicable. Data was extracted by reading the full text and completing a spreadsheet form with this information. Following data extraction, descriptive statistics were used to illustrate the main characteristics of the review literature.

Next, we conducted a three-step process for thematic synthesis (Thomas & Harden, 2008) to facilitate in-depth analysis using the software Atlas.ti. Although a strict double-blind procedure was not applied throughout, the initial coding phase was performed independently by two of the authors, without access to each other's codes, to reduce potential influence and enhance objectivity. Open coding was conducted at a descriptive level, focusing on relevance to the research questions, clarity, and mutual exclusivity. Discrepancies were resolved through discussion and detailed comparison of assigned codes, using the predefined coding criteria. When consensus could not be reached, the third author was consulted to make the final decision. Second, the descriptive codes were discussed with the three authors and then refined through an iterative process, merging them and moving toward more analytical categories (Thomas & Harden, 2008). Broader themes emerged by examining how descriptive codes and analytical categories connected to form meaningful insights related to the research questions. Coded data was revisited several times to ensure consistent interpretation. Third, after the broader themes emerged, they were organised within analytical categories. The data extracted for each analytical category was then summarised in a narrative manner, and a report was generated to build an argument addressing the research question. In line with the methodology for scoping reviews (Levac et al., 2010), no formal risk bias or quality appraisal was conducted. The inclusion of a wide range of document types, including research articles, editorials, and conference proceedings limited the applicability of standard risk bias tools. Variability in methodological quality among sources was observed; however, these differences were not systematically assessed. Methodological limitations of

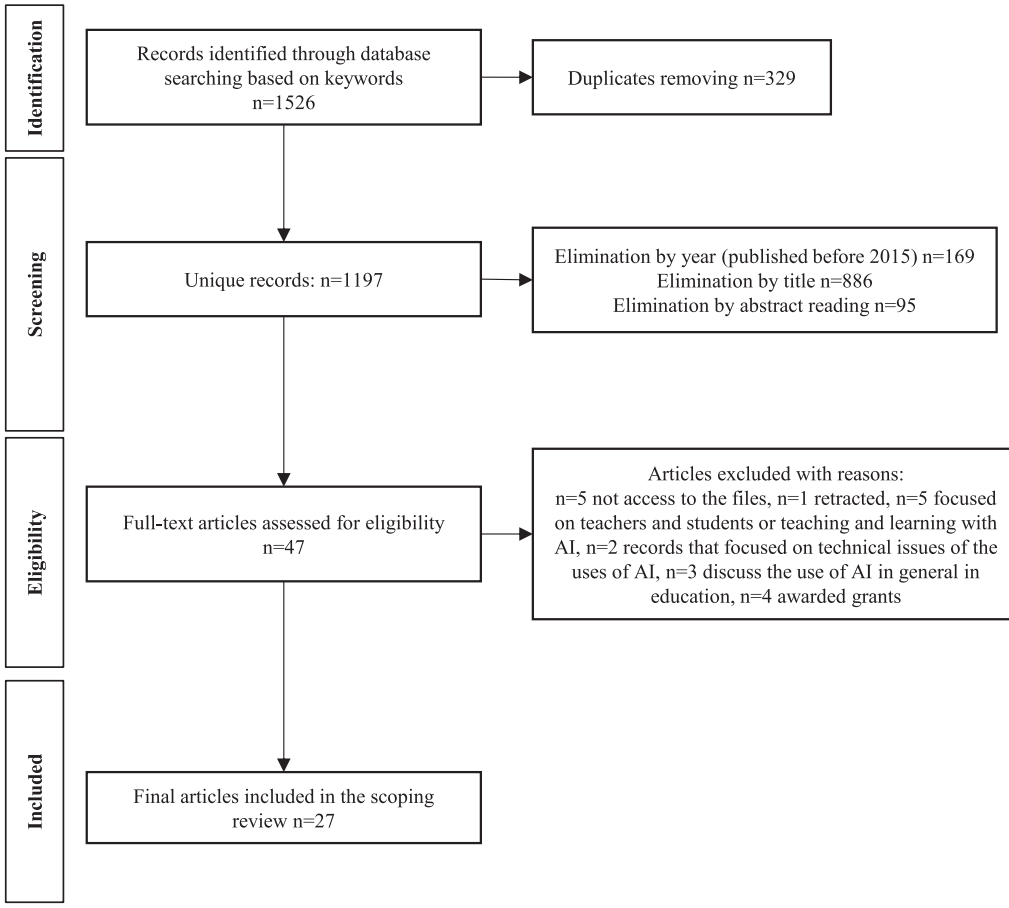

FIGURE 1 Chart flow for the identification and selection process of the literature (Page et al., 2021).

the selected articles, such as poorly described methods or incomplete reporting of findings, were noted during data extraction and synthesis and were taken into consideration when interpreting the findings.

RESULTS

A total of 27 studies were included in this scoping review, which explore the opportunities and challenges school leaders face with the advancement of AI and its applications within education, as well as the skills and abilities required to lead the integration of these technologies in schools. First, a descriptive analysis of the studies included in the review is presented, followed by an elaboration on the main findings related to the research questions. A table in the appendix provides a list of selected articles.

General description of the studies

The relationship between AI and school leadership is an emerging field that has experienced rapid, exponential growth in recent years, with a notable concentration of publications

in 2023 (see Figure 2). Given the increasing relevance and potential impact of this topic, scientific output in this area is expected to continue to expand in the coming years.

In terms of geographical distribution, based on the affiliation of the corresponding author, eight studies were conducted in the USA and seven in China. Other contributing countries include Turkey, Australia, Indonesia, Northern Cyprus, Pakistan, Palestine, Qatar, Spain and the United Kingdom. The majority of publications are research articles, followed by book chapters, concept and position papers, editorials, columns, informative articles, proceedings and interviews. In terms of research approach, two-thirds of the identified records are empirical. Among these, focusing on studies that specify the role composition of their samples, we find that the aggregated number of school principals included in the empirical studies totals 917 participants (see Appendix 1). Most empirical research articles employed qualitative methodologies, while four used quantitative methods, and one followed a systematic literature review. Qualitative studies were based on data collected from interviews, focus groups, case studies, and vignette descriptions, with school principals as the main participants (Dagli et al., 2023; Ghamrawi et al., 2024; Mogas et al., 2022). However, some articles also included other participants, such as teachers, students or educational experts (e.g. Chiu, 2023; Niu et al., 2023; Pham, 2023). Quantitative studies primarily used questionnaires to gather data from school principals, though teachers were also included (A'mar & Eleyan, 2022; Berkat et al., 2024; Cheng & Wang, 2023; Hao et al., 2021). One article used a systematic literature review (Chiu et al., 2023), while other articles did not apply specific methodologies due to the nature of their content (e.g. Ahmad et al., 2022; Collins, 2023; Gulson & Taylor, 2017; Karakose & Tülübas, 2024; Özmutlu, 2023; Quian, 2021; Wang, 2020, 2021a, 2021b).

From this descriptive analysis, some geographical trends emerged. The United States is the most prolific contributor, with empirical research ($n=6$)—all of them based on qualitative methods—and studies using theoretical approaches ($n=2$). China also shows a strong representation, particularly through empirical research articles ($n=5$) adopting quantitative ($n=2$) and qualitative methods ($n=3$), and other types of contributions (systematic review $n=1$ and proceeding n = 1). European representation is fragmented ($n=6$), with individual contributions from countries such as the UK, Turkey or Spain, with a mix of empirical research ($n=3$) and theoretical approaches ($n=3$). Other regions are also represented, including countries such as Australia, Indonesia, Pakistan, Palestine and Qatar, though with one or two studies each.

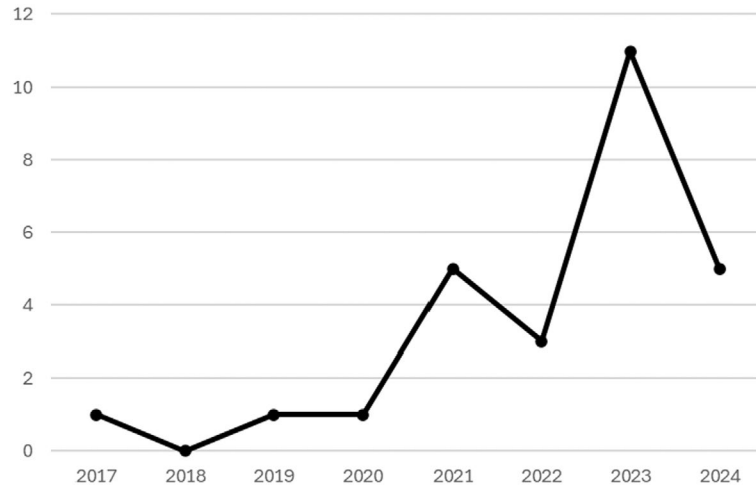

FIGURE 2 Distribution of the included studies according to year of publication.

Furthermore, only a minority of studies explicitly examine the use of GenAI in the context of school management and leadership. While a few refer to advanced AI applications that imply generative capabilities, the majority of the studies treat AI as a broad category without addressing the specific characteristics or implications of GenAI (see Appendix 1).

Table 2 summarises the descriptive characteristics of the articles included in the scoping review.

TABLE 2 Descriptive characteristics of included articles.

	Freq.
Country of corresponding author	
Australia	2
China	7
Indonesia	1
Northen Cyprus	1
Pakistan	1
Palestine	1
Qatar	1
Spain	1
Turkey	3
UK	1
USA	8
Type of publication	
Book chapter	2
Column	1
Concept paper	2
Informative	1
Editorial	3
Interview	1
Position paper	2
Proceeding	1
Research article	14
Research approach	
Theoretical approach	9
Empirical research	18
Method	
Not applicable	9
Qualitative study	13
Quantitative study	4
Systematic literature review	1
GenAI distinction	
Yes	7
No	16
Partially	4

Thematic synthesis of the included articles

Two main categories and 10 themes were identified. Table 3 provides an overview of the categorical structure (for a detailed classification of selected articles into the categorical structure, see Appendix 2). The first category focuses on the opportunities and challenges that AI poses for school principals when integrating these technologies into school leadership and educational policy. Studies in this category describe the uses of AI for educational leadership (e.g. Berkat et al., 2024; Cheng, 2023; Chiu, 2023; Chiu et al., 2023; Dunnigan et al., 2023; Gulson & Taylor, 2017; Karakose, 2024; Karakose & Tülübas, 2024; Niu et al., 2023; Wang, 2020, 2021a, 2021b) and the potential of AI to support school leaders' work (e.g. Karakose, 2024; Karakose & Tülübas, 2024; Wang, 2021b). This category also addresses the ethical challenges AI presents to school leaders when integrating these technologies into schools (Papa & Jackson, 2021; Pham, 2023).

The second category focuses on identifying the skills required by school leaders (e.g. A'mar & Eleyan, 2022; Dagli et al., 2023; Hao et al., 2021) and the role school principals play in adopting AI (e.g. Cheng & Wang, 2023; Chiu, 2023; Dunnigan et al., 2023; Tyson & Sauers, 2021; Wang & Han, 2023). Additionally, these studies provide recommendations for increasing AI usage in school management (e.g. Ahmad et al., 2022; Berkat et al., 2024; Gulson & Taylor, 2017) while highlighting the needs and preferences of school leaders regarding AI use in their schools (e.g. Borasi et al., 2024; Dunnigan et al., 2023; Wang, 2020).

Opportunities: Potential uses of AI and AI-human combination for decision-making

In terms of opportunities, the analysed literature points to a wide variety of potential uses of AI in school leadership responsibilities, including curriculum coordination and development, student dropout prevention, facial recognition for safety, resource allocation, monitoring student performance, learning personalisation, and teacher hiring and performance evaluation (e.g. Berkat et al., 2024; Cheng & Wang, 2023; Chiu, 2023; Chiu et al., 2023; Dunnigan et al., 2023; Gulson & Taylor, 2017; Karakose, 2024; Karakose & Tülübas, 2024; Niu et al., 2023; Wang, 2020, 2021a, 2021b). For example, the study by Niu et al. (2023) on the use of AI-based system management learning demonstrates that school principals value the information output provided by AI technology, as it offers access to an overview report of the school's teaching and learning situation, enabling better support and resource allocation for teachers and students. In another study, Dunnigan et al. (2023) reports that school principals expressed interest in AI's potential to personalise and differentiate instructional materials. Additionally, in a systematic literature review, Chiu et al. (2023) observed that AI technologies provided educational administrators with evidence to support decision-making, and Wang (2020) argued that AI can enhance efficiency and accuracy in educational leaders' decision-making processes. Fullan et al. (2023), Karakose (2024), and Karakose and Tülübas (2024) point to AI's impact on school management processes, indicating that AI integration is likely to improve the efficiency of administrative tasks such as maintaining and analysing student records, decision-making, planning, budgeting, and communication with teaching staff and parents. In this regard, Tyson and Sauers (2021) found in a study on AI adoption by school leaders that AI has a positive impact on leaders' workloads, allowing them to analyse and use data more quickly and effectively.

Moreover, the analysed literature refers to a ‘human-AI combination’ in decision-making processes. Scholars emphasise the complementary role of humans and AI, suggesting a ‘symbiotic relationship’ (Wang, 2020) or viewing AI as a tool to extend or ‘augment’

TABLE 3 Overview of the categorical structure.

Main categories	Sub-categories	Themes	Examples of codes	Example of coded text
Opportunities and challenges. RQ1	Opportunities	Potential uses of AI in school leadership	Provide better support and resources	'Principals have access to the overview report of the whole school teaching and learning situation, so that they can provide better support and resources for teachers and students' (Niu et al., 2023, p. 220)
			Main roles in administration	'The three main roles assigned to AI in administration are (i) improving the performance of management platforms, (ii) providing convenient and personalised services, and (iii) supporting educational decision-making with evidence' (Chiu et al., 2023, p. 9)
			Analysed and use data	'The interviews capture how technology had a positive impact on leaders' workload. They describe that AI allowed them to analyse and use data much more quickly and effectively' (Tyson & Sauers, 2021, p. 278)
		AI-Human combination for decision-making	Complementary role	'Scholars now accentuate the complementary role of humans and AI, suggesting a more symbiotic relationship in which both human and AI could bring in their own strengths and overcome their limitations' (Karakose, 2024, p. 9)
			Symbiotic role	'Placing AI in an educational organisation, I conceptualised a symbiotic role of human-AI decision-making' (Wang, 2021a, p. 6)
			Combination	'This combination produces intensified interaction between people, networks, algorithms and computational capacities' (Gulson & Taylor, 2017)
	Challenges	Biases	Bias	'Those who understand the sources of the data used to train GenAI know full well that it contains biases, misinformation, inaccuracies, and very strong English language, western culture orientation' (Dunnigan, et al., 2023, p. 882)
			Bias	'Data, despite the appearance of objectivity, do not protect school leaders from making biased, erroneous decisions' (Wang, 2020, p. 12)
			Bias	'In educational leaders' AI-assisted DIDM, AI may [be] bias[ed] against students from minorities and from low socioeconomic families, and students with special needs' (Wang, 2021b, p. 5)
		Privacy and Security	Security and privacy concerns	'There are security and privacy concerns that imperil the adoption of AI-assisted DIDM in education' (Wang, 2021b, p. 6)
			Privacy issues	'… if an AI technology has some privacy issues, neither the teachers nor the students will accept it, and neither will the educational [organisation] choose it to adopt or implement' (Ahmad et al., 2022, p. 5)
			Concerns on students' privacy and security	'There are important issues that primary school administrators should consider about how to use AI technology in schools. [THE] analysis can help determine how the use of AI technology in schools can be effectively managed by addressing concerns such as student privacy, [and] security' (Dagli et al., 2023, p. 15241)
		Lack of transparency	Hidden data	'The kind of data collected on students and how this data is used in systems is often hidden from the end users, including educational leaders' (Papa & Jackson, 2021, p. 738)
			Back box	'The problem is since the algorithms and decisions are a black box, it is difficult, even to those who develop the AI algorithms, to really know how a decision is made' (Wang, 2021b, p. 20)

(Continues)

TABLE 3 (Continued)

Main categories	Sub-categories	Themes	Examples of codes	Example of coded text
		Digital Divide	Regional inequality	'The application of AI will expand the regional inequality caused by digital divide […] Therefore, when managers of local education […] do not take into account the lack of information equipment and information literacy in poor rural areas and remote mountainous areas, the digital divide will inevitably be widened […]'. (Quian, 2021, p. 90)
			Educational inequalities	'[…] school leaders highlighted the potential for Education 4.0 to exacerbate the digital divide and perpetuate educational inequalities based on students' and families' socio-economic status' (Ghamrawi et al., 2024, p. 185)
Leaders' role and skills for AI adoption. RQ2	Leaders' role	Factors influencing AI adoption	Attitudes	'Principals have a high willingness to adopt AI education, but only 16.3% of schools carry out […]' (Hao et al., 2021, p. 259)
			Influence of social networks	'School leaders […] indicated that they were expose[d] to AI through their extant social networks' (Tyson & Sauers, 2021, p. 277)
			Skills and knowledge	'School principals generally ignored the potential of the newest technological developments' (Mogas et al., 2022, p. 888)
		Digital leadership	Digital leadership	'Digital leadership is linked to the three categories of AIED incorporation: Learning from AI, Learning about AI, and Learning with AI' (Cheng & Wang, 2023, p. 8)
			Social influence	'School principals are also expected to practice digital leadership through which they can create the necessary 'social influence process" (Karakose & Tülübas, 2024, p. 10)
			Support structures	'This study revealed a great deal about the leaders that have embraced AI as well as the structure they have created to support AI' (Tyson & Sauers, 2021, p. 282)
	Competence and skills	Identification of skills needs	AI literacy	'AI and media literacy should be explicitly added to or included in professional standards for teachers and leaders […] standards should include AI ethical and moral issues, big data and machine learning (AI literacy) […]' (Chiu, 2023, p. 13)
			Soft skills	'[…] the intuitive and common-sense judgment of managers is necessary to reconcile the machine output with reality before making a final decision' (Karakose & Tülübas, 2024, p. 10)
			Social competence	'[…] school leaders need their networks, relationships, and colleagues more than ever to forge a sensible way through' (Fullan et al., 2023, p. 343)
		Professional development	Training	'There is a need for more effective technology leadership training programs […] for school principals' (A'mar & Eleyan, 2022, p. 793)
			Adaptation to new advancements	'[the introduction of new technology] will require school leaders to constantly adapt and expand their technological knowledge and skills simply to remain ahead of the AI curve' (Fullan et al. 2023, p. 342)
			Understanding the new technology	'[…] leaders desir[e] better understanding and appreciation of what AI could do, as well as its risks and implications for K-12 schools' (Borasi et al., 2024, p. 48)

human capacities (Karakose, 2024), potentially improving the efficiency and effectiveness of school management (Berkat et al., 2024; Chiu, 2023; Özmutlu, 2023; Papa & Jackson, 2021; Wang, 2021a, 2021b). The human-AI combination offers the advantage

of data-processing power while leaving the decision-making authority with educational leaders, bringing unique strengths to school leadership. On the one hand, AI—with its efficiency and computational capacity to process large amounts of data—can enhance evidence-based decision-making by providing analysis and recommendations based on vast volumes of information. School leaders can use AI to improve administrative functions, such as maintaining and analysing student records, decision-making, and communication with staff and families (Karakose, 2024), while enhancing quality management processes, including planning, implementation and evaluation (Berkat et al., 2024). On the other hand, decision-making in educational contexts often involves emotional and social factors, which have a significant impact on individual lives, requiring human intervention for moral, value-based decisions (Wang, 2021a, 2021b). This complementary relationship—where both humans and AI leverage their strengths—should be encouraged. In terms of school management and decision-making, Karakose (2024) argues that intuition and common-sense judgement remain necessary to reconcile AI output with reality before making a decision. The systematic literature review by Chiu et al. (2023) indicates that AI technologies can help educational management teams make decisions by presenting evidence, and Wang (2021b) stresses the importance of using such information to support school leaders' decision-making processes. Additionally, two articles highlight AI's potential to free up time for critical tasks, allowing principals to focus on more complex issues that require human leadership, such as contextualising and interpreting data (Karakose, 2024) or addressing the social and emotional aspects of leadership, such as maintaining close relationships with teachers, team members, communicating with parents and the educational community, and following intuition when making decisions under uncertain conditions (Ghamrawi et al., 2024; Wang, 2020).

Challenges biases, privacy and security, transparency and digital divide

Regarding the main challenges school leaders face with the advancement of AI in education, the reviewed literature highlights several issues. Based on the analysis of selected scientific articles, emerging themes include ethical concerns such as biases, data privacy and security, and transparency, as well as other challenges like exacerbating the digital divide. One significant issue emphasised in the literature is bias, where AI systems can amplify existing prejudices related to race, gender, and socio-economic status (Dunnigan et al., 2023; Pham, 2023; Sellar & Gulson, 2019; Wang, 2020, 2021b), influencing decisions related to student assessment, teacher hiring, or school closures. AI systems can be biased due to the datasets used to train them, potentially leading to biased outcomes (Dunnigan et al., 2023; Pham, 2023; Sellar & Gulson, 2019), which educational leaders must recognise in order to prevent discrimination in AI-assisted decision-making. As a result, educational leaders need to remain vigilant about biases in AI used in schools, and despite the appearance of objectivity, school leaders must be aware of potential biases (Wang, 2021b).

Closely related to biases, transparency is another major concern. A lack of transparency can obscure biased processes and make it difficult for users to ensure fairness, accountability, and ethical use. AI algorithms often function as a ‘black box’, (Chiu et al., 2023; Gulson & Taylor, 2017; Wang, 2021b) making it difficult even for experts to understand the decision-making processes behind the AI's outputs. This opacity in decision-making can lead to unintended consequences, especially when decisions appear optimal but are based on incomplete or biased data (Gulson & Taylor, 2017). Chiu et al. (2023) observed that most teachers lack an understanding of how AI technologies work, meaning they have often been teaching with a ‘black box’. A similar argument applies to school leaders who are wary of potential drawbacks to increased AI usage, as

noted by Tyson and Sauers (2021). This lack of transparency makes it challenging for school leaders to rely on and explain AI-driven decisions.

Additionally, data privacy and security are critical concerns, as AI systems often collect and manage sensitive information, posing risks of privacy violations and data breaches with potentially long-term consequences (Ahmad et al., 2022; Dagli et al., 2023; Papa & Jackson, 2021; Wang, 2020, 2021b). In the study conducted by Dagli et al. (2023), school leaders attach great importance to maintaining privacy and security as they integrate AI technologies into their schools. Moreover, Papa and Jackson (2021) argues that AI systems tend to collect incidental data that may not be used for learning but could still be subject to misuse. One example is the use of virtual assistants that can have access to children's voices without parents' consent (Wang, 2020). Additionally, AI systems used in teacher hiring and evaluation processes may reinforce existing biases, such as favouring candidates from certain backgrounds or penalising teachers based on biased performance data (Wang, 2020, 2021b).

Furthermore, the digital divide presents a substantial ethical issue, as unequal access to AI technology can exacerbate existing educational disparities (Dunnigan et al., 2023; Papa & Jackson, 2021; Quian, 2021; Wang, 2021b). The commercialisation of these products—which limits access to advanced AI features—disproportionately affects underfunded schools (Dunnigan et al., 2023; Wang, 2021b), deepening the digital divide and raising concerns about educational equity (Wang, 2021b). In the study conducted by Papa and Jackson (2021), educational experts expressed concerns about the uneven implementation and differential access to AI technologies. Similarly, Dagli et al. (2023) and Mogas et al. (2022) found that school leaders were concerned about the lack of financial resources necessary for the effective adoption of AI technologies in schools.

Leaders' role: Factors influencing AI adoption and digital leadership

As with any technological adoption in education, school leaders play a crucial role in the acceptance and integration of AI technologies in schools. However, the available literature identifies various attitudes and behaviours that influence the extent of AI implementation (e.g. A'mar & Eleyan, 2022; Cheng & Wang, 2023; Ghamrawi et al., 2024; Hao et al., 2021; Karakose & Tülübas, 2024; Mogas et al., 2022; Tyson & Sauers, 2021; Wang, 2021a, 2021b; Wang & Han, 2023).

The analysed studies reveal significant diversity in school leaders' willingness to adopt AI. While some studies indicate positive attitudes toward integrating AI in schools (Dagli et al., 2023; Hao et al., 2021; Tyson & Sauers, 2021), actual implementation remains low (Hao et al., 2021) due to perceived risks and ethical concerns (Ghamrawi et al., 2024; Quian, 2021; Tyson & Sauers, 2021), technological limitations (Mogas et al., 2022), and the complexity of integrating AI into the curriculum (A'mar & Eleyan, 2022; Quian, 2021). Tyson and Sauers (2021) found that leadership behaviours, social networks, and exposure to technology significantly shape school leaders' decisions, with leaders being influenced by their professional connections (Tyson & Sauers, 2021). Moreover, Hao et al. (2021) revealed that principals with high proficiency in information technology are more likely to adopt AI with lower perceived risk, while those less proficient tend to be more conservative due to their lack of experience. This study also identifies factors affecting AI adoption, including perceived effort, perceived risks, performance benefits of AI, and social support from the school community (Hao et al., 2021).

The literature also highlights digital leadership as both a crucial competence and a strategic approach that school leaders must develop to guide and support the integration of digital technologies, including AI, into educational environments (Cheng & Wang, 2023;

Dagli et al., 2023; Ghamrawi et al., 2024; Karakose & Tülübas, 2024; Wang, 2021a, 2021b). Digital leadership involves providing strategic vision, guidance and support to ensure AI is effectively used to enhance school performance (Cheng & Wang, 2023). Cheng and Wang (2023) observed that digital leadership is linked to learning from AI, about AI, and with AI. They also found that digital leadership plays a critical role in overcoming barriers to AI adoption by promoting teachers' willingness to adopt AI-based practices. Similarly, Dagli et al. (2023) emphasise the role of school leaders in ensuring the necessary resources and infrastructure to support AI technologies. Karakose and Tülübas (2024) argue for a shift from a leader-centred to a more collaborative and distributed leadership model in the context of AI integration. This approach aligns with the findings of Tyson and Sauers (2021), who stressed the importance of involving school personnel and community stakeholders in the AI adoption process.

Competence and skills: Needs identification and professional development

The literature also addresses the skills and abilities school leaders need to develop in response to AI integration and the digital transformation it will bring (e.g. Borasi et al., 2024; Cheng & Wang, 2023; Chiu, 2023; Collins, 2023; Dunnigan et al., 2023; Ghamrawi et al., 2024; Gulson & Taylor, 2017; Hao et al., 2021; Karakose, 2024; Karakose & Tülübas, 2024; Mogas et al., 2022; Wang, 2020, 2021b). While school leaders recognise the potential of AI for school improvement, there is often a lack of clarity regarding its concrete benefits (Cheng & Wang, 2023; Dunnigan et al., 2023; Mogas et al., 2022). Dunnigan et al. (2023) emphasise that school leaders need more guidance from AI experts and industry professionals to help them integrate AI into schools. Additionally, leaders seek simple, personalised resources about AI to share with teachers, students, parents, and community members (Borasi et al., 2024). Wang (2020) argues that school leaders must enhance their data literacy and understanding of AI, including data collection, analysis, and interpretation, to make informed decisions. Furthermore, leaders must identify AI's opportunities while recognising its limitations (Wang, 2020).

Beyond data literacy, the selected articles indicate that school leaders will need soft skills such as team building, collaboration (Cheng & Wang, 2023; Karakose & Tülübas, 2024), emotional and social intelligence (Karakose & Tülübas, 2024; Wang, 2020), adaptability, and innovation (Karakose & Tülübas, 2024), as well as the ability to navigate ambiguity and uncertainty (Ghamrawi et al., 2024). For example, leaders need to understand the emotional and mental states of others when presenting data during teacher feedback sessions (Wang, 2020). School leaders must also build trust-based relationships with the school community (Ghamrawi et al., 2024; Karakose, 2024) and ensure that AI supports the well-being of students and staff, keeping education rooted in human care (Ghamrawi et al., 2024; Wang, 2021b). Ghamrawi et al. (2024) found that school leaders believe ethical and moral leadership is more crucial than ever in an AI-enriched educational environment, due to the potential risks involved, emphasising the importance of transformational and distributed leadership that prioritises humanity.

Several studies emphasise the importance of promoting ongoing professional development (Borasi et al., 2024; Cheng & Wang, 2023; Chiu, 2023; Chiu et al., 2023; Dagli et al., 2023; Dunnigan et al., 2023; Fullan et al., 2023; Ghamrawi et al., 2024; Hao et al., 2021; Wang, 2020, 2021b) to equip school leaders with the necessary competencies to navigate AI-enriched environments in education. Scholars argue that many school leaders currently lack the knowledge, resources and information needed to address this still unclear and confusing phenomenon (Cheng & Wang, 2023; Dunnigan et al., 2023). Professional development could help bridge this gap and provide leaders with a better understanding and

appreciation of AI's potential (Borasi et al., 2024), thereby mitigating barriers to AI adoption and enabling school leaders to support the school community in this digital transformation (Cheng & Wang, 2023).

DISCUSSION

The geographical distribution analysis underscores a dominance of empirical and theoretical research from China and the United States. In contrast, European contributions are scarce and fragmented, consisting mostly of concept papers and editorials, possibly reflecting early-stage exploration of the topic. This disparity might be linked to differing AI governance approaches at national or regional levels (Weber & Heidelmann, 2024), which can shape the scope and directions of AI applications across multiple life domains, particularly in education. While analysing the impact of AI governance models on research outputs falls beyond the scope of this review, the generalisability of its findings across geographical contexts should be interpreted with caution.

Challenges and problems faced by school leaders with the advancement of AI

This review reveals not only the multifaceted challenges school leaders face with AI integration, but also the limited theoretical tools currently available to support them—highlighting a disconnect between technological advancement and leadership readiness. On the one hand, AI offers promising tools to support decision-making by automating tasks and enabling data-driven insights. However, the scoping review also underscores several ethical and logistical challenges. One prominent issue is the 'black box' nature of AI systems, where the lack of transparency in algorithmic decisions fosters distrust among educators and stakeholders (Kosztelnik, 2019). School leaders, often unprepared to manage these systems, struggle to navigate the ethical implications of deploying AI in diverse educational environments. The literature reveals concerns about AI systems reinforcing existing biases, particularly in how student data is used to make decisions that can disproportionately impact marginalised groups (Obermeyer et al., 2019; Zou & Schiebinger, 2018). Wang (2023a, 2023b) emphasises the need for responsible AI use, with a focus on fairness and accountability.

Another significant challenge relates to the digital divide. As AI technologies require robust infrastructure and resources, schools in low-income areas often lack the necessary technological capacity to fully implement AI systems (Li et al., 2024). This exacerbates disparities in educational outcomes and poses a critical issue for educational leaders who must advocate for equal access to technology. Ensuring that all students benefit from AI advancements is not only a technical issue but also an ethical obligation for school leaders, particularly when it comes to promoting equity in personalised learning (Karakose, 2024).

Skills and abilities required of school leaders to ensure the effective implementation of AI in schools

In response to the second research question, this review identified a wide range of skills necessary for educational leaders in the age of AI. The findings show that beyond technical competence, leaders must develop a combination of digital literacy, ethical oversight, and emotional intelligence. AI tools offer data-driven insights, but leaders must be able

to critically evaluate the output of these systems, recognising when human judgement is required to navigate complex moral and ethical issues (Wang, 2021a). AI cannot replace the human elements of leadership, such as empathy and the ability to foster trust within the school community (Davenport & Kirby, 2016; Frick et al., 2013).

Transparency is not merely a best practice—it is foundational to stakeholder trust. Without it, AI adoption may exacerbate scepticism, resistance and inequity, particularly in under-resourced schools where leaders may lack the capacity to scrutinise opaque systems (Hoy & Tschannen-Moran, 1999). The literature also emphasises the importance of ongoing professional development in equipping leaders and educators with both the technical and soft skills necessary for effective AI integration (McLeod & Richardson, 2011). This professional development must focus not only on technical upskilling but also on fostering a critical understanding of the limitations, biases, and ethical considerations associated with AI (Wang, 2023a).

Finally, leadership in the AI era requires a mindset shift toward fostering innovation and adaptability. The findings suggest that leaders must act as facilitators of change, driving a culture of continuous learning and adaptation within their schools (Avolio et al., 2009). Rather than merely implementing AI tools, leaders must guide their institutions through the cultural transitions associated with AI adoption, ensuring that teachers and students are not just passive consumers of these technologies but are active participants in their ethical and innovative use (Fullan et al., 2023).

Despite growing interest in AI in education, the voices of school principals remain underrepresented. While existing research often centres on teachers and students, school leaders are central to ethical and strategic AI implementation (Karakose & Tülübas, 2024; Tyson & Sauers, 2021). Their perspectives are vital for developing relevant frameworks, yet most leadership models fail to reflect the unique challenges AI presents at the organisational level.

A notable gap in the literature is the tendency to treat AI as a monolithic concept. Only a minority of studies clearly distinguish between AI and GenAI, limiting our understanding of how each form affects leadership tasks differently (Chiu, 2023; Dunnigan et al., 2023). GenAI represents a new stage in AI development, characterised by its ability to create human-like content. Its creative potential, along with its associated risk (Fui-Hoon Nah et al., 2023), demands a differentiated approach to educational leadership. This lack of differentiation has practical implications: for instance, GenAI raises distinct concerns about content accuracy, authorship, and trust that are rarely addressed in current leadership training or policy guidance (Wang, 2021b). As such, school leadership teams must be aware of the challenges GenAI presents in order to make informed decisions about its adoption, design appropriate training and promote ethical and pedagogically sound use of this technology.

Without clearer theoretical frameworks that account for these distinctions, school leaders may be ill-equipped to critically assess AI tools or guide ethical use in their schools. Future research must move beyond identifying broad topics and instead interrogate how these conceptual oversights impact real-world decision-making, professional development needs, and trust in AI systems.

The following implications draw upon the findings of this study, emphasising strategies to address the digital divide, enhance leadership skills, and ensure ethical and effective AI adoption. By addressing these aspects, educational leaders can harness AI to enhance organisational efficiency while fostering equity and trust within their communities

Addressing the digital divide

The unequal access to AI technologies, often due to financial and infrastructural disparities, remains a pressing concern. Schools in underserved areas may struggle to

implement AI systems effectively, further exacerbating educational inequities (Karakose, 2024; Wang, 2021b). Addressing the digital divide requires targeted interventions. One practical solution is the provision of government grants and fostering public-private partnerships to fund AI implementation in under-resourced schools. Such initiatives can ensure that all students, regardless of socio-economic background, benefit from AI's potential to personalise learning and improve educational outcomes. Additionally, developing low-cost, open-source AI tools can make these technologies more accessible to schools with limited budgets, thereby promoting inclusivity (Li et al., 2024).

Developing nuanced leadership skills

AI adoption in educational settings requires leaders to possess both technical proficiency and soft skills. Beyond understanding the mechanics of AI, leaders must critically evaluate AI-generated outputs and integrate them into decision-making processes without compromising ethical and human-centred considerations (Davenport & Kirby, 2016; Karakose, 2024). Professional development programmes are essential to equip leaders with competencies such as data literacy, ethical oversight, and strategic planning for AI integration (McLeod & Richardson, 2011; Wang, 2020). Furthermore, mentorship networks can provide a platform for leaders to share best practices and learn from successful AI implementations in other schools. Emotional intelligence is not just a complementary skill but a counterbalance to the algorithmic logic of AI systems. As decision-making becomes more data-driven, the capacity of leaders to interpret these outputs through relational and ethical lenses becomes increasingly vital (Ghamrawi et al., 2024).

Ensuring ethical AI implementation

The potential biases in AI algorithms and concerns over transparency highlight the need for ethical oversight in AI adoption. Leaders must navigate these challenges to build trust in AI systems and safeguard the interests of all stakeholders (Kosztelnik, 2019; Wang, 2021b). Promoting the use of explainable AI algorithms is critical to ensuring that decision-making processes are transparent and interpretable. Educational leaders should also receive training to identify and mitigate biases in AI systems, ensuring that decisions driven by AI are fair and equitable. Moreover, fostering a culture of ethical awareness within schools can help prevent misuse and build confidence in AI technologies (Chiu et al., 2023).

Fostering a culture of innovation

For AI to be successfully integrated into educational management, a cultural shift is required within schools. Leaders must inspire innovation, adaptability, and a willingness to embrace new technologies among staff and students (Kavitha & Lohani, 2018; Karakose & Tülübas, 2024). Workshops and peer-learning sessions can expose leaders to successful AI implementations, reducing perceived risks and resistance. Encouraging collaboration between educational leaders, AI experts, and industry professionals can further enhance understanding and support the development of innovative practices (Dagli et al., 2023). By embedding AI literacy into the organisational culture, schools can ensure sustained engagement with these technologies.

The integration of AI into educational leadership offers opportunities to improve efficiency, personalise learning, and enhance decision-making. By adopting a holistic

approach that prioritises equity, transparency, and professional development, educational leaders can leverage AI to drive positive change while maintaining the human-centred values that underpin effective education. This balanced approach will be essential for navigating the complexities of AI adoption and maximising its potential benefits in diverse educational contexts.

LIMITATIONS

This scoping review is not without limitations. Although grey literature was included, limiting the search to scientific databases resulted in a narrower selection of eligible publications, which excluded a broader range of tier 2 and tier 3 records (Adams et al., 2017). Expanding the search scope could potentially uncover additional relevant articles. While some scholars argue that scoping reviews should assess the methodological quality of included studies (Tricco et al., 2018), others acknowledge the difficulties in evaluating quality across such a diverse range of publication types (Levac et al., 2010). Given these challenges, a quality assessment of individual sources was not conducted, influencing the quality of the results.

Furthermore, the heterogeneity of the included articles, with their varying aims, methods, and geographical contexts, posed challenges in identifying clear patterns and synthesising the findings. As observed in the results, the geographical distribution of selected studies is uneven across regions, which might affect the generalisability of the results. Additionally, the search strategy focused on terms such as 'school management' and 'school principal', but did not include regional or terminological variations such as 'school head'. This may have limited the representativeness of the included studies. Expanding the keywords used in the search terms could enhance the comprehensiveness and inclusivity of the review.

CONCLUSION

This scoping review provides an initial mapping of the existing literature on the use of AI in educational leadership, highlighting both its transformative potential and the challenges it poses. AI offers substantial opportunities for streamlining administrative tasks, improving decision-making, and personalising learning experiences. However, school leaders must be cautious about the ethical and practical implications of AI integration. Leaders must ensure that AI enhances rather than replaces human judgement, particularly in areas that require moral and ethical decision-making.

Key themes emerging from the review include the necessity of digital literacy and ethical oversight among educational leaders, the risks posed by biased algorithms, and the need for professional development to ensure effective AI integration. Furthermore, the review highlights the widening digital divide and the need for educational leaders to advocate for equitable access to AI technologies across all schools. Leaders must also develop strategies to build trust and transparency with their stakeholders, ensuring that AI systems are used responsibly and in alignment with the core values of education (Benbya et al., 2020).

The findings from this scoping review suggest that AI can significantly enhance educational leadership, but only if it is implemented thoughtfully and ethically. There is a clear need for future research to explore the long-term impacts of AI on school leadership practices and student outcomes, particularly in diverse educational contexts. Educational leaders must embrace AI as a tool for positive change while remaining vigilant about the ethical, equity, and professional challenges that accompany its adoption (Berkat, 2023a, 2023b; Cheng, 2023).

AUTHOR CONTRIBUTIONS

Ana-Inés Renta-Davids: Conceptualization; investigation; methodology; writing – original draft; writing – review and editing. **Marta Camarero-Figuerola:** Conceptualization; investigation; writing – original draft; methodology; writing – review and editing. **Mar Camacho:** Conceptualization; investigation; funding acquisition; writing – original draft; writing – review and editing; methodology.

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CONFLICT OF INTEREST STATEMENT

We have no conflicts of interests to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

No ethical approval was required as this is a review article with no original research data.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX 1

Overview of the selected articles.

	Authors	Country	Type of publication	Research approach	Method	Data collection	Principals' sample size	Mention of IA or GenAI	GenIA distinction
1	Ahmad et al. (2022)	Pakistan	Concept paper	Theoretical approach	Not applicable	Not applicable	–	Uses the general term 'AI technology'	No
2	A'mar and Eleyan (2022)	Palestine	Research article	Empirical research	Quantitative study	Questionnaires, $n=442$ principals and $n=953$ teachers from Palestinian public schools	$n=442$	Mentions AI only in the context of advanced technologies influencing school leadership	No
3	Berkat et al. (2024)	Indonesia	Research article	Empirical research	Quantitative study	Questionnaire $n=178$ teachers, principals, and supervisors	It does not specify role composition of the sample	Discusses AI and big data in the context of school sustainability and education quality management, but it treats AI as a broad category	No
4	Borasi et al. (2024)	USA	Informative	Empirical research	Qualitative study	Interview 36 leaders	$n=36$	Explicitly refers to GenAI	Yes
5	Cheng and Wang (2023)	China	Research article	Empirical research	Quantitative study	Questionnaire $n=204$ ($n=71$ school principals, $n=70$ middle managers, and $n=63$ subjects teachers)	$n=71$	Briefly references the recent surge of GenAI (e.g. ChatGPT) but focuses on AI in education (AIED)	Partially
6	Chiu (2023)	China	Research article	Empirical research	Qualitative study	Open question survey and focus groups $n=88$ school leaders and teachers	It does not specify role composition of the sample	Explicitly focuses on GenAI (e.g. ChatGPT, Midjourney) and its implications for learning, teaching, assessment, and administration	Yes
7	Chiu et al. (2023)	China	Research article	Empirical research	Systematic literature review	Articles included in the review $n=92$	It does not specify role composition of the sample	A general literature review on AI in education, discussing tools like tutoring systems and analytics, but not distinguishing GenAI	No
8	Collins (2023)	USA	Interview	Empirical research	Qualitative study	IA expert Interview = 1	It does not specify role composition of the sample	Centres on ChatGPT, analysing it as a case of GenAI	Yes
9	Dagli et al. (2023)	Northen Cyprus	Research article	Empirical research	Qualitative study	Interviews $n=18$ school administrators (primary schools)	$n=18$	Refers to AI and metaverse technologies, but without specific focus on GenAI	No
10	Dunnigan et al. (2023)	USA	Column	Empirical research	Qualitative study	Focus group with educational leaders	It does not indicate sample size	Discusses school leaders' reactions and strategies in response to the rapid rise of GenAI	Yes
11	Fullan et al. (2023)	Australia	Editorial	Theoretical approach	Not applicable	Not applicable	–	Explicitly distinguishes general AI and GenAI	Yes
12	Ghamrawi et al. (2024)	Qatar	Book Chapter	Empirical research	Qualitative study	Focus group interview $n=16$ school leaders	$n=16$	Discusses AI as part of Industry 4.0, but makes no mention of GenAI specifically	No
13	Gulson and Taylor (2017)	Australia	Concept paper	Theoretical approach	Not applicable	Not applicable	–	Examines the integration of AI into educational policy and governance, but it predates GenAI developments	No
14	Hao et al. (2021)	China	Research article	Empirical research	Quantitative study	Questionnaire $n=295$ school principals and vice-presidents	$n=295$	Discusses AI education policy and willingness to adopt AI education, but no GenAI differentiation	No

APPENDIX 1 (Continued)

	Authors	Country	Type of publication	Research approach	Method	Data collection	Principals' sample size	Mention of IA or GenAI	GenIA distinction
15	Karakose and Tülübas (2024)	Turkey	Editorial	Theoretical approach	Not applicable	Not applicable	–	Discusses AI broadly and its impact on leadership but does not distinguish GenAI	No
16	Karakose (2024)	Turkey	Editorial	Theoretical approach	Not applicable	Not applicable	–	Focuses on AI's future impact on leadership roles, but does not specify GenAI tools	No
17	Mogas et al. (2022)	Spain	Research article	Empirical research	Qualitative study	Semi-structured interview $n=25$ school principals and managers	$n=25$	Discusses AI in the context of smart schools and Industry 4.0 but does not mention GenAI	No
18	Niu et al. (2023)	China	Research article	Empirical research	Qualitative study	Case study, Semi-structured interviews $n=1$ school principal, $n=2$ teachers, $n=2$ students, Questionnaire $n=15$ students	$n=1$	Addresses advanced AI applications, such as intelligent systems, but does not explicitly define GenAI	Partially
19	Özmutlu (2023)	Turkey	Book Chapter	Theoretical approach	Not applicable	Not applicable	–	Discusses AI in the context of educational leadership and educational management, but GenAI is not differentiated	No
20	Papa and Jackson (2021)	USA	Research article	Empirical research	Qualitative study	Vignette describing a futuristic classroom $n=24$ experts in education	It does not specify role composition of the sample	Discusses AI's ethical implications and algorithmic bias, but does not define GenAI	Partially
21	Pham (2023)	USA	Research article	Empirical research	Qualitative study	In-depth interviews n = 4 (educators and executives)	$n=4$	Discusses AI's broad impacts, including applications like AI tutors and virtual teachers, but does not distinguish GenAI	Partially
22	Quian (2021)	China	Proceeding	Theoretical approach	Not applicable	Not applicable	–	General discussion of AI in educational management, teaching, and learning	No
23	Sellar and Gulson (2019)	UK	Research article	Empirical research	Qualitative study	Case study, semi-structured interview $n=70$ policy makers, educators, school teams, educational administrations, and technological companies.	It does not specify role composition of the sample	Discusses AI and data infrastructures in education policy, focusing on automated thinking and data governance without reference to GenAI	No
24	Tyson and Sauers (2021)	USA	Research article	Empirical research	Qualitative study	Case study, semi-structured interview $n=7$ school leaders	$n=7$	Focuses on a specific AI tool (ALEKS) used for instructional purposes	No
25	Wang (2020)	USA	Position paper	Theoretical approach	Not applicable	Not applicable	–	Mentions neural networks and deep learning, including examples like facial recognition and pattern prediction	Yes
26	Wang (2021a, 2021b)	USA	Position paper	Theoretical approach	Not applicable	Not applicable	–	Mentions machine learning, deep learning, and neural networks, with brief references to predictive and adaptive systems	Yes
27	Wang and Han (2023)	China	Research article	Empirical research	Qualitative study	Case study $n=3$ schools, interviews $n=2$ school principals and $n=2$ teachers	$n=2$	Discusses AI curriculum leadership and implementation in primary/secondary schools, though GenAI is not mentioned specifically	No

APPENDIX 2

Classification of the selected articles according to categorical structure.

Author	Year	Potential uses of AI in school leadership	AI-human combination for decision-making	Biases	Privacy and security	Transparency	Digital divide	Factors influencing AI adoption	Digital leadership	Identification of skills needs	Professional development
Ahmad et al.	2022		X		X						
A'mar and Eleyan	2022	X						X		X	
Berkat et al.	2024	X	X		X						
Borasi et al.	2024				X					X	X
Cheng and Wang	2023	X						X	X	X	X
Chiu	2023	X	X					X		X	X
Chiu et al.	2023	X	X			X					X
Collins	2023									X	
Dagli et al.	2023				X		X	X	X	X	X
Dunnigan et al.	2023	X		X			X	X		X	X
Fullan et al.	2023	X									X
Ghamrawi et al.	2024							X	X	X	X
Gulson and Taylor	2017	X	X			X	X			X	
Hao et al.	2021							X		X	X
Karakose and Tülübas	2024	X	X					X	X	X	
Karakose	2024	X	X		X					X	
Mogas et al.	2022	X					X	X		X	
Niu et al.	2023	X	X								
Özmutlu	2023		X								
Papa and Jackson	2021		X	X	X	X	X				
Pham	2023			X	X	X					
Quian	2021						X	X			
Sellar and Gulson	2019	X	X	X	X						
Tyson and Sauers	2021	X			X	X		X			
Wang	2020	X	X	X	X	X				X	X
Wang	2021	X	X	X	X		X	X	X	X	X
Wang and Han	2023	X			X			X		X	X