

AI-Driven Decision Support Systems for School Leaders: A Systematic Literature Review of School Improvement Practices in Malaysian Urban Public Secondary Schools

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Abstract

This systematic literature review examined how artificial intelligence (AI)-driven decision support systems (DSS) are represented in existing literature as tools to support school leaders' decision-making for school improvement in Malaysian urban public secondary school contexts. Guided by Digital Leadership Theory, the Data-Driven Decision-Making Framework, Organisational Learning Theory and Sensemaking Theory, the review adopted a qualitative systematic literature review methodology. ERIC was used as the main structured database search, while Google Scholar and DOAJ were used as supplementary sources. A total of 363 records were screened at the title and abstract stage, 52 full-text articles were assessed for eligibility, 27 studies were appraised for quality, and 16 studies met the quality threshold for final thematic synthesis. Across these studies, 131 extracted data segments were coded and synthesised. Five themes were generated: AI-augmented leadership practices and decision-support functions; data-informed and predictive school improvement planning; leadership readiness, organisational learning and human-centred change; ethical governance, accountability and trust in AI-supported decision-making; and resource availability, equity and contextual fit for sustainable AI implementation. The findings indicate that AI-driven DSS can support school leaders by strengthening data interpretation, predictive planning, administrative efficiency, instructional leadership and targeted intervention. However, AI does not directly produce school improvement. Its value depends on leadership judgement, professional capacity, ethical governance, stakeholder trust, digital infrastructure and contextual adaptation. The study concludes that AI-supported decision-making should be understood as augmented school leadership, where AI supports but does not replace human interpretation, ethical responsibility and context-sensitive decision-making.

Keywords: artificial intelligence; decision support systems; school leadership; school improvement; systematic literature review; Malaysian urban public secondary schools

1. Introduction

1.1 The Broader Context

The integration of AI in education is part of a broader trend of leveraging technology to address complex educational challenges. Globally, AI is increasingly recognised as a tool for enhancing data-informed decision-making, optimising resource allocation and improving administrative and instructional efficiency (Chen et al., 2020; Holmes et al., 2019; Zawacki-Richter et al., 2019). As schools become data-rich environments, AI-driven DSS may help school leaders extract actionable insights and make strategic decisions that support school improvement (Langeveldt, 2024; Mandinach & Gummer, 2016; Wang, 2021).

In Malaysia, urban public secondary schools face resource constraints, increasing student diversity, pressure to meet national educational benchmarks, and gaps in digital readiness and data utilisation (Noman, 2022; Ramalingam & Maniam, 2024). The *Malaysia Education Blueprint 2013–2025* provides a foundational policy context through its emphasis on innovation and data-informed leadership (Ministry of Education Malaysia [MOE], 2013). The Digital Education Policy strengthens digital capabilities, while the Malaysian National Artificial Intelligence Roadmap 2021–2025 and the National Guidelines on AI Governance and Ethics provide strategic and ethical direction for responsible AI adoption (MOE, 2023; Ministry of Science, Technology and Innovation [MOSTI], 2021, 2024).

1.2 Identifying the Research Gap

Despite growing international interest in AI in education, there remains limited consolidated understanding of how AI-driven DSS support school leaders' decision-making for school improvement, particularly in Malaysian urban public secondary school contexts. Existing literature has increasingly examined AI in teaching, learning analytics and educational technology, but comparatively fewer studies focus on school leadership decision-making, strategic planning and evidence-informed school improvement (Chen et al., 2020; Holmes et al., 2019; Wang et al., 2024; Zawacki-Richter et al., 2019).

This gap is significant for Malaysian school leaders and policymakers. Urban public secondary schools operate in complex environments shaped by diverse learner needs, enrolment pressures, uneven resources, digital readiness gaps and increasing expectations for data-informed leadership (MOE, 2013; Noman, 2022; Ramalingam & Maniam, 2024). Although AI-driven DSS may support predictive analytics, pattern recognition, monitoring and planning, the leadership conditions required for meaningful use remain insufficiently synthesised (Langeveldt, 2024; Mandinach & Gummer, 2016; Mustafa et al., 2024; Wang, 2021).

1.3 The Need for the Present Study

The problem is not simply the limited availability of AI tools, but the absence of a clear, leadership-focused synthesis showing how they may be used responsibly and contextually for school improvement. Without such synthesis, AI adoption risks becoming fragmented, technically driven or disconnected from improvement priorities. School leaders may underuse AI because of limited readiness or over-rely on AI-generated outputs without sufficient professional judgement, ethical governance or contextual interpretation (Argote & Miron-Spektor, 2011; Noman, 2022; UNESCO, 2023; Weick, 1995).

This study addresses the problem through a qualitative systematic literature review of scholarly and reputable institutional literature published between 2019 and 2025. Rather than claiming that AI directly produces school improvement, it examines how existing literature links AI-supported leadership decision-making to evidence-informed school improvement planning and implementation.

1.4 Research Purpose and Questions

The aim of this study was to synthesise existing literature on AI-driven DSS for school leaders and to examine how AI-supported decision-making is linked to school improvement in Malaysian urban public secondary school contexts.

The study was guided by three research questions:

- What global and Malaysian-relevant practices of AI-driven decision support systems for school leaders in supporting school improvement in Malaysian urban public secondary schools are reported in existing literature?
- What challenges in integrating AI-driven decision support systems into school improvement strategies in Malaysian urban public secondary schools are reported in existing literature?
- How is AI-supported decision-making by school leaders associated with school improvement in Malaysian urban public secondary schools within existing literature?

1.5 Significance of the Study

This study is significant for policymakers, educators, school leaders and researchers. It provides evidence-based insights into how AI may support leadership and instructional decision-making in Malaysian urban schools. Theoretically, it applies Digital Leadership Theory, the Data-Driven Decision-Making Framework, Organisational Learning Theory and Sensemaking Theory (Argote & Miron-Spektor, 2011; Mandinach & Gummer, 2016; Mandinach et al., 2006; Sheninger, 2019; Weick, 1995). Methodologically, it demonstrates a rigorous single-reviewer SLR supported by structured appraisal, coding and an audit trail.

2. Literature Review

2.1 The Concept of AI-Driven Decision Support Systems

AI-driven DSS integrate technologies such as machine learning, predictive analytics and natural language processing to synthesise educational data into actionable insights (Chen et al., 2020; Holmes et al., 2019; Mustafa et al., 2024). They can identify trends, forecast outcomes and generate recommendations that support strategic and operational decisions (Langeveldt, 2024; Mandinach & Gummer, 2016).

For school leaders, the value of AI-driven DSS lies not merely in processing data but in supporting decisions. Dashboards, predictive models and automated analytics are useful only when leaders interpret their outputs, connect them to school priorities and make context-sensitive decisions. AI-driven DSS should therefore assist judgement without replacing professional responsibility (Mandinach & Gummer, 2016; Wang, 2021).

2.2 Global, Regional and Malaysian Literature

Globally, AI-driven DSS support data-informed school leadership through administrative automation, learning analytics, predictive models and early-warning interventions (Chen et al., 2020; Martin et al., 2024; Wang et al., 2024). These applications can help leaders monitor performance, identify risks and allocate resources more effectively.

In Southeast Asia, adoption is shaped by teacher attitudes, technological confidence and perceptions of AI's usefulness (Mustafa et al., 2024; Wang et al., 2024). AI-driven DSS are more likely to succeed when capacity-building respects pedagogical norms and local values (UNESCO, 2023).

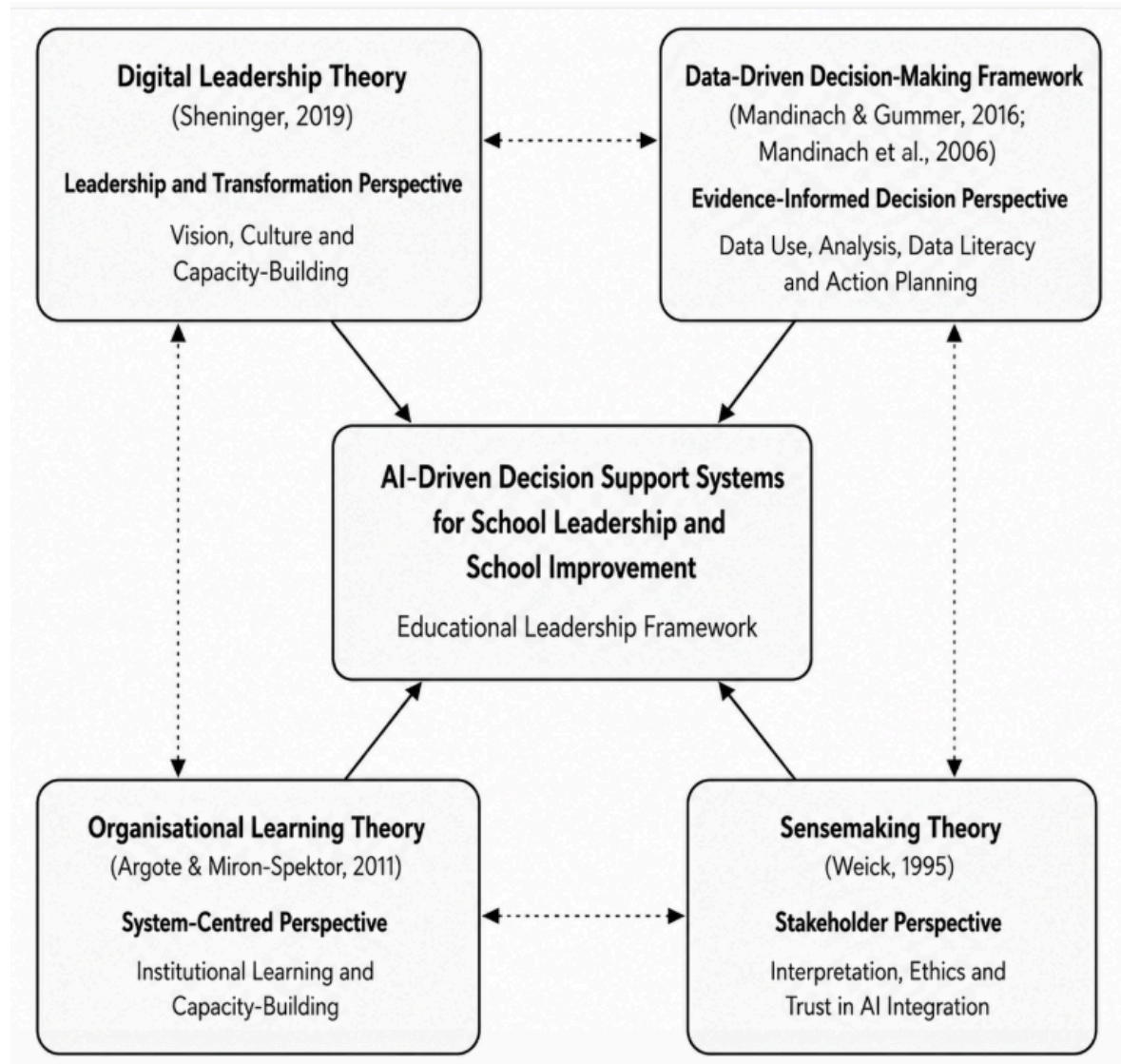
In Malaysia, AI-driven DSS implementation in urban public secondary schools remains fragmented and exploratory. The literature identifies insufficient training, limited leadership awareness, resistance to change and uneven infrastructure as barriers (Mustafa et al., 2024; UNESCO, 2023). It therefore suggests an emerging need for predictive analytics and data-informed tools that support targeted intervention and strategic planning, rather than widespread implementation.

2.3 Theoretical Framework

The study is guided by four leadership-focused theoretical perspectives. Digital Leadership Theory explains how school leaders guide digital transformation and build readiness for responsible AI adoption (Sheninger, 2019). The Data-Driven Decision-Making Framework explains how educational data are interpreted and translated into evidence-informed action (Mandinach & Gummer, 2016; Mandinach et al., 2006). Organisational Learning Theory explains how schools build collective capacity and embed new routines (Argote & Miron-Spektor, 2011), while Sensemaking Theory explains

how school leaders interpret AI-generated information within complex and uncertain school contexts (Weick, 1995).

Figure 1: Theoretical Framework (Adapted from Argote & Miron-Spektor, 2011; Mandinach & Gummer, 2016; Mandinach et al., 2006; Sheninger, 2019; Weick, 1995)

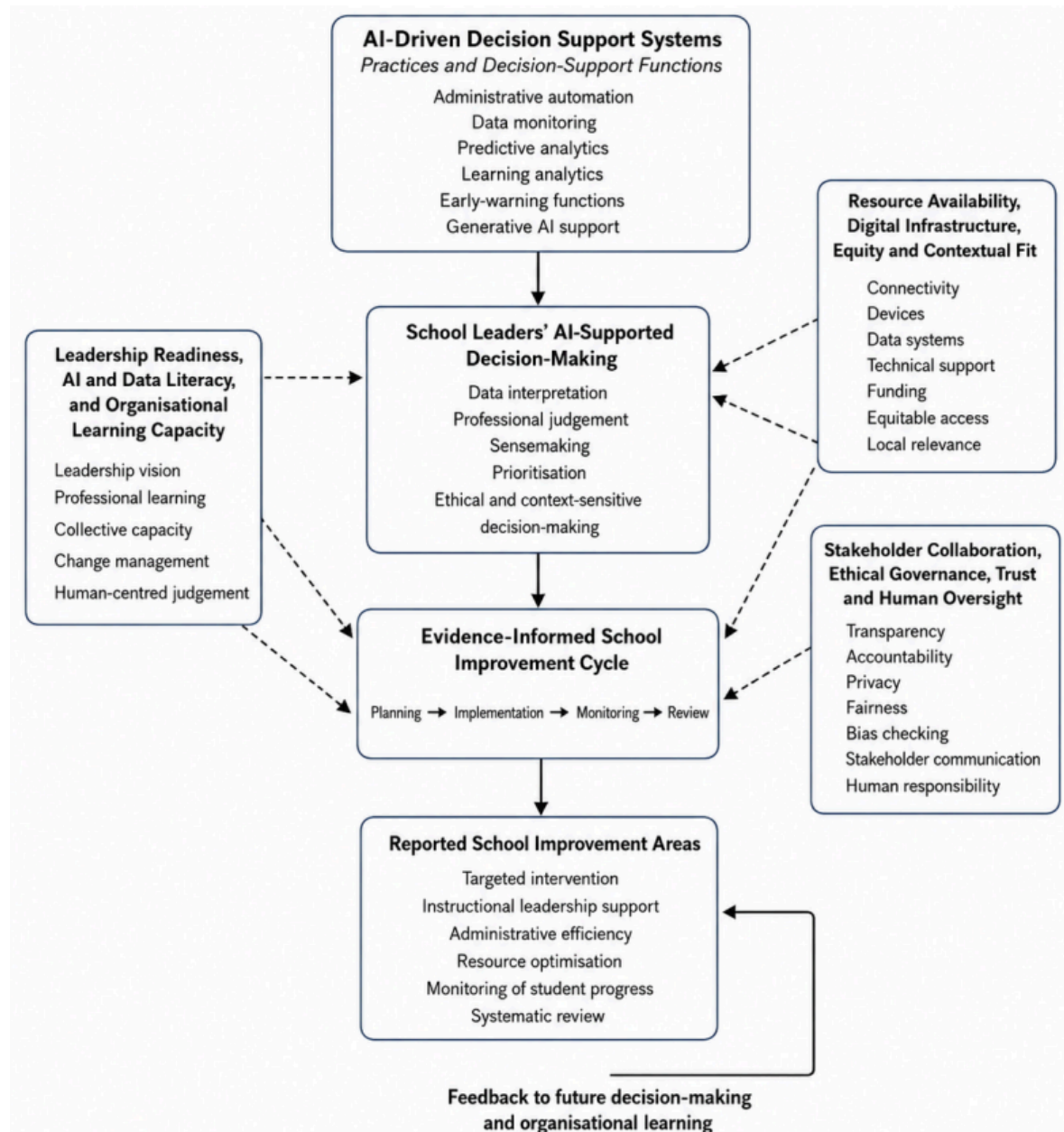


2.4 Conceptual Framework

The conceptual framework explains how AI-driven DSS practices and decision-support functions inform school leaders' AI-supported decision-making and contribute to evidence-informed school improvement planning, implementation, monitoring and review. Professional judgement, data interpretation, sensemaking and contextual prioritisation mediate this pathway.

Figure 2: Conceptual Framework (Developed by the researcher based on literature synthesis)

The three enabling conditions are leadership readiness, AI and data literacy, and organisational learning capacity; resource availability, digital infrastructure, equity and contextual fit; and stakeholder collaboration, ethical governance, trust and human oversight.



3. Methodology

3.1 Research Design

This study adopted a qualitative systematic literature review (SLR) methodology. The unit of analysis was published scholarly and reputable institutional literature, rather than school leaders, teachers, students or schools. The study did not involve empirical fieldwork, interviews, surveys or the implementation of AI tools in school settings.

The SLR followed a structured, replicable and transparent process, adapting PRISMA 2020 to guide identification, screening, eligibility and inclusion (Page et al., 2021). The review covered literature published between 2019 and 2025. K–12 was retained only as a search and retrieval term; screening and synthesis focused on literature that directly or meaningfully informed public secondary school leadership, school improvement and Malaysian urban relevance.

3.2 Sources of Literature and Study Selection

The evidence base comprised peer-reviewed journal articles, academic conference papers and reputable institutional reports. ERIC was the main structured database, while Google Scholar and DOAJ were supplementary sources. Search strings combined terms related to AI, decision support, school leadership and school level.

Inclusion criteria were English-language journal articles, conference papers or reputable institutional reports published between 2019 and 2025 that addressed AI-driven DSS, AI-supported decision-making, educational leadership or school improvement in K–12 or public secondary school contexts.

Exclusion criteria were blogs, editorials, opinion pieces and news items; publications outside the date range; higher education-only studies; studies focused solely on student AI use; and studies without a meaningful link to leadership decision-making or school-level improvement.

3.3 Data Collection and Analysis

The review included systematic searching, title and abstract screening, full-text eligibility review, quality appraisal, data extraction, coding and thematic synthesis. A rubric assessed clarity and theoretical alignment, research design and methods, sampling and data collection, and relevance to AI-driven DSS in K–12 school leadership. Each dimension was scored from 1 to 5, and studies scoring at least 15 out of 20 were retained.

A standardised Excel matrix recorded study details, context, methodology, AI/DSS focus, leadership decision focus, school improvement linkage, extracted segments, codes, themes, research-question mapping, conceptual-framework lens, quality scores and audit-trail notes.

Data were analysed through thematic analysis and thematic synthesis following Braun and Clarke's (2021) six-phase approach. Codes and themes were developed from the literature, while interpretation was guided by the research questions and conceptual framework.

3.4 Ethical Considerations

Because the study used secondary literature only, it did not involve human participants. Ethical care was maintained through accurate representation of the reviewed studies and citation in accordance with APA 7th edition.

4. Findings

4.1 Search and Screening Results

The search process identified an approximate broad pool of 21,856 records across 14 search runs. Of 363 records screened at the title and abstract level, 52 proceeded to full-text review. Twenty-five full texts were excluded, 27 studies entered quality appraisal, and 16 met the threshold for final synthesis. These studies yielded 131 coded data segments

Table 4.1: Search and Screening Summary

Review Stage	Number
Search runs logged	14
Approximate broad identification pool	21,856
Records screened at title and abstract stage	363
Records excluded at title and abstract stage	311
Records included for full-text eligibility review	52
Full-text articles excluded	25
Studies retained after full-text review	27
Studies passing quality appraisal	16
Final extraction segments coded	131

4.2 Characteristics of Included Studies

The 16 included studies were published between 2023 and 2025 and represented Cyprus, the United States, Germany, Turkey, Nigeria, Hong Kong SAR, Pakistan, Norway, Indonesia, Israel and the multi-country Arab region. No included study was conducted directly in Malaysian urban public secondary schools; the studies were retained for their transferable evidence on leadership, public secondary education, resource constraints, digital readiness, AI governance and school improvement planning.

Table 4.2: Characteristics of Studies Included in Final Synthesis

Study ID	Author(s) & Year	Country/ Region	School Level	AI/DSS Focus	Methodology	Quality Score
S002	Kafa (2025)	Cyprus	Primary/ secondary	Digitalisation and AI leadership support	Qualitative	16/20
S003	Doss et al. (2025)	USA	K–12 public	Generative AI guidance, training and governance	Mixed-methods	16/20
S005	Renta-Davids et al. (2025)	International	Primary/ secondary	AI in educational leadership and governance	Scoping review	17/20
S006	Pietsch & Mah (2025)	Germany	Primary/ secondary/ special needs	AI transformation and digital mindset	Quantitative	16/20
S007	Kesim et al. (2025)	Turkey	K–12 private	AI influence on school culture and leadership	Qualitative case study	15/20
S012	Kim et al. (2024)	USA	K–12 leadership	ChatGPT for problems of practice	Qualitative case study	15/20
S014	Ezenwagu et al. (2025)	Nigeria	Public secondary	AI-driven educational reforms	Descriptive survey	15/20
S015	Cheng & Wang (2023)	Hong Kong SAR	Primary/ secondary	Digital leadership and AI incorporation	Quantitative	16/20
S019	Dike & Kobani (2025)	Nigeria	Public senior secondary	AI and digital connectivity	Correlational survey	16/20
S020	Friday (2025)	Nigeria	Secondary	AI governance and ethical challenges	Descriptive survey	15/20
S021	Abideen et al. (2023)	Pakistan	Secondary	Machine learning for enrolment prediction	Quantitative	15/20
S022	Lunde (2024)	Norway	Lower secondary	Learning analytics and quality monitoring	Qualitative	16/20
S023	Gunadi (2025)	Indonesia	Elementary	AI-assisted supervision and teacher performance	Qualitative	15/20
S024	Ghamrawi et al. (2025)	Multi-country Arab	Private/ International K–12	Generative AI and the 5C's framework	Qualitative interpretive	15/20

Study ID	Author(s) & Year	Country/Region	School Level	AI/DSS Focus	Methodology	Quality Score
S025	Berkovich (2025)	Israel	Public primary/secondary	Generative AI in instructional leadership	Quantitative survey	15/20
S027	Kim & Wargo (2025)	USA	Rural K–12 STEM	AI integration in rural STEM education	Mixed-methods	15/20

4.3 Quality Appraisal Results

Of the 27 studies appraised, 16 met the minimum quality threshold and were classified as “Pass”. **Scores ranged** from 15 to 17, with an average of 15.5. Nine studies scored 15, six scored 16 and one scored 17; **the** remaining 11 studies were excluded.

4.4 Thematic Findings

Five main themes were generated from the thematic synthesis.

Table 4.4: Main Themes, Subthemes, and Supporting Studies

Theme	Subthemes	Supporting Studies
Theme 1: AI-Augmented Leadership Practices and Decision-Support Functions	Digital communication and coordination; shared digital workflows; administrative automation; AI-supported leadership decision support	S002, S007, S012, S019, S020, S021, S023
Theme 2: Data-Informed and Predictive School Improvement Planning	Data monitoring and analytics; predictive analytics and early warning; school improvement planning and priority setting; instructional leadership support; teacher decision support	S007, S012, S015, S019, S021, S022, S023, S025
Theme 3: Leadership Readiness, Organisational Learning and Human-Centred Change	Strategic vision and school-wide AI integration; change management; professional development; leadership readiness and AI literacy; human-centred judgement; organisational culture	S002, S003, S005, S006, S007, S012, S014, S015, S019, S023, S024, S025
Theme 4: Ethical Governance, Accountability and Trust	Policy and governance frameworks; ethical risk, bias, privacy and fairness; accountability, transparency and trust	S003, S005, S007, S019, S020, S022, S024, S025

Theme	Subthemes	Supporting Studies
Theme 5: Resource Availability, Equity and Contextual Fit	Infrastructure and technical capacity; equity and digital divide; contextual adaptation and local fit; resource-constrained implementation	S002, S005, S007, S012, S014, S015, S019, S022, S023, S027

Theme 1: AI-Augmented Leadership Practices and Decision-Support Functions. AI-supported leadership develops from strong digital foundations and is most valuable when it augments professional judgement. Digital communication, shared workflows and administrative automation support coordination and free leaders to focus on planning and instructional leadership. AI tools can also generate options, analyse information, identify patterns and offer recommendations (S002, S007, S012, S019, S020, S021, S023).

Theme 2: Data-Informed and Predictive School Improvement Planning. AI-driven DSS contribute to improvement when they help leaders transform data into priorities, interventions and sustained planning cycles. Predictive analytics, early-warning systems and reporting platforms support performance monitoring, risk identification, priority setting and timely intervention (S007, S012, S015, S019, S021, S022, S023, S025).

Theme 3: Leadership Readiness, Organisational Learning and Human-Centred Change. AI-supported school improvement is a leadership and organisational learning challenge, not merely a technical task. Strategic vision, school-wide direction, professional learning, AI literacy, change management and human-centred judgement were recurring conditions for effective use (S002, S003, S005, S006, S007, S012, S014, S015, S019, S023, S024, S025).

Theme 4: Ethical Governance, Accountability and Trust in AI-Supported Decision-Making. Ethical governance is central to responsible AI use. Schools require clear policies, monitoring, academic-integrity guidance and human oversight. The literature identified risks involving bias, privacy, data security, opacity, unfairness, accountability and stakeholder trust (S003, S005, S007, S019, S020, S022, S024, S025).

Theme 5: Resource Availability, Equity and Contextual Fit for Sustainable AI Implementation. Sustainable implementation depends on connectivity, devices, data systems, technical support, funding, equitable access and local relevance. Uneven access to technology, expertise and infrastructure may widen existing inequalities, making phased and context-sensitive adoption essential (S002, S005, S007, S012, S014, S015, S019, S022, S023, S027).

4.5 Integrated Synthesis Across Research Questions

Table 4.5: Research Question Synthesis Matrix

Research Question	Key Findings	Supporting Themes
RQ1: Global and Malaysian-relevant practices of AI-driven DSS	Practices range from digital communication and administrative automation to predictive analytics, instructional supervision and school-wide AI integration	Theme 1, Theme 2
RQ2: Challenges in integrating AI-driven DSS	Challenges include leadership readiness gaps, limited professional development, ethical governance concerns, infrastructure constraints and contextual adaptation needs	Theme 3, Theme 4, Theme 5
RQ3: Link between AI-supported decision-making and school improvement	AI-supported decision-making supports school improvement through data-informed planning, early intervention, instructional leadership, administrative efficiency and systematic review, but this link is conditional on responsible leadership and organisational capacity	Theme 2, Theme 3, Theme 4, Theme 5

5. Discussion

5.1 Summary of Key Findings

AI-driven DSS can support school leaders' decision-making, but their value is neither automatic nor purely technical. They are most useful when leaders organise information, interpret data, identify risks, set priorities, plan interventions and strengthen instructional leadership. Meaningful contribution to school improvement depends on leadership readiness, professional competence, ethical governance, infrastructure, stakeholder trust and contextual adaptation.

5.2 Discussion in Relation to Research Questions

RQ1: Global and Malaysian-Relevant Practices of AI-Driven DSS. Practices ranged from digital communication and administrative automation to data monitoring, predictive analytics, instructional supervision, teacher decision support and school-wide AI integration. This shows that AI readiness begins with disciplined digital leadership and reliable workflows, not sophisticated tools alone (Kafa, 2025).

RQ2: Challenges in Integrating AI-Driven DSS. Challenges were multidimensional and included leadership readiness, AI literacy, professional development, organisational culture, ethical governance, infrastructure, equity and contextual fit. Leaders need data-interpretation skills, ethical awareness and confidence to question AI-generated outputs, while teachers and leaders require sustained, role-specific training rather than one-off workshops.

RQ3: Link Between AI-Supported Decision-Making and School Improvement. AI-supported decision-making was associated with improved data interpretation, earlier risk identification,

targeted intervention, instructional leadership, administrative efficiency and systematic planning. However, AI does not automatically improve schools. Leaders must interpret its insights responsibly and connect them to school goals, student needs, staff capacity, ethical safeguards and contextual realities.

5.3 Discussion in Relation to the Conceptual Framework

The findings support the conceptual framework's positioning of AI-driven DSS as a decision-support mechanism that informs school leaders' AI-supported decision-making and evidence-informed improvement planning. AI can help leaders interpret data, identify trends, predict risks, generate options and support planning, but it strengthens rather than replaces leadership judgement.

The findings also confirm three enabling conditions: leadership readiness, AI and data literacy, and organisational learning capacity; resource availability, digital infrastructure, equity and contextual fit; and stakeholder collaboration, ethical governance, trust and human oversight. Together, these conditions shape whether AI implementation is feasible, sustainable and trusted.

5.4 Implications for Malaysian Urban Public Secondary School Leadership

The findings suggest five priorities for Malaysian urban public secondary school leadership. AI should be treated as a strategic leadership tool linked to improvement priorities, instructional leadership, resource planning and student support. Leadership development should include AI literacy, data interpretation and ethical judgement. Schools should strengthen data systems, documentation and workflows before introducing advanced tools, manage implementation as a phased change process, and communicate clearly with staff, students and parents to protect trust and maintain human responsibility.

5.5 Limitations

The study was limited by its single-reviewer design, although a structured appraisal rubric, audit trail, codebook and reflexive memos strengthened transparency. Scopus and Web of Science were not searched, and the final evidence base comprised only 16 studies in an emerging field. Direct empirical evidence from Malaysian urban public secondary schools was limited; the studies also varied in design, context, school level and AI focus. As a secondary literature review, the study did not capture Malaysian school leaders' lived experiences.

5.6 Recommendations

Recommendations include clearer system-level guidance on responsible AI use; leadership development in AI literacy and data-informed decision-making; readiness audits; stronger

digital foundations; phased pilot implementation; sustained, role-specific professional development; and governance covering acceptable use, data protection, fairness, transparency, accountability and human oversight. AI-supported evidence use should be embedded within school improvement cycles and monitored to ensure that it supports rather than widens equity.

5.7 Suggestions for Future Research

Future research should examine how Malaysian urban public secondary school leaders understand and use AI-driven DSS in practice. School-based and longitudinal studies could investigate readiness, governance, professional learning and integration into improvement planning. Comparative research across urban, rural, public and private contexts, together with teacher, middle-leader, student and parent perspectives, would strengthen contextual understanding.

5.8 Conclusion

This study examined how AI-driven DSS are represented as tools supporting school leaders' decision-making for school improvement in Malaysian urban public secondary school contexts. The findings show potential to strengthen data interpretation, predictive planning, administrative efficiency, instructional leadership and targeted intervention. However, AI does not improve schools by itself; its value depends on leadership readiness, judgement, ethics and organisational capacity.

The central conclusion is that AI-supported decision-making should be understood as augmented school leadership. AI can organise information, identify patterns, generate options and support planning, but human leaders remain responsible for interpretation, ethical judgement, stakeholder engagement and contextual decision-making.

Malaysian urban public secondary schools should therefore introduce AI-driven DSS carefully and strategically, supported by strong digital foundations, clear governance, professional development, stakeholder trust, adequate resources and context-sensitive implementation. Used responsibly, AI can support better-informed decisions, but the deeper work of school improvement remains human, relational and contextually grounded.

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