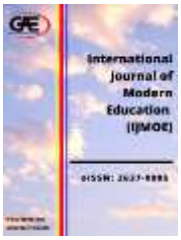
International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472



INTERNATIONAL JOURNAL OF MODERN EDUCATION (IJMOE)
www.gaexcellence.com/ijmoe

INSTRUCTIONAL COMPETENCY IN DIGITAL ECOSYSTEM CULTURE: A SYSTEMATIC REVIEW OF ASSISTANT HEADTEACHERS' LEADERSHIP

Erna Suwardi[1]*, Muhamad Suhaimi Taat[2], Roslee Talip[3], Mohd Sobrye Paimin[4]

[1]Faculty of Education and Sport Studies, Universiti Malaysia Sabah, Malaysia
ERNA_SUWARDI_DP23@iluv.ums.edu.my https://orcid.org/0009-0007-4880-6475
[2]Faculty of Education and Sport Studies, Universiti Malaysia Sabah, Malaysia
suhaimi@ums.edu.my https://orcid.org/0000-0003-2599-7559
[3]Faculty of Education and Sport Studies, Universiti Malaysia Sabah, Malaysia
roslee_73@ums.edu.my https://orcid.org/0000-0001-8987-158X
[4]Faculty of Education and Sport Studies, Universiti Malaysia Sabah, Malaysia
mohd_sobrye_dt24@iluv.ums.edu.my https://orcid.org/0009-0003-3291-0826

Article Info:

Article history:
Received date: 25.01.2026
Revised date: 12.02.206
Accepted date: 26.02.206
Published date: 04.03.2026

To cite this document:

Suwardi, E., Taat, M. S., Talib, R., & Paimin, M. S. (2026). Instructional Competency in Digital Ecosystem Culture: A Systematic Review of Assistant Headteachers' Leadership. *International Journal of Modern Education, 8*(29), 443-472.

Abstract:

The rapid digitalisation of education has intensified the demand for leadership practices that go beyond technical adoption to shaping sustainable school cultures. This study conducted a Systematic Literature Review (SLR) guided by the PRISMA 2020 protocol and PICo framework to examine how digital ecosystem culture influences the instructional competency of Assistant Headteachers in primary education. A total of 32 peer-reviewed studies published between 2020 and 2025 in Scopus and Web of Science were systematically identified, screened, and thematically analysed. Six interrelated themes emerged: digital competence, professional learning communities, differentiated professional development, socio-technical integration, addressing barriers to digital competency, and networking and collaboration beyond school walls. Collectively, these themes highlight the evolving role of Assistant Headteachers as strategic instructional leaders who must balance technological, pedagogical, and cultural demands. The findings extend theoretical perspectives on distributed and supportive leadership while providing practical insights for leadership training and policy development. This review not only synthesises current evidence but also advances the conceptualisation of Assistant Headteachers as pivotal ecosystem builders, offering a framework that can inform both future empirical research and educational policy reform.

International Journal of Modern Education
EISSN: 2637-0905
Volume 8 Issue 29 (March 2026) PP. 443-472

DOI: 10.35631/IJMOE.829028 **Keyword:**

Instructional Competency, Assistant Headteachers, Digital Ecosystem Culture, Systematic Literature Review, Malaysian Primary Education

Introduction

Amidst the accelerating wave of digitalisation across sectors, education systems worldwide are increasingly pressured to implement technological reforms that go beyond infrastructure upgrades and classroom-level adoption. For schools, this entails embedding technology not only in pedagogical processes but also across leadership practices, teacher development, and institutional culture. In Malaysia, the urgency to cultivate a robust digital ecosystem has intensified in the post-pandemic era, aligning with national strategic agendas such as the MyDigital initiative and post-COVID educational recovery frameworks (Abbas et al., 2023; Hamzah et al., 2021).

Nonetheless, the establishment of this digital culture remains uneven, particularly in contexts where leadership is passive or reactive. Empirical evidence shows that when school leadership lacks a coherent digital vision, even well-resourced institutions often fail to implement meaningful technological reforms, resulting in fragmented ICT use and limited instructional transformation (Raptis et al., 2024; Wollscheid et al., 2024).

At the heart of this challenge lies the complex construct of instructional competency, which represents a multidimensional domain extending beyond subject expertise and administrative oversight. Instructional competency includes digital literacy, pedagogical adaptability in integrating emerging technologies, and a strategic vision that inspires technology driven innovation at the school level (Zakaria et al., 2021). Contemporary educational systems increasingly evaluate school leaders not merely on operational efficiency or compliance with procedures, but on their ability to foster a culture of continuous digital transformation and personalised, technology enhanced learning. Recent studies indicate that when instructional leaders actively model the use of digital tools, establish clear expectations for engagement, and mentor teachers in ICT integration, schools attain higher levels of digital ecosystem maturity, stronger collaboration, and sustained professional growth (Lau & Han, 2024; Yakob & Don, 2025).

Nevertheless, the effort to cultivate a digital ecosystem culture in schools still encounters many obstacles. A large number of schools continue to struggle with infrastructure issues such as unstable internet connections, outdated equipment, and limited technical support. These problems are even more severe in rural or less privileged schools, where the digital gap remains a significant barrier to equitable transformation. Beyond the physical shortcomings, many teachers do not receive continuous and meaningful training, which leaves them unprepared to

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472
use technology effectively in their teaching practices (Donald & Hashim, 2025; Yap et al., 2024). On the human side, fears of becoming irrelevant, resistance to change, and uncertainty about new approaches reduce the willingness of teachers to explore digital innovation. In situations where leadership guidance is weak or inconsistent, schools lose the steady support needed to maintain progress (Okunlola, 2024). The problem is further compounded by the lack of shared leadership and formal mentoring, which limits collective ownership and weakens the momentum of digital transformation (Alde, 2024).

Despite these challenges, emerging evidence suggests that Assistant Headteachers can play a pivotal role as facilitators of distributed digital leadership. Case studies demonstrate that when Assistant Headteachers act as enablers of collaboration, innovation becomes more sustainable and embedded in daily school operations. These leaders not only guide instructional practices but also nurture a culture of continuous digital growth and collaborative problem-solving (Buyukgoze et al., 2022; Lu & Chen, 2025). To explore this evolving role, this study adopts a systematic literature review (SLR) approach to critically synthesise empirical studies published between 2020 and 2025, focusing on how digital ecosystem culture contributes to the development of instructional competency among Assistant Headteachers in primary education. Guided by the PRISMA 2020 protocol and informed by the PICo framework, this review addresses three interconnected dimensions: Population (P), referring to instructional leaders in Malaysian primary schools; Interest (I), focusing on digital ecosystem culture; and Context (Co), relating to educational leadership and technology integration within school environments (Brennan & Munn, 2021; Hernández-Cruz et al., 2024; Parums, 2021). Based on these dimensions, three research questions were developed to guide the review:

What are the dimensions of instructional competency among Assistant Headteachers in the context of digital transformation?

To what extent does digital ecosystem culture shape or enhance the instructional competency of Assistant Headteachers, particularly in the implementation of digital pedagogical practices? What leadership strategies have been identified as effective in fostering a sustainable digital ecosystem culture among instructional leaders in primary education settings?

These research questions provide conceptual clarity and methodological direction for the review, ensuring that the analysis systematically identifies thematic patterns, addresses research gaps, and highlights implications for practice and policy in the context of digitally transforming schools. Beyond this, the questions serve as a conceptual lens through which fragmented evidence from multiple studies can be synthesised into coherent themes that reflect both theoretical and practical advancements. They also allow the review to critically interrogate not only the presence of digital initiatives but also their depth, sustainability, and relevance to instructional leadership. By sitting inquiry within these clearly defined dimensions, the review contributes to the development of a structured evidence base that strengthens understanding of how digital ecosystem culture interacts with instructional competency in primary education.

Literature Review

This study adopted a Systematic Literature Review (SLR) guided by the PRISMA 2020 protocol (Page et al., 2021), ensuring transparency, rigour and reproducibility. The four phases of PRISMA which are identification, screening, eligibility and inclusion were systematically applied. The PICo framework informed the research questions and search strategy, focusing on

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Population (instructional leaders in Malaysian primary schools), Interest (digital ecosystem culture) and Context (educational leadership and technology integration). This combined approach ensured a comprehensive and conceptually grounded review, reducing ambiguity in study selection and strengthening alignment with research objectives. The integration of PRISMA procedures also enhanced replicability, while the use of PICo supported theoretical breadth. Together, these frameworks provided a rigorous foundation for synthesising evidence and generating meaningful implications for leadership practice in primary education. By situating the review within established methodological standards, the study strengthens its contribution to both scholarly discourse and practical application. It also highlights how structured frameworks can support the development of clearer, evidence-based insights for guiding school leadership in the digital era.

Identification

In this study, essential steps of the systematic review process were meticulously employed to gather a comprehensive body of relevant literature. The process began with the careful selection of keywords, followed by the identification of related terms through dictionaries, thesauri, encyclopaedias and previous research. All relevant terms were consolidated, and refined search strings were formulated for both the Web of Science and Scopus databases (as presented in Table 1). The identification stage yielded a total of 1,214 records from two databases: Web of Science (n = 209) and Scopus (n = 1,005). All records were exported and compiled for screening. These records were subsequently subjected to systematic screening to ensure alignment with the research objectives and to eliminate duplicates. The rigorous procedures applied at this stage strengthened the validity, reliability and comprehensiveness of the review process.

In addition, the use of dual databases minimised the risk of publication bias, while the inclusion of multiple reference sources ensured that the search strategy captured both breadth and depth of existing scholarship. Furthermore, the structured and transparent search protocol enhanced the reproducibility of the review, allowing future researchers to replicate or extend the search process with consistency. Such methodological transparency is essential in systematic reviews to uphold scholarly rigour and methodological credibility. This foundation provided a strong platform for the thematic synthesis that followed and ensured that the scope of the review was sufficiently inclusive to reflect diverse perspectives across educational systems. By embedding this careful groundwork, the study established the necessary robustness to support meaningful analysis and reliable interpretation of findings.

Table 1: Search Strategy in Scopus and Web of Science

Scopus	TITLE-ABS-KEY ("instructional competency" OR "instructional leadership" OR "instructional capacity") AND ("digital ecosystem" OR "digital culture") AND ("assistant principal" OR "school leader") AND ("primary education" OR "elementary school") AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND DOCTYPE (ar) AND LANGUAGE (English) Date of Access: May 2025

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

WoS	("instructional competency" OR "instructional leadership" OR "instructional capacity") AND ("digital ecosystem" OR "digital culture") AND ("assistant principal" OR "school leader") AND ("primary education" OR "elementary school") (Topic) AND 2020 OR 2021 OR 2022 OR 2023 OR 2024 OR 2025 (Publication Years) AND Article (Document Types) AND English (Languages) Date of Access: Jun 2025

Screening

Potentially relevant studies were screened to ensure alignment with the research questions, focusing on instructional leadership within digital ecosystem culture in primary school settings. While the empirical evidence was drawn from studies conducted across different countries, the synthesis was interpreted with particular relevance to the Malaysian primary school context.

The inclusion criteria emphasized peer-reviewed journal articles in English, published between 2020 and 2025, with final publication status and without geographical restriction. Book chapters, proceedings, reviews, and non-empirical works were excluded.

Table 2: The Selection Criterion Is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Publication Year	2020 – 2025	< 2020
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Geographic Scope	Any country, if aligned with PICo context	Studies unrelated to school instructional leadership

Eligibility

In the eligibility phase, a total of 149 full-text articles that had successfully passed the initial screening were examined in greater depth to determine their alignment with the objectives and scope of this review. At this stage, a more detailed and systematic evaluation was undertaken to ensure conceptual coherence and methodological robustness. The review process emphasised methodological rigour, clarity of research design, and the strength of empirical evidence in order to retain only studies that demonstrated substantive relevance to the research questions. Each article was carefully assessed for consistency with the PICo framework, with particular attention given to the defined parameters: Population (primary school instructional leaders, including assistant headteachers), Interest (digital ecosystem culture), and Context (school-based instructional leadership settings). This structured assessment ensured that the

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472
selected studies directly addressed the intersection between digital ecosystem dynamics and instructional competency development.

Articles were excluded if they did not explicitly centre on school leadership within primary education contexts, involved higher education or unrelated organisational sectors, lacked empirical research design, or failed to meet the predefined inclusion criteria. Additional scrutiny was applied to studies that were conceptually adjacent but did not provide direct analytical insights into instructional competency or digital ecosystem culture. As a result, 117 articles were excluded at this stage, leaving 32 studies deemed eligible for final synthesis. This refinement process enhanced the credibility, analytical precision, and internal consistency of the evidence base, thereby strengthening confidence in the conclusions drawn from the systematic review.

Inclusion

After the eligibility review, 32 studies were finally retained for the synthesis. These articles were included because they dealt directly with the link between digital ecosystem culture and instructional competency in primary education and clearly fitted the PICo framework. Only studies that satisfied both methodological and conceptual standards were taken forward, which kept the evidence base focused and relevant to the aims of this review. This step also helped avoid the inclusion of papers that were less precise or not grounded in strong data. In other words, the inclusion phase acted as the final filter that separated relevant and high-quality works from those that would have weakened the overall analysis. By doing so, the review could move into the analysis stage with a solid and defensible pool of evidence.

The final group of studies offered a varied but coherent set of perspectives that enriched the review. They covered issues of instructional leadership, digital transformation, and the development of competency among Assistant Headteachers, allowing for a more rounded understanding of the topic. The inclusion of studies from diverse backgrounds provided breadth, while the consistency in meeting quality standards added depth to the evidence base. Taken together, these 32 studies created a strong platform for thematic analysis, ensuring that the findings would be academically reliable and practically meaningful.

International Journal of Modern Education
EISSN: 2637-0905
Volume 8 Issue 29 (March 2026) PP. 443-472

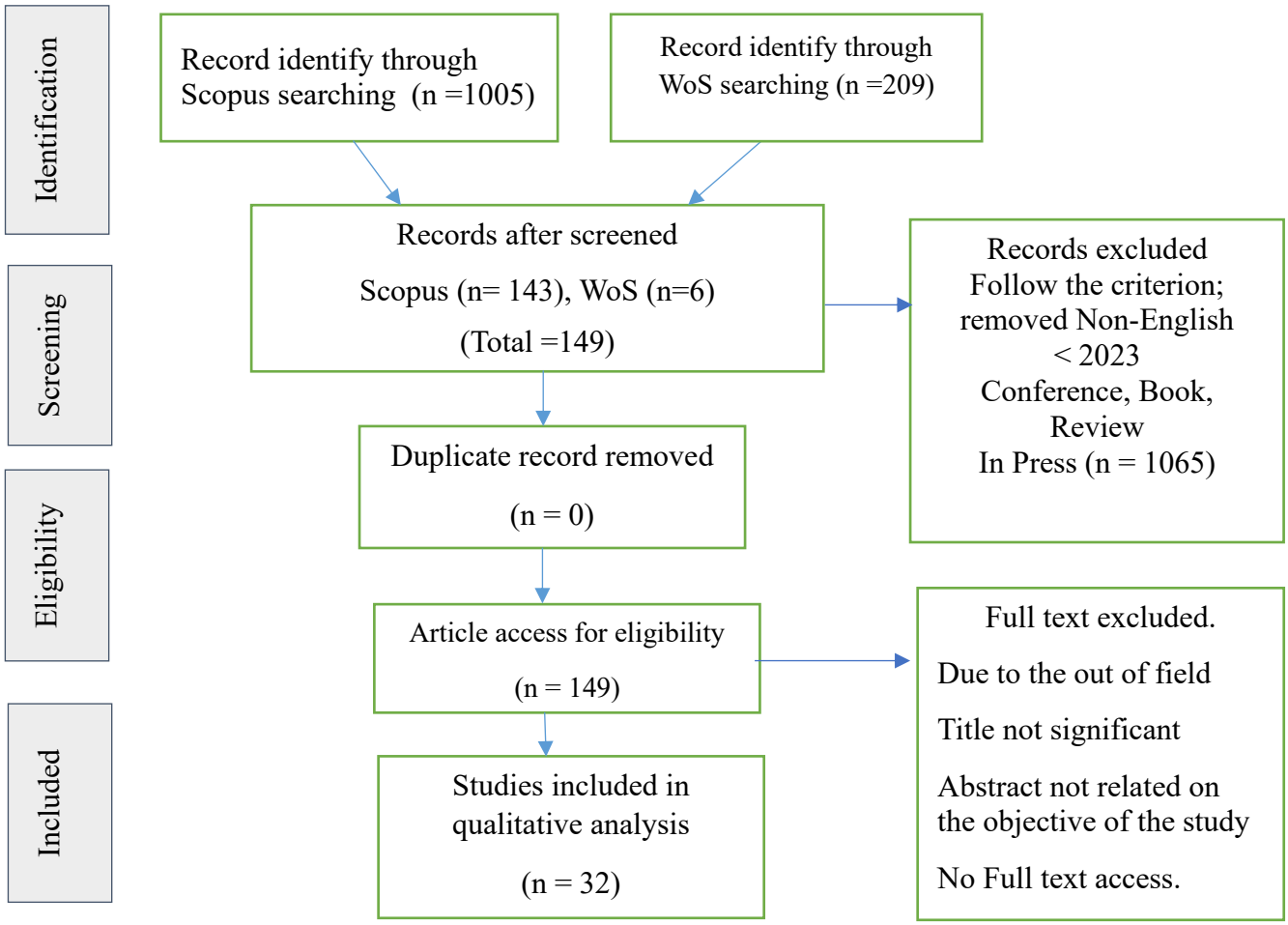


Figure 1. PRISMA 2020 Flow Diagram of The Study Selection Process (Adapted From Page Et Al., 2021)

Data Abstraction and Analysis

The synthesis of findings from 32 selected studies employed an integrative thematic approach, which was chosen for its ability to consolidate diverse insights into a coherent analytical framework. This method facilitated the extraction and categorisation of recurring concepts, providing a deeper understanding of how Assistant Headteachers conceptualise, develop, and apply instructional competency within digitally evolving school environments. The analysis was guided by three broad domains: definitions and dimensions of instructional competency, professional development and institutional support, and leadership practices that shape digital school culture. In this way, the analytical framework not only structured the review but also ensured consistency in how evidence was interpreted across studies.

Each study was independently reviewed and coded against these domains, and the coding process was carried out iteratively to allow for refinement as new patterns emerged. To maintain rigour, a reflective coding log was kept to document decisions and revisions, while collaborative discussions among reviewers ensured transparency and resolved discrepancies. This systematic process allowed recurring insights to be refined and clustered into six emergent

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 8 Issue 29 (March 2026) PP. 443-472
themes that reflected the multidimensional nature of digital instructional leadership. The iterative approach also enabled flexibility to capture context-specific variations across different educational environments. As a result, the synthesis achieved both depth and adaptability in identifying critical insights.

Reliability was further strengthened through cross validation of interpretations across multiple reviewers, which reduced potential bias and enhanced confidence in the stability of findings. The integrative thematic strategy therefore ensured both methodological robustness and conceptual depth, producing a structured synthesis of how Assistant Headteachers contribute to cultivating instructionally competent and digitally fluent school cultures. These six emergency themes form the empirical foundation for the findings presented in the next section. In doing so, the analysis created a strong bridge between the reviewed evidence and the research questions guiding this study. This bridging role highlights the importance of thematic synthesis as more than just a technical exercise but a means of theory-building.

Beyond methodological rigour, the synthesis also paid attention to the contextual richness of the selected studies. Each article was not only coded for thematic content but also considered in terms of its setting, sample characteristics, and cultural factors that shaped its findings. This attention to context enabled the review to avoid treating all studies as homogenous and instead recognised the variations across national policies, school environments, and leadership practices. Such sensitivity ensured that the emergent themes reflected both shared patterns and context-specific nuances, making the synthesis more relevant for application in diverse primary education systems. By valuing contextual variation, the review provided a nuanced evidence base that could inform both global debates and localised practices.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Table 3: Number And Details of Primary Studies Database

No	Authors	Title	Year	Journal	Scopus	WOS
1	Rasdiana, Wiyono, et al. (2024)	Elevating Teachers' Professional Digital Competence: Synergies of Principals' Instructional E-Supervision, Technology Leadership and Digital Culture for Educational Excellence in Digital-Savvy Era	2024	Education Sciences	/	/
2	W. L. Sterrett & Richardson (2023)	Innovation beyond the pandemic: the powerful potential of digital principal leadership	2023	Development and Learning in Organizations	/	/
3	Cisneros-Barahona et al. (2024)	Assessing Teacher Digital Competence. An analysis integrating descriptive, inferential, and multivariate perspectives	2024	RIED-Revista Iberoamericana de Educacion a Distancia	/	
4	Howell et al. (2025)	Designing Performance-Based Professional Development: Stakeholder Views on Essential Competencies and Approaches	2025	Education Sciences	/	/
5	Al Nuaimi et al. (2023)	The importance of the school principals' role in the digital transformation of the education sector	2024	International Journal of Comparative Education and Development	/	/
6	Schmitz et al. (2023)	Transformational leadership for technology integration in schools: Empowering teachers to use technology in a more demanding way	2023	Computers and Education	/	/

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

No	Authors	Title	Year	Journal	Scopus	WOS
7	Riski et al. (2023)	Implementation of a Digital Leadership Model in Improving the Quality of Islamic Boarding Schools	2024	Munaddhomah	/	
8	Rasdiana, Nurhadi, et al. (2024)	The effect of digital leadership in nurturing teachers' innovation skills for sustainable technology integration mediated by professional learning communities	2024	Journal of Infrastructure, Policy and Development	/	
9	AlAjmi (2022)	The impact of digital leadership on teachers' technology integration during the COVID-19 pandemic in Kuwait	2022	International Journal of Educational Research	/	/
10	Hassan & Berkovich (2023)	Digital instructional leadership in schools facing different levels of challenging contexts: A survey study during the COVID-19 pandemic	2023	Management in Education	/	/
11	Akim et al. (2024)	Toward Digital School: The Level of Usage, Competency and Awareness for Digital Storage among School Administrators Pre to the Covid-19 Era	2024	Journal of Advanced Research in Applied Sciences and Engineering Technology	/	
12	Izhak Berkovich (2023)	The great resignation: Exploring the effect of regular and digital instructional leadership on teachers' intention to leave	2023	Management in Education	/	/

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

No	Authors	Title	Year	Journal	Scopus	WOS
13	Nubun et al. (2024)	Exploring Digital Leadership Competencies among School Administrators and Digital Maturity in Sarawak, Malaysia: From Teachers' Perspectives	2024	Pakistan Journal of Life and Social Sciences	/	
14	Omar & Ismail (2020)	Mobile Technology Integration in the 2020s: The Impact of Technology Leadership in the Malaysian Context	2020	Universal Journal of Educational Research	/	
15	(Berhanu et al., 2022)	Teachers' digital competencies and technology integration in education: Insights from secondary schools in Wolaita Zone, Ethiopia	2022	Social Sciences and Humanities Open	/	
16	W. Sterrett & Richardson (2022)	Innovation beyond the pandemic: the powerful potential of digital principal leadership	2023	Development and Learning in Organizations	/	
17	Yurinova et al. (2022)	Transprofessional competences of school teachers in the digital environment: education employers' perspective	2022	Education and Information Technologies	/	/
18	Thyssen et al. (2023)	From TPACK to DPACK: The "Digitality-Related Pedagogical and Content Knowledge"-Model in STEM-Education	2023	Education Sciences	/	/
19	Artacho et al. (2020)	Teacher Training in Lifelong Learning—The Importance of Digital Competence in the Encouragement of Teaching Innovation	2020	Sustainability (Switzerland)	/	/
20	Karakose et al. (2021)	Examining Teachers' Perspectives on School Principals' Digital Leadership Roles and	2021	Sustainability (Switzerland)	/	/

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

No	Authors	Title	Year	Journal	Scopus	WOS
		Technology Capabilities during the COVID-19 Pandemic				
21	So-Oabeb & du Plessis (2023)	Leadership competencies for teacher professional development: perspectives of Namibian principals, heads of departments and teachers	2023	Perspectives in Education	/	
22	I. Berkovich & Hassan (2024)	Principals' digital instructional leadership during the pandemic: Impact on teachers' intrinsic motivation and students' learning	2024	Educational Management Administration and Leadership	/	/
23	Ab (2024)	Developing Teacher Technology Leadership in Digital Transformation:Perspectives from Professional Learning Community in One Chinese University	2024	ICEIT 2024	/	
24	H. Shaked (2020)	Boundaries of Israeli Assistant Headteachers' Instructional Leadership	2020	Leadership and Policy in Schools	/	/
25	Parlar et al. (2024)	Instructional leadership as a predictor of collaborative culture in schools	2024	International Journal of Leadership in Education	/	/
26	Leithwood et al. (2020)	Seven strong claims about successful school leadership revisited	2020	School Leadership and Management	/	/

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

No	Authors	Title	Year	Journal	Scopus	WOS
27	Witthöft et al. (2024)	Leading digital innovation in schools: the role of the open innovation mindset	2024	Journal of Research on Technology in Education	/	/
28	Kirinić et al. (2023)	E-Schools Project-Framework for Digital Competencies of School Principals: Competencies in the Area of Digital Technologies in Learning and Teaching	2023	ICIM 2023	/	
29	Karousiou (2025)	Navigating challenges in school digital transformation: insights from school leaders in the Republic of Cyprus	2025	Educational Media International	/	/
30	Haim Shaked et al. (2020)	How National Context Indirectly Influences Instructional Leadership Implementation: The Case of Israel	2020	Educational Administration Quarterly	/	/
31	Tzafilkou et al. (2023)	Assessing teachers' digital competence in primary and secondary education: Applying a new instrument to integrate pedagogical and professional elements for digital education	2023	Education and Information Technologies	/	/
32	Moreira-Choez et al. (2024)	Influence of gender and academic level on the development of digital competencies in university teachers: a multidisciplinary comparative analysis	2024	Frontiers in Education	/	/

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Quality Appraisal

To ensure methodological integrity, all 32 studies that passed the eligibility stage were subjected to a structured quality appraisal. The assessment was conducted using the guidelines of Kitchenham and Stuart (2007), complemented by appraisal criteria adapted from Abouzahra et al. (2020). Three independent reviewers evaluated each study with a three-point rubric (Yes = 1, Partly = 0.5, No = 0), and a cumulative score above 3.0 was set as the threshold for acceptable rigour. This procedure allowed the review to assess not only the methodological soundness of the studies but also their conceptual alignment with the objectives of this research. By applying a transparent and systematic appraisal, the review ensured consistency in evaluating study quality and avoided the inclusion of weak or irrelevant evidence. The outcome of this appraisal established a credible foundation for the thematic synthesis, reinforcing both the reliability and the validity of the findings that followed.

Thematic Synthesis

All 32 studies that successfully passed the quality appraisal were synthesised thematically to address the three research questions outlined in this review. The integrative thematic approach enabled the clustering of recurring concepts and practices into coherent patterns that captured the complexity of instructional leadership in digitally transforming school environments. By examining how Assistant Headteachers conceptualise, develop, and apply instructional competency within these contexts, the analysis revealed both commonalities across studies and variations shaped by local settings.

From this process, six emergent themes were identified as central to understanding the interplay between digital ecosystem culture and instructional competency. These themes reflect distinct but interconnected dimensions: (i) conceptualisations and dimensions of instructional competency, (ii) the role of professional development and continuous learning, (iii) institutional and technical support structures, (iv) leadership practices that drive digital transformation, (v) cultural and contextual enablers of digital adoption, and (vi) challenges, gaps, and future directions for digital instructional leadership. Together, these themes form the analytical foundation for the findings, offering both theoretical insights and practical implications for primary education leadership.

This thematic synthesis not only identified patterns across studies but also highlighted the varying levels of methodological quality and conceptual contribution among them. To illustrate this, the results of the quality appraisal are presented in Table X, which summarises the performance of each study against the six appraisal criteria. The table provides a transparent overview of how the included works scored in terms of clarity, methodological soundness, theoretical grounding, and relevance. By presenting these details, the review strengthens its credibility and allows readers to better appreciate the robustness of the evidence base prior to engaging with the thematic findings.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Table 4. Quality Appraisal of the 32 Included Studies Based on Six Evaluation Criteria (QA1–QA6)

Author	Title	QA1	QA 2	QA 3	QA 4	QA 5	QA 6	Total Mark	%
Schmitz et al. (2023)	Transformational leadership for technology integration in schools: Empowering teachers to use technology in a more demanding way	1	1	1	1	1	1	6.0	100
W. L. Sterrett & Richardson (2023)	Innovation beyond the pandemic: the powerful potential of digital principal leadership	1	1	1	1	1	0.5	5.5	91.7
Cisneros-Barahona et al. (2024)	Assessing Teacher Digital Competence. An analysis integrating descriptive, inferential, and multivariate perspectives	1	1	1	1	0.5	1	5.5	91.7
Howell et al. (2025)	Designing Performance-Based Professional Development: Stakeholder Views on Essential Competencies and Approaches	1	1	1	1	0.5	1	5.5	91.7
Al Nuaimi et al. (2023)	The importance of the school principals' role in the digital transformation of the education sector	1	1	1	1	0.5	1	5.5	91.7
Rasdiana, Wiyono, et al. (2024)	Elevating Teachers' Professional Digital Competence: Synergies of Principals' Instructional E-Supervision, Technology Leadership and Digital Culture for Educational Excellence in Digital-Savvy Era	1	1	1	1	0.5	0.5	5.0	83.3
Riski et al. (2023)	Implementation of a Digital Leadership Model in Improving the Quality of Islamic Boarding Schools	1	1	1	1	0.5	0.5	5.0	83.3

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Author	Title	QA1	QA 2	QA 3	QA 4	QA 5	QA 6	Total Mark	%
Rasdiana, Nurhadi, et al. (2024)	The effect of digital leadership in nurturing teachers' innovation skills for sustainable technology integration mediated by professional learning communities	1	1	1	1	0.5	0.5	5.0	83.3
AlAjmi (2022)	The impact of digital leadership on teachers' technology integration during the COVID-19 pandemic in Kuwait	1	1	1	1	0.5	0.5	5.0	83.3
Hassan & Berkovich (2023)	Digital instructional leadership in schools facing different levels of challenging contexts: A survey study during the COVID-19 pandemic	1	1	0.5	1	0.5	0.5	4.5	75.0
Akim et al. (2024)	Toward Digital School: The Level of Usage, Competency and Awareness for Digital Storage among School Administrators Pre to the Covid-19 Era	1	1	0.5	1	0.5	0.5	4.5	75.0
Izhak Berkovich (2023)	The great resignation: Exploring the effect of regular and digital instructional leadership on teachers' intention to leave	1	1	0.5	1	0.5	0.5	4.5	75.0
Nubun et al. (2024)	Exploring Digital Leadership Competencies among School Administrators and Digital Maturity in Sarawak, Malaysia: From Teachers' Perspectives	1	1	0.5	1	0.5	0.5	4.5	75.0
Omar & Ismail (2020)	Mobile Technology Integration in the 2020s: The Impact of Technology Leadership in the Malaysian Context	1	1	0.5	1	0.5	0.5	4.5	75.0

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Author	Title	QA1	QA 2	QA 3	QA 4	QA 5	QA 6	Total Mark	%
Berhanu et al. (2022)	Teachers' digital competencies and technology integration in education: Insights from secondary schools in Wolaita Zone, Ethiopia	1	1	0.5	1	0.5	0.5	4.5	75.0
W. Sterrett & Richardson (2022)	Innovation beyond the pandemic: the powerful potential of digital principal leadership	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Yurinova et al. (2022)	Transprofessional competences of school teachers in the digital environment: education employers' perspective	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Thyssen et al. (2023)	From TPACK to DPACK: The "Digitality-Related Pedagogical and Content Knowledge"-Model in STEM-Education	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Artacho et al. (2020)	Teacher Training in Lifelong Learning—The Importance of Digital Competence in the Encouragement of Teaching Innovation	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Karakose et al. (2021)	Examining Teachers' Perspectives on School Principals' Digital Leadership Roles and Technology Capabilities during the COVID-19 Pandemic	1	1	0.5	0.5	0.5	0.5	4.0	66.7
So-Oabeb & du Plessis (2023)	Leadership competencies for teacher professional development: perspectives of Namibian principals, heads of departments and teachers	1	1	0.5	0.5	0.5	0.5	4.0	66.7

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Author	Title	QA1	QA 2	QA 3	QA 4	QA 5	QA 6	Total Mark	%
I. Berkovich & Hassan (2024)	Principals' digital instructional leadership during the pandemic: Impact on teachers' intrinsic motivation and students' learning	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Ab (2024)	Developing Teacher Technology Leadership in Digital Transformation:Perspect ives from Professional Learning Community in One Chinese University	1	1	0.5	0.5	0.5	0.5	4.0	66.7
H. Shaked (2020)	Boundaries of Israeli Assistant Headteachers' Instructional Leadership	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Parlar et al. (2024)	Instructional leadership as a predictor of collaborative culture in schools	1	1	0.5	0.5	0.5	0.5	4.0	66.7
Leithwoo d et al. (2020)	Seven strong claims about successful school leadership revisited	1	1	0.5	0.5	0.5	0	3.5	58.3
Witthöft et al. (2024)	Leading digital innovation in schools: the role of the open innovation mindset	1	1	0.5	0.5	0.5	0	3.5	58.3
Kirinić et al. (2023)	E-Schools Project-Framework for Digital Competencies of School Principals: Competencies in the Area of Digital Technologies in Learning and Teaching	1	1	0.5	0.5	0.5	0	3.5	58.3
Karousiou (2025)	Navigating challenges in school digital transformation: insights from school leaders in the Republic of Cyprus	1	1	0.5	0.5	0.5	0	3.5	58.3
Haim Shaked et al. (2020)	How National Context Indirectly Influences Instructional Leadership Implementation: The Case of Israel	1	1	0.5	0.5	0.5	0	3.5	58.3

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Author	Title	QA1	QA 2	QA 3	QA 4	QA 5	QA 6	Total Mark	%
Tzafilkou et al. (2023)	Assessing teachers' digital competence in primary and secondary education: Applying a new instrument to integrate pedagogical and professional elements for digital education	1	1	0.5	0.5	0	0	3.0	50.0
Moreira-Choez et al. (2024)	Influence of gender and academic level on the development of digital competencies in university teachers: a multidisciplinary comparative analysis	1	1	0.5	0.5	0	0	3.0	50.0

Highest-Scoring Paper:

Schmitz et al. (2023) achieved the highest appraisal score (6.0/6, 100%) as the study demonstrated a clearly articulated research purpose, employed a robust empirical design, and was strongly anchored in transformational leadership theory. The paper provided comparative insights into how school leaders empower teachers to integrate digital technologies in cognitively demanding ways, and it explicitly acknowledged methodological limitations, thereby enhancing its academic rigour.

Lowest-Scoring Paper:

Tzafilkou et al. (2023) and Moreira-Choez et al. (2024) received the lowest appraisal scores (3.0/6, 50%), reflecting certain methodological and theoretical weaknesses. While Tzafilkou et al. (2023) made a valuable contribution by proposing a new instrument to assess teachers' digital competence, the study remained largely descriptive, with limited critical discussion of its broader theoretical implications or constraints. Similarly, Moreira-Choez et al. (2024) examined gender and academic-level differences in university teachers' digital competencies, but the analysis was primarily comparative, offering little engagement with deeper theoretical debates or limitations. As a result, both studies provide useful descriptive insights but lack the analytical depth and critical reflection found in stronger works within the review.

Result

This review identified six major themes across the selected studies, illustrating how digital ecosystem culture shapes the professional development and instructional competency of Assistant Headteachers in primary schools. The thematic synthesis highlights the dynamic interplay between leadership practices, technological adaptation, and the evolving instructional roles of middle leaders in the digital era.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Theme 1: Enhanced Digital Competence

Digital competence emerged as one of the most dominant dimensions shaping instructional competency among Assistant Headteachers, particularly in schools undergoing digital transformation. This theme directly addresses RQ1 by underscoring that digital competence is no longer confined to technical proficiency but is increasingly recognised as a strategic leadership asset that supports planning, monitoring, and the enhancement of pedagogical practices. Studies such as Hassan and Berkovich (2023), AlAjmi (2022), and Rasdiana et al. (2024) demonstrated that Assistant Headteachers with strong digital fluency were better positioned to mentor teachers, align technology with instructional objectives, and stimulate pedagogical innovation. Crucially, these competencies were not developed in isolation but were embedded within broader digital ecosystems that integrated technology into daily instructional routines.

Despite broad consensus on its importance, the level and manifestation of digital competence varied significantly across educational systems and national contexts. In countries where institutional frameworks and national policies actively supported digital transformation, Assistant Headteachers displayed more proactive leadership, employing digital strategies to strengthen instructional supervision and lesson design (Sterrett & Richardson, 2022; Karakose et al., 2021). Conversely, in schools constrained by limited infrastructure or fragmented digital strategies, leaders struggled to leverage technology meaningfully in their instructional roles. This variation illustrates that digital competence is not merely an individual trait but one cultivated through systemic alignment between leadership roles, teacher readiness, and school-level ICT policies.

Several studies, including Schmitz et al. (2023), further identified digital confidence as a mediating factor. Leaders working within robust digital ecosystems demonstrated greater initiative in implementing pedagogical change, while those in resource-poor contexts often exhibited hesitancy or passivity. This underscores that digital competence extends beyond technological literacy to encompass instructional judgement, pedagogical design, and the capacity to draw on digital insights for evidence-based decision-making.

Taken together, the synthesis across studies (n = 24) reinforces that digital competence represents a multidimensional instructional capability, encompassing technological fluency, instructional discernment, and pedagogical foresight. It also signals a shift in leadership identity from enforcing compliance to enabling innovation. Assistant Headteachers with higher levels of digital competence were more likely to reposition their instructional leadership around collaborative decision-making, evidence-informed use of digital tools, and continuous professional learning. Moreover, studies such as Artacho et al. (2020) and Moreira-Choez et al. (2024) revealed that enhanced digital competence positively correlated with instructional impact, particularly when reinforced by a coherent school-wide digital vision. The weight of evidence affirms that digital competence is not an optional enhancement but an instructional imperative for Assistant Headteachers operating in progressive digital school systems.

Theme 2: Role of Professional Learning Communities (PLCs)

Professional Learning Communities (PLCs) consistently emerged as a powerful mechanism for strengthening instructional competency among Assistant Headteachers in digitally transforming schools. Addressing RQ2, the literature highlighted that PLCs served as

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472
collaborative platforms which moved beyond conventional, top-down models of professional development. Instead, they enabled Assistant Headteachers to critically reflect on practice, exchange digital pedagogical strategies, and co-construct solutions to instructional challenges (So-Oabeb & du Plessis, 2023; Parlar et al., 2024; Rasdiana, Nurhadi, et al., 2024; Karousiou, 2025). Importantly, these communities fostered a culture of shared responsibility and collective learning, reframing digital integration not as an externally imposed requirement but as a shared professional journey.

While the effectiveness of PLCs was widely acknowledged, their impact was not uniform. In schools with strong digital cultures, PLCs functioned as innovation hubs that facilitated peer mentoring, experimentation with digital tools, and continuous pedagogical renewal. By contrast, in schools where digital integration was at an earlier stage, PLCs tended to operate reactively, focusing on short-term problem solving rather than long-term instructional reform. For example, So-Oabeb and du Plessis (2023) observed that Assistant Headteachers in digitally maturing contexts promoted open conversations and collaborative inquiry, demonstrating that PLCs are central to cultivating leadership competencies and shared responsibility for digital integration.

From a synthesis perspective, PLCs functioned as more than venues for technical upskilling. They acted as mechanisms of transformational learning and leadership redefinition. Assistant Headteachers who engaged actively in PLCs displayed enhanced capacities for strategic thinking, reflective supervision, and cross-disciplinary collaboration. More significantly, these platforms redefined leadership identity, positioning Assistant Headteachers as instructional leaders among equals and advancing a bottom-up approach to digital integration. Evidence across multiple studies confirmed that sustained participation in PLCs was associated with greater confidence in leading technology-rich instruction and stronger coherence between school-wide digital strategies and classroom practices.

Taken collectively, the findings reaffirm that PLCs are not peripheral initiatives but structural pillars of digital instructional leadership. They provide the relational, reflective, and adaptive space necessary for embedding digital culture into the everyday life of schools. By doing so, PLCs enable Assistant Headteachers to shift from passive recipients of external training to active co-constructors of professional knowledge, thereby elevating their role as transformative leaders in the digital age.

Theme 3: Differentiated and Targeted Professional Development

Differentiated and targeted professional development (PD) emerged as a pivotal mechanism for cultivating digital instructional competency among Assistant Headteachers, particularly within schools navigating digital transition. Addressing RQ2, the literature emphasised that PD tailored to the leadership demands and contextual realities of middle leaders yielded more sustainable outcomes than generic, one-size-fits-all training. Studies such as Howell et al. (2025) and Ab (2024) showed that effective PD was characterised by its close alignment with the instructional responsibilities of Assistant Headteachers, responsiveness to varying levels of teacher digital maturity, and sensitivity to the structural demands of individual schools. Crucially, these programmes moved beyond surface-level training on digital tools and instead focused on the practical enactment of digital leadership, ranging from lesson supervision and teacher mentoring to the planning of data-informed instruction. PD that incorporated reflection,

experimentation, and coaching within school contexts proved particularly effective in developing confident, digitally competent instructional leaders.

Yet, evidence also highlighted inconsistencies in implementation. In many cases, PD initiatives were overly didactic, disconnected from classroom realities, and preoccupied with technical mechanics rather than pedagogical integration (Artacho et al., 2020; Moreira-Choez et al., 2024). In several contexts, particularly in developing countries, programmes were driven by compliance or administrative requirements, often fragmented and lacking continuity. This diluted their impact and undermined the empowerment of Assistant Headteachers as strategic instructional leaders. Common barriers such as limited time, insufficient access to expert mentorship, and heavy administrative workloads further constrained the effectiveness of PD. These findings underscore that the success of PD depends not only on the quality of its content but also on its delivery model, adaptability, and capacity to foster leadership agency.

Synthesising insights across studies (n = 19), several defining characteristics of effective PD for digital instructional leadership became evident: it must be sustained, differentiated, embedded within school practice, and pedagogically anchored. Rather than treating Assistant Headteachers as passive recipients of training, successful programmes positioned them as active contributors in shaping the digital learning ecosystems of their schools. When PD was integrated with professional learning communities or peer mentoring systems, its impact was amplified through collaborative reflection and shared inquiry (So-Oabeb & du Plessis, 2023). Ultimately, the literature reinforces that differentiated and targeted PD is not a supplementary support but a structural foundation for sustainable instructional leadership in the digital age.

Theme 4: Addressing Barriers to Digital Competency

Despite the growing adoption of digital tools in schools, many studies reported that Assistant Headteachers continued to face persistent challenges in building and applying digital instructional competencies. Research by Schmitz et al. (2023), Hassan and Berkovich (2023), and Rasdiana, Wiyono, et al. (2024) highlighted barriers such as uncertainty in using technology, lack of access to contextually relevant training, heavier workloads, and cultural resistance to change. In some cases, Assistant Headteachers were hesitant to apply digital tools in supervision because they were unsure of their impact on teaching or feared making mistakes. These barriers often stemmed from insufficient exposure, the absence of digital mentorship, and rigid administrative systems that discouraged innovation. The evidence suggests that digital competence is not only a technical matter but also reflects the leadership culture, the emotional readiness of staff, and the overall organisational climate.

Several studies documented strategies that Assistant Headteachers employed to overcome these challenges. Effective leaders relied on peer mentoring, reflective engagement within professional learning communities, and role adjustments that created safer spaces for experimentation with digital tools. For instance, So Oabeb and du Plessis (2023) reported that Assistant Headteachers encouraged open dialogue about fears and anxieties related to digital tools, which in turn fostered psychological safety and mutual learning. Through the reviewed literature, success was stronger when leaders communicated a clear digital vision, provided consistent support, and allocated time for continuous professional growth. These findings reinforce the idea that instructional leadership in the digital age requires more than managing tools. It requires cultivating human conditions that enable transformation. Assistant

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Headteachers emerged as bridge builders between institutional aspirations and teachers' concerns.

The barriers to digital competence should therefore not be seen simply as individual weaknesses. They reflect systemic challenges that demand empathetic and context sensitive leadership. When Assistant Headteachers received institutional backing and professional trust, they were better able to foster inclusive digital ecosystems that valued growth rather than perfection. Strong leadership in this domain did not depend only on personal mastery of digital tools but also on the ability to develop collective confidence among staff. Several studies concluded that sustainable transformation occurs when Assistant Headteachers create non punitive environments for trial and error, lead by example, and align school goals with teacher realities. Addressing digital barriers is thus not merely about technical training but about a cultural shift in leadership, where Assistant Headteachers act as co creators of pedagogical change in the digital age.

Theme 5: Networking and Collaboration Beyond School Walls

A key theme across the reviewed literature shows how Assistant Headteachers extended their instructional leadership beyond their schools by engaging in digital networks and cross-institutional collaborations. These networks enabled leaders to access new pedagogical ideas, share best practices, and compare strategies with peers at regional and international levels (Kirinić et al., 2023; Karousiou, 2025; Witthöft et al., 2024). This reflects a significant shift from traditional site-based management to a more distributed style of leadership. The culture of digital ecosystems reinforced this shift by facilitating professional engagement through virtual conferences, online professional learning communities, and national leadership platforms. Evidence from multiple studies confirmed that Assistant Headteachers who participated actively in external networks demonstrated greater agility and foresight in leading their schools (Leithwood et al., 2020; Nubun et al., 2024).

Collaboration also extended to partnerships with universities, technology companies, local authorities, and NGOs. Studies such as Artacho et al. (2020), Parlar et al. (2024), and Moreira-Choez et al. (2024) showed how external collaborations provided access to mentorship, technology grants, and leadership fellowships that enhanced instructional capacity. These partnerships enabled schools to move beyond isolated digital adoption towards systemic transformation. In addition, research by Howell et al. (2025) and Al Nuaimi et al. (2023) indicated that collaboration with stakeholders outside the school environment was essential in aligning professional development with systemic goals and sustaining long-term digital innovation. By drawing on external support, Assistant Headteachers were able to embed digital culture more deeply within instructional practice.

Other studies emphasised the bridging function of external networks in strengthening digital leadership capacity. For example, Berhanu et al. (2022) highlighted the role of international comparisons in refining digital training models, while Yurinova et al. (2022) and Thyssen et al. (2023) illustrated how exposure to broader pedagogical and technological frameworks enabled school leaders to adapt digital competencies to diverse contexts. In addition, research by Cisneros-Barahona et al. (2024) and Tzafilkou et al. (2023) showed that international collaborations in digital competence assessment created opportunities for Assistant Headteachers to benchmark their practices and incorporate innovative evaluation methods.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472
Such evidence suggests that networking is not only about sharing knowledge but also about building confidence in applying digital competencies across varied instructional environments.

Synthesis across literature (n = 15) confirms that networking and collaboration are not optional activities but strategic imperatives for digital leadership. By engaging with broader ecosystems, Assistant Headteachers shifted from being inward-facing managers to becoming ecosystem architects who shaped change across multiple levels. Partnerships with local and international actors enriched their capacity to design professional development, respond to digital challenges, and innovate instructional strategies. Collectively, these studies affirm that collaboration beyond school walls is a critical pathway for building resilient, future-oriented instructional leadership. It enables Assistant Headteachers to access external resources, adapt global insights to local realities, and foster sustainable digital ecosystems that extend far beyond individual school boundaries.

Discussion

This systematic literature review explored how Assistant Headteachers shape instructional competency through the culture of digital ecosystems in primary schools. Six themes were identified, namely digital competence, professional learning communities, differentiated professional development, socio-technical integration, addressing barriers to digital competency, and networking and collaboration beyond school walls. Taken together, these themes provide a comprehensive and evidence-based understanding of how instructional leadership is being reshaped in the digital era. The findings show that Assistant Headteachers need to move beyond technical familiarity and embrace leadership approaches that are adaptive, strategic, and relational, while remaining anchored in pedagogical priorities and systemic change.

The review affirms the relevance of distributed and supportive leadership theories. Assistant Headteachers are not merely implementers of policies; they function as facilitators of teacher growth, promoters of instructional innovation, and enablers of collective learning. These roles are shaped by context, as illustrated by the contrast between schools with strong digital ecosystems and those constrained by limited resources. The development of digital instructional competency is therefore not linear. It is influenced by national policy frameworks, school culture, institutional support, and the professional agency of individual leaders. Assistant Headteachers who maximise internal structures such as professional learning communities and extend their leadership through cross-institutional collaborations are more likely to create sustainable, future-ready digital teaching cultures.

The implications of these findings are significant for practice, training, and policy. For school leaders, the results emphasise the need to create enabling environments that support experimentation, reflective practice, and collaborative problem solving. For policymakers, leadership development programmes should be contextually grounded, systemically aligned, and responsive to the realities of diverse school settings. Assistant Headteachers should no longer be regarded solely as administrative intermediaries but repositioned as strategic instructional leaders with the capability to drive meaningful digital transformation within schools. Equally important, the review highlights the value of cross-sector collaboration, showing that partnerships with universities, technology providers, district authorities, and NGOs provide mentorship, resources, and reflective spaces that strengthen leadership capacity.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

Beyond its practical implications, this review also contributes to theory by extending the application of distributed leadership and socio-technical systems perspectives into the context of primary education in Malaysia. It demonstrates how these frameworks can be operationalised to explain the dynamic interplay between culture, competency, and leadership practices in digital schooling. At the same time, the review identifies gaps in existing models, particularly the limited exploration of emotional and ethical dimensions of digital leadership. These insights open avenues for refining current frameworks and developing new models that are more responsive to the realities of school leaders in resource-constrained and culturally diverse settings.

In conclusion, Assistant Headteachers should be recognised as ecosystem builders at the heart of digital transformation. Their responsibility extends beyond managing tools to shaping school cultures that value resilience, adaptability, and innovation. The evidence affirms that the sustainability of digital ecosystems in schools depends less on the technology itself and more on the leadership capacity to embed it meaningfully. As such, Assistant Headteachers stand as pivotal agents of educational change in the twenty-first century, bridging the gap between institutional aspirations and classroom realities. Their role is not only to guide present transformations but also to future-proof schools against emerging challenges, ensuring that digitalisation contributes to equity, inclusion, and long-term educational excellence.

Acknowledgements: The authors would like to thank Universiti Malaysia Sabah and the Ministry of Education Malaysia for their support throughout this study. Sincere appreciation is also extended to colleagues and peers who provided constructive feedback during the preparation of this manuscript. The authors also acknowledge the guidance of the PRISMA 2020 protocol and the scholarly contributions of past researchers whose works formed the basis of this review. Gratitude is expressed to the editorial team and reviewers for their efforts in improving the quality of this article. The authors did not receive any funding for this research. The authors declare no conflict of interest.

Funding Statement: This research received no external funding.

Conflict of Interest Statement: The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have contributed to this work and approved the final version of the manuscript for submission to the International Journal of Modern Education (IJMOE).

Ethics Statement: This study obtained conditional approval to be conducted through the eRAS/IRAS system under the Ministry of Education Malaysia (MOE), Educational Planning and Research Division (EPRD) (Reference No.: KPM.600-3/2/3-eras(19710); dated 26 March 2024). The implementation of the study was also subject to approval from the State Education Department (Jabatan Pendidikan Negeri, JPN) and the respective school administrators. Participation was voluntary, informed consent was obtained prior

	to data collection, and respondents' confidentiality and anonymity were assured. The data were used solely for academic and research purposes.
Author Contribution Statement:	All authors contributed significantly to the development of this manuscript. Erna Suwardi was responsible for the conceptualization, methodology, and overall supervision of the study. Muhamad Suhaimi Taat handled data collection and analysis. Roslee Talip contributed to the interpretation of results. Mohd Sobrye contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 8 Issue 29 (March 2026) PP. 443-472

References

Ab, C. H. (2024). Developing Teacher Technology Leadership in Digital Transformation: Perspectives from Professional Learning Community in One Chinese University. *2024 13th International Conference on Educational and Information Technology (ICEIT)*, 361–366. https://doi.org/10.1109/ICEIT61397.2024.10540889

Abbas, W. F., Mahrin, M. N., & Maarop, N. (2023). Revisit the COVID-19 Pandemic as a Catalyst Towards Digital Transformation in Malaysia Higher Education Institutions. *2023 IEEE 8th International Conference on Recent Advances and Innovations in Engineering (ICRAIE)*, 1–6. https://doi.org/10.1109/ICRAIE59459.2023.10468465

Akim, U. A., Rosli, M. S., & Saleh, N. S. (2024). Toward Digital School: The Level of Usage, Competency and Awareness for Digital Storage Among School Administrators Pre to the Covid-19 Era. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *34*(1), 249–256. https://doi.org/10.37934/ARASET.34.1.249256

Al Nuaimi, H., Ahmad, S. Z., & Khalid, K. (2023). The importance of the school principals' role in the digital transformation of the education sector. *International Journal of Comparative Education and Development*, *26*(1), 17–37. https://doi.org/10.1108/IJCED-05-2023-0044

AlAjmi, M. K. (2022). The impact of digital leadership on teachers' technology integration during the COVID-19 pandemic in Kuwait. *International Journal of Educational Research*, *112*, 101928. https://doi.org/https://doi.org/10.1016/j.ijer.2022.101928

Alde, A. S. (2024). Digital Leadership and School Management Capabilities of School Administrators and Teachers Digital Teaching Performance: Basis for Professional Development Program. *International Journal for Multidisciplinary Research*. https://doi.org/10.36948/ijfmr.2024.v06i03.23615

Artacho, E. G., Martínez, T. S., Ortega Martín, J. L., Marín Marín, J. A., & García, G. G. (2020). Teacher training in lifelong learning-the importance of digital competence in the encouragement of teaching innovation. *Sustainability (Switzerland)*, *12*(7). https://doi.org/10.3390/su12072852

Berhanu, E., Labiso, T., & Thuo, M. (2022). Teachers' digital competencies and technology integration in education: Insights from secondary schools in Wolaita Zone, Ethiopia. *Social Sciences & Humanities Open*, *6*, 100355. https://doi.org/10.1016/j.ssaho.2022.100355

Berkovich, I., & Hassan, T. (2024). Principals' digital instructional leadership during the pandemic: Impact on teachers' intrinsic motivation and students' learning. *Educational Management Administration and Leadership*, *52*(4), 934–954. https://doi.org/10.1177/17411432221113411

Berkovich, Izhak. (2023). The great resignation: Exploring the effect of regular and digital instructional leadership on teachers' intention to leave. *Management in Education*, 08920206231163984. https://doi.org/10.1177/08920206231163984

Brennan, S., & Munn, Z. (2021). PRISMA 2020: a reporting guideline for the next generation of systematic reviews. *JBI Evidence Synthesis*, *19 5*, 906–908. https://doi.org/10.11124/JBIES-21-00112

Buyukgoze, H., Caliskan, O., & Gümüş, S. (2022). Linking distributed leadership with collective teacher innovativeness: The mediating roles of job satisfaction and professional collaboration. *Educational Management Administration & Leadership*. https://doi.org/10.1177/17411432221130879

Cisneros-Barahona, A. S., Marqués-Molías, L., Samaniego-Erazo, G., & Mejía-Granizo, C. (2024). Assessing Teacher Digital Competence. An analysis integrating descriptive,

inferential, and multivariate perspectives. *RIED-Revista Iberoamericana de Educacion a Distancia*, *27*(2). https://doi.org/10.5944/ried.27.2.39122

Donald, K. H., & Hashim, H. (2025). Exploring Digital Education: Experiential Insights of ESL Teachers in Rural Malaysian Schools. *International Journal of Research and Innovation in Social Science*. https://doi.org/10.47772/ijriss.2025.903sedu0067

Hamzah, N., Nasir, M., & Wahab, J. L. A. (2021). The Effects of Principals' Digital Leadership on Teachers' Digital Teaching during the Covid-19 Pandemic in Malaysia. *Journal of Education and E-Learning Research*. https://doi.org/10.20448/JOURNAL.509.2021.82.216.221

Hassan, Tahani, & Berkovich, Izhak. (2023). Digital instructional leadership in schools facing different levels of challenging contexts: A survey study during the COVID-19 pandemic. *Management in Education*, 08920206231207586. https://doi.org/10.1177/08920206231207586

Hernández-Cruz, L. M., De Jesús Llanes-Chiquini, C. M., Mex-Álvarez, D. C., & Carbache-Mora, C. (2024). Perspective of leadership in higher education: A systematic literature review. *Journal Schools of Economic Thought and Methology*. https://doi.org/10.35429/jsetm.2024.8.14.1.9.

Howell, H., Bhatia, A., O'Dwyer, E. P., Kevelson, M., Mikeska, J. N., & Cisterna, D. (2025). Designing Performance-Based Professional Development: Stakeholder Views on Essential Competencies and Approaches. In *Education Sciences* (Vol. 15, Number 2). https://doi.org/10.3390/educsci15020204

Karakose, T., Polat, H., & Papadakis, S. (2021). Exploring Teachers' Perspectives on the Role of Digital Leadership in the COVID-19 Pandemic and Tech Skills of School Leaders. *Sustainability*, *13*, 13448. https://doi.org/https://doi.org/10.3390/su132313448

Karousiou, C. (2025). Navigating challenges in school digital transformation: insights from school leaders in the Republic of Cyprus. *Educational Media International*, *62*(1), 54–76. https://doi.org/10.1080/09523987.2025.2461324

Kirinić, V., Hrustek, N. Ž., & Mekovec, R. (2023). E-Schools Project-Framework for Digital Competencies of School Principals: Competencies in the Area of Digital Technologies in Learning and Teaching. *2023 International Conference on Information Management (ICIM)*, 83–87. https://doi.org/10.1109/ICIM58774.2023.00021

Lau, J., & Han, W. (2024). Nurturing Digital Leadership Among Student Leaders in ASEAN Higher Education. *Personalia Pelajar*. https://doi.org/10.17576/personalia.2701.2024.20

Leithwood, K., Harris, A., & Hopkins, D. (2020). Seven strong claims about successful school leadership revisited. *School Leadership and Management*, *40*(1), 5–22. https://doi.org/10.1080/13632434.2019.1596077

Lu, S.-H., & Chen, C.-C. (2025). Principals' distributed leadership and the effectiveness of school innovation management: the mediating role of school organisational culture. *Journal of Educational Administration*. https://doi.org/10.1108/jea-04-2024-0109

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J. A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J. J., Devereaux, P. J., Dickersin, K., Egger, M., Ernst, E., Gøtzsche, P. C., … Tugwell, P. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*(7). https://doi.org/10.1371/journal.pmed.1000097

Moreira-Choez, J. S., Lamus de Rodríguez, T. M., Arias-Iturralde, M. C., Vega-Intriago, J. O., Mendoza-Fernández, V. M., Zambrano-Acosta, J. M., & Cardenas-Hinojosa, R. D. (2024). Influence of gender and academic level on the development of digital

competencies in university teachers: a multidisciplinary comparative analysis. *Frontiers in Education*, *9*(August), 1–10. https://doi.org/10.3389/feduc.2024.1436368

Nubun, C. C., Hassan, Z., & Hamidi, H. (2024). Exploring Digital Leadership Competencies among School Administrators and Digital Maturity in Sarawak, Malaysia: From Teachers' Perspectives. *Pakistan Journal of Life and Social Sciences (PJLSS)*, *22*(2), 2994–3009. https://doi.org/10.57239/pjlss-2024-22.2.00220

Okunlola, J. O. (2024). Unpacking the Drivers and Barriers of Digital Leadership Practice in Education: A Study of High School Leaders' Experiences. *Journal of Education and Learning Technology*. https://doi.org/10.38159/jelt.2024573

Omar, M. N., & Ismail, S. N. (2020). Mobile Technology Integration in the 2020s: The impact of technology leadership in the Malaysian context. *Universal Journal of Educational Research*, *8*(5), 1874–1884. https://doi.org/10.13189/ujer.2020.080524

Parlar, H., Turkoglu, M. E., & Cansoy, R. (2024). Instructional leadership as a predictor of collaborative culture in schools. *International Journal of Leadership in Education*, *27*(4), 715–738. https://doi.org/10.1080/13603124.2021.1913235

Parums, D. (2021). Editorial: Review Articles, Systematic Reviews, Meta-Analysis, and the Updated Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Guidelines. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, *27*. https://doi.org/10.12659/MSM.934475

Raptis, N., Psyrras, N., Koutsourai, S.-E., & Konstantinidi, P. (2024). Examining the Role of School Leadership in the Digital Advancement of Educational Organizations. *European Journal of Education and Pedagogy*. https://doi.org/10.24018/ejedu.2024.5.2.817

Rasdiana, Nurhadi, T., Muh. Ilham Akbar, B., Salim, F. A., Novitasari, A. T., Cholidah, R. N., Susanto, K., Ma'rifatin, S., Rawe, N. S. H. A., Paranoan, C. A. C., Sartika, R. P., Kadju, M. D. P., & Habibah, L. B. (2024). The effect of digital leadership in nurturing teachers' innovation skills for sustainable technology integration mediated by professional learning communities. *Journal of Infrastructure, Policy and Development*, *8*(10). https://doi.org/10.24294/jipd.v8i10.8480

Rasdiana, Wiyono, B. B., Imron, A., Rahma, L., Arifah, N., Azhari, R., Elfira, Sibula, I., & Maharmawan, Muh. A. (2024). Elevating Teachers' Professional Digital Competence: Synergies of Principals' Instructional E-Supervision, Technology Leadership and Digital Culture for Educational Excellence in Digital-Savvy Era. In *Education Sciences* (Vol. 14, Number 3). https://doi.org/10.3390/educsci14030266

Riski, A., Tambunan, R., Anggraeni, N., & Alam, F. (2023). Implementation of the Spiritual Leadership Model in Improving the Quality of Education in Islamic Boarding Schools. *JOELS: Journal of Election and Leadership*, *4*(2), 159–167. https://doi.org/10.31849/joels.v4i2.16287

Schmitz, M.-L., Antonietti, C., Consoli, T., Cattaneo, A., Gonon, P., & Petko, D. (2023). Transformational leadership for technology integration in schools: Empowering teachers to use technology in a more demanding way. *Computers & Education*, *204*, 104880. https://doi.org/https://doi.org/10.1016/j.compedu.2023.104880

Shaked, H. (2020). Boundaries of Israeli Assistant Principals' Instructional Leadership. *Leadership and Policy in Schools*, *19*(3), 497–511. https://doi.org/10.1080/15700763.2019.1585552

Shaked, Haim, Benoliel, Pascale, & Hallinger, Philip. (2020). How National Context Indirectly Influences Instructional Leadership Implementation: The Case of Israel. *Educational Administration Quarterly*, *57*(3), 437–469. https://doi.org/10.1177/0013161X20944217

So-Oabeb, J., & du Plessis, A. (2023). Leadership competencies for teacher professional development: perspectives of Namibian principals, heads of departments and teachers. *Perspectives in Education*, *41*(2), 16–32. https://doi.org/10.38140/pie.v41i2.7097

Sterrett, W. L., & Richardson, J. W. (2023). Innovation beyond the pandemic: the powerful potential of digital principal leadership. *Development and Learning in Organizations: An International Journal*, *37*(2), 14–17. https://doi.org/10.1108/DLO-03-2022-0059

Sterrett, W., & Richardson, J. (2022). Innovation beyond the pandemic: the powerful potential of digital principal leadership. *Development and Learning in Organizations: An International Journal*, *37*. https://doi.org/10.1108/DLO-03-2022-0059

Thyssen, C., Huwer, J., Irion, T., & Schaal, S. (2023). From TPACK to DPACK: The "Digitality-Related Pedagogical and Content Knowledge"-Model in STEM-Education. *Education Sciences*, *13*(8). https://doi.org/10.3390/educsci13080769

Tzafilkou, K., Perifanou, M., & Economides, A. A. (2023). Assessing teachers' digital competence in primary and secondary education: Applying a new instrument to integrate pedagogical and professional elements for digital education. *Education and Information Technologies*, *28*(12), 16017–16040. https://doi.org/10.1007/s10639-023-11848-9

Witthöft, J., Aydin, B., & Pietsch, M. (2024). Leading digital innovation in schools: the role of the open innovation mindset. *Journal of Research on Technology in Education*, *0*(0), 1–20. https://doi.org/10.1080/15391523.2024.2398528

Wollscheid, S., Tømte, C., Egeberg, G., Karlstrøm, H., & Fossum, L. W. (2024). Research trends on digital school leadership over time: Science mapping and content analysis. *Educ. Inf. Technol.*, *30*, 747–778. https://doi.org/10.1007/s10639-024-12909-3

Yakob, W. R. W., & Don, Y. (2025). Influence of digital leadership on Malaysian public university branding: professionals' identity as mediator. *International Journal of Evaluation and Research in Education (IJERE)*. https://doi.org/10.11591/ijere.v14i1.28286

Yap, P., Moses, P., Cheah, P. K., Khambari, M. N. Md., Wong, S. L., & Yu, F.-Y. (2024). Digital Divide: Facilitating Conditions and Usage of Google Classroom for Teachers in Rural and Urban Secondary Schools in Malaysia. *Journal of ICT in Education*. https://doi.org/10.37134/jictie.vol11.2.6.2024

Yurinova, E. A., Byrdina, O. G., & Dolzhenko, S. G. (2022). Trans professional competences of school teachers in the digital environment: education employers' perspective. *Education and Information Technologies*, *27*(2), 1841–1863. https://doi.org/10.1007/s10639-021-10687-w

Zakaria, I., Nor, M., Alias, B. S., & Hamid, A. (2021). The Influence of Principals' Strategic Leadership on Students' Outcome. *The International Journal of Academic Research in Business and Social Sciences*, *11*, 407–417. https://doi.org/10.6007/IJARBSS/V11-I2/8844