KOLOKIUM
Jurnal Pendidikan Luar Sekolah
http://kolokium.ppj.unp.ac.id/
Jurusan Pendidikan Luar Sekolah
Fakultas Ilmu Pendidikan
Universitas Negeri Padang
Sumatera Barat, Indonesia

Volume 14, Nomor 1, 2026
DOI: 10.24036/kolokium.v14i1.1269

Received 19 February 2026
Approved 23 April 2026
Published 28 April 2026

Bridging Generational Gaps in Teachers' Digital Literacy: A Systematic Review on Educational Leadership and Performance

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ABSTRACT

The rapid digital transformation in education has exposed a clear generational gap among teachers in mastering digital literacy. Younger teachers tend to navigate technology with greater ease, while senior teachers often encounter barriers that affect their confidence and classroom performance. This study aims to explore how educational leadership can help bridge this generational divide and enhance teachers' digital competence. Adopting a systematic literature review guided by the PRISMA framework, the analysis covered studies published between 2020 and 2025 from major databases, including Scopus, Web of Science, and ERIC. The findings show that leadership practices emphasizing empathy, collaboration, and continuous learning are most effective in reducing generational gaps and fostering inclusive digital competence. However, existing frameworks rarely integrate generational diversity, leadership behavior, and performance management within one conceptual model. This study introduces the concept of Adaptive Intergenerational Leadership (AIL), a synthesis that combines transformational and adaptive leadership principles to foster bidirectional learning between digital native and digital immigrant teachers. The results contribute to educational leadership theory and offer practical implications for developing inclusive, innovative, and human centered school ecosystems in the digital era.

Keywords: Digital Literacy, Generational Gap, Educational Leadership, Teacher Performance, Systematic Review

INTRODUCTION

In Indonesia, the digital transformation of education has accelerated rapidly since the COVID-19 pandemic (Picauly, 2024). The period of remote learning became a pivotal moment for teachers to adapt to digital technologies, although their levels of readiness and capacity remained uneven (Lisna Syahfitri et al., 2025; Saumantri, 2022). National initiatives such as *Merdeka Belajar*, *Guru Penggerak*, and the *Merdeka Mengajar* Platform reflect the government's efforts to strengthen teachers' digital competence. However, a noticeable generational gap persists in practice (Sinambela et al., 2024). Younger teachers, who have grown up as digital

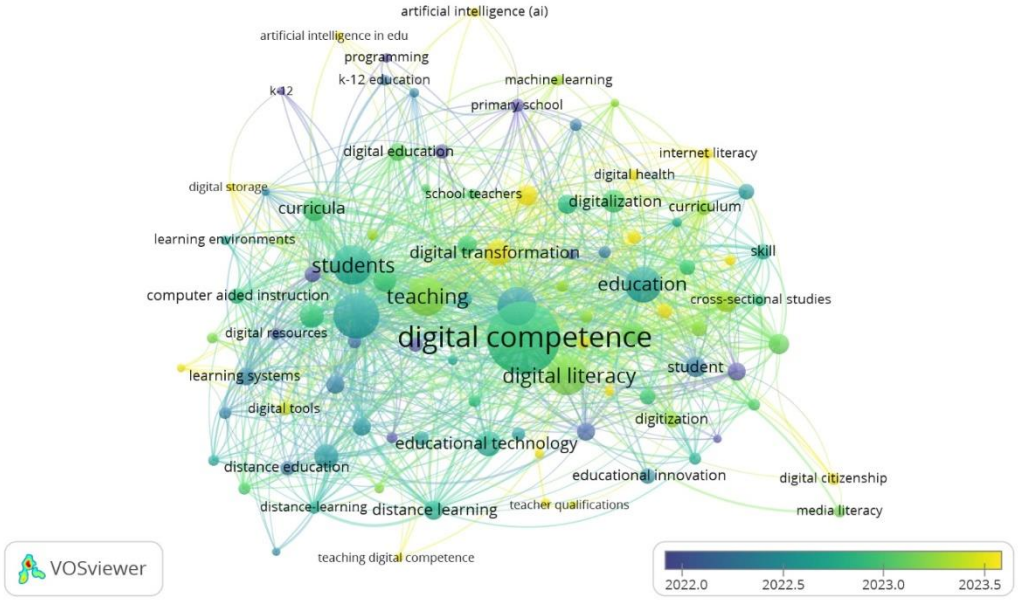
natives, tend to be more adaptive and explorative in using technology, while senior teachers often regarded as digital immigrants face more complex challenges (Annisa, 2019).

These challenges manifest not only as resistance to new technologies but also as cognitive gaps in understanding how the digital ecosystem operates, digital fatigue resulting from rapid adaptation demands, and cultural unease caused by the shifting pedagogical values they have long upheld (Camarini et al., 2024; Luo et al., 2023). Many senior teachers continue to perceive the use of technology as an additional task rather than an integral part of pedagogical practice (Alptekin & Taneri, 2025; Prestridge, 2017). Consequently, intergenerational collaboration is often hindered by differences in work rhythm, technological language, and preferences toward digital innovation (Irfan & Makruf, 2021).

This generational gap carries serious implications for leadership and performance management within schools. Principals are now required to lead teams composed of individuals with diverse generational backgrounds and varying levels of digital proficiency, while maintaining a balance between teachers' productivity and emotional well-being (Elmanisar et al., 2024). In this context, leadership serves as a crucial bridge—not only to provide direction but also to mediate and integrate generational differences so that the school's digital ecosystem remains both harmonious and productive.

To gain a clearer understanding of the trajectory of this research, a bibliometric analysis using *VOSviewer* was conducted on publications related to teacher digital literacy between 2020 and 2025. The visualization (Figure 1) reveals that terms such as *digital competence*, *digital literacy*, *digital transformation*, and *teaching* dominate the global research connectivity map. Other key nodes include *educational technology*, *digital education*, and *digital citizenship*. However, the link between digital literacy, leadership, and performance management remains underexplored, highlighting a research gap concerning the role of leadership in bridging generational divides within the digital era.

Figure 1 VOSviewer visualization of keyword co-occurrence in studies on teacher digital literacy



Therefore, this study seeks to systematically review international literature published between 2020 and 2025 concerning generational gaps in teachers' digital literacy and their implications for leadership and performance management in schools. The objectives of this study are to: (1) identify current trends and directions in research on intergenerational digital literacy; (2) map effective leadership models that bridge generational differences in digital competence; and (3) formulate conceptual recommendations to enhance teacher performance within the context of digital schooling.

The expected findings are not only intended to enrich theoretical discourse on digital literacy and educational leadership but also to provide a conceptual foundation for developing leadership models that are adaptive, collaborative, and sensitive to generational dynamics within schools. In this way, the digital transformation of education can progress in a more human-centered, equitable, and sustainable manner.

METHOD

This study employed a systematic literature review (SLR) approach to comprehensively examine international studies addressing digital teacher literacy, generational gaps, and leadership strategies for professional development in the digital era. The SLR approach was chosen because it enables researchers to identify, evaluate, and synthesize previous research findings in a structured and transparent manner, ensuring both rigor and contextual relevance (Simamora et al., 2024). The review procedure followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which consist of four main stages: identification, screening, eligibility, and inclusion (Matosas-lópez et al., 2024).

Literature research was conducted across major international databases, such as Scopus, ScienceDirect, and ERIC to ensure comprehensive coverage of peer-reviewed and high-quality publications. The search used a combination of keywords related to teacher digital literacy, generational gap, intergenerational collaboration, educational leadership, and professional development. The publication period was limited to 2020–2025 to capture the most recent developments and post-pandemic transformations in education.

The detailed search strategy and the number of results obtained from each database are presented in Table 1.

Table 1 Search Strategy and Initial Results

Database	Search String	Result
Scopus	("teacher digital literacy" OR "digital competence") AND ("generational gap" OR "intergenerational collaboration") AND ("educational leadership" OR "professional development")	145
Web of Science	("teacher" AND "digital literacy") AND ("generation" OR "age differences") AND ("leadership" OR "school performance")	98
Google Scholar	("teacher digital skills" OR "digital literacy") AND ("cross-generational" OR "multigenerational") AND ("leadership" OR "teacher performance")	76

To ensure the relevance and quality of the reviewed literature, clear inclusion and exclusion criteria were established before the screening process. Articles were included if they were peer-reviewed journal papers written in English, published between 2020 and 2025, and explicitly addressed the themes of teacher digital literacy, generational differences, leadership, or professional development within the context of primary and secondary education.

Conversely, studies were excluded if they did not directly relate to generational issues or teacher digital competence, lacked conceptual or empirical grounding, or appeared in non-journal formats such as conference papers, theses, or book chapters. Publications outside the specified time frame or those not available in full text were also removed from the dataset. A summary of the inclusion and exclusion criteria applied in this review is presented in Table 2.

Table 2 Inclusion and Exclusion Criteria

Criteria types	Inclusion	Exclusion
Publication year	Articles published between 2020–2025	Articles published before 2020
Language	English	Non-English
Document type	Peer-reviewed journal articles	Conference papers, book chapters, or unpublished theses

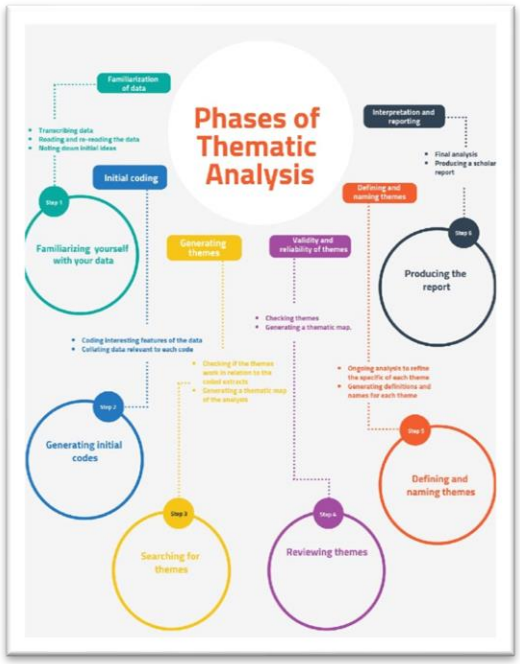
Focus area	Studies addressing teacher digital literacy, generational gap, leadership, or performance	Studies unrelated to digital literacy or generational dynamics

All eligible articles were re-evaluated for thematic relevance, methodological rigor, and their contribution to bridging generational gaps in teachers' digital competence. The quality assessment considered the clarity of research objectives, methodological soundness, and alignment between findings and stated research focus.

After the selection process, data extraction was conducted systematically to maintain accuracy and transparency. Each article was coded using a structured matrix covering bibliographic details (author, year, country, publication outlet), research design, educational context, generational focus, digital literacy dimension, leadership model, and key findings. This enabled identification of cross-study patterns and comparison of methodological approaches.

To synthesize the data, thematic analysis was conducted following Braun and Clarke's (2006) six-phase framework: (1) familiarization with data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. Through this iterative process, key themes concerning generational diversity, leadership practices, digital competence, and teacher performance were identified and interpreted in line with the research objectives.

Figure 2 Data Analysis Process based on Braun and Clarke's (2006) Thematic Analysis Framework.



(Source: Sendze, M., 2019)

Complementing the qualitative synthesis, a bibliometric analysis using VOSviewer visualized keyword co-occurrence networks and co-authorship patterns. This dual approach,

combining thematic and bibliometric analyses, provided a comprehensive view of scholarly developments on teacher digital literacy and educational leadership during 2020–2025, thereby enhancing the robustness and interpretive depth of the findings.

DISCUSSION

This section presents the findings of the systematic literature review derived from fifteen selected research articles. The analysis was conducted to identify key patterns, themes, and emerging trends in studies addressing generational gaps in teachers' digital literacy, as well as their implications for leadership and performance management in schools. The data synthesis process involved a thematic grouping of each study based on its research focus, methodology, and key findings relevant to the issues of educational leadership and digital transformation.

Table 3 presents a summary of the fifteen studies included in this review, outlining their methodological approaches, major findings, and identified research gaps.

Table 3 Systematic Reviewed of Selected Research Articles

Title	Author/Year	Method	Findings	Gaps
A systematic review on digital literacy	Tinmaz, Hasan, et all. (2022).	Systematic literature review	Identifies the definitions, dimensions, and indicators of digital literacy across various educational contexts.	Does not address generational gaps or educational leadership.
The Impact of The First Millennial Teachers on Education: Views Held by Different Generations of Teachers	Galvan, et all. (2023).	Mixed method	Younger teachers bring digital innovation and high flexibility; older teachers are more experience-oriented and resistant to change.	Has not linked these dynamics with leadership strategies or institutional performance.
Enhancing Digital Literacy Skills among Teachers for Educational Transformation	Temirkhanova, et all. (2024).	Quantitative	Improving teachers' digital literacy contributes to learning innovation and school effectiveness.	Does not explore generational differences or challenges of cross-age collaboration.
A Systematic Review of Digital Competence Evaluation in Education	López-Nuñez et al. (2024).	Systematic literature review	Maps digital competency measurement instruments for teachers in various countries.	Does not consider generational or leadership contexts.
Teacher E-Leadership in the Digital Age: A Systematic Review of Research and Practice	Xueying, et all. (2025).	Systematic literature review	E-leadership enhances teachers' digital adaptation	Does not explicitly connect e-leadership with

			and collaborative culture.	generational diversity.
Migrant Teachers' Self-Estimated Digital Competence	Kack, et all. (2019).	Quantitative descriptive	Teachers from diverse backgrounds have varying levels of digital confidence.	Lacks focus on generational or performance implications.
Digital Natives, Digital Immigrants, and Digital Learners: An International Empirical Integrative Review	Creighton. (2019).	Systematic literature review	Confirms real differences between digital natives and immigrants in adopting technology.	Does not focus on teaching or leadership contexts.
Digital Immigrants Meets Digital Natives: Bridging the Gap through Digital Pedagogy	Tiomes. (2024).	Qualitative	Limited technical knowledge and lack of training hinder senior teachers' digital pedagogy.	Lacks discussion of leadership or performance management systems.
Systematic review on digital transformation among teachers in public schools	Razak, et all. (2023).	Systematic literature review	Describes patterns of digital transformation among teachers.	This study does not examine the dimensions of the generation gap specifically.
Digital Literacy Among Elementary School Teachers: Age and Year of Service Perspective Review	Fazis, Safrizal & Yulia. (2024)	Quantitative descriptive	Younger teachers show higher digital literacy than older teachers.	Does not address leadership or performance responses.
Examining Digital Competence among Filipino Public School Teachers: Generational Gaps, InstitutionalSupport and ICT Perceptions	Wong, et all. (2025).	Quantitative descriptive	Shows positive relation between teachers' ICT attitudes and competence; stresses importance of supportive school culture.	Does not connect leadership models to management strategies.
The Generational Digital Gap within Dual Vocational Education and Training Teachers	Prieto, et all. (2020).	Quantitative	Finds need for continuous digital training; older teachers need more support.	Fails to explore leadership mediation or performance outcomes.
Empowering Educators: The Impact of Reverse Mentoring on Developing Scientific Mindset and Research Skills	Julia, et all. (2024).	Qualitative analysis	Reverse mentoring enhances both senior and novice teachers' digital and research skills.	Does not address how leadership facilitates mentoring schemes.
Leading digital innovation in schools: the role of the open innovation mindset	Jasmin, et all. (2024).	Qualitative survey	Schools led by open, innovation-oriented leaders achieve better	Does not examine generational moderation effects.

			digital transformation.	
Digital leadership in education: A bibliometric analysis	Okunlola, et all. (2025).	Bibliometric analysis	Highlights surge in research on e-leadership, innovation, and teacher competence.	Recommends testing leadership effects on generational gaps.

From the synthesis of the fifteen studies, three major themes emerged: (1) the sociocultural roots of generational gaps in digital literacy, (2) the mediating role of leadership in fostering digital inclusion, and (3) the emergence of adaptive intergenerational collaboration frameworks. The analysis of fifteen international studies reveals consistent patterns in how digital transformation intersects with generational diversity and leadership in schools. Research on teachers' digital literacy between 2020 and 2025 is dominated by discussions on the measurement of digital competence, the influence of age and teaching experience, and the evolving role of school leadership in fostering technological adaptation.

Most studies emphasize that digital literacy is not evenly distributed across generations; younger teachers, identified as digital natives, tend to exhibit higher digital fluency and innovation capacity compared to senior teachers who often face challenges in technological confidence and pedagogical integration. These differences, as explained by Mannheim's Generational Cohort Theory (1952) (Gamaliel, 2023), are not simply age-based but sociocultural, rooted in distinct formative experiences with technology. Thus, the generational gap is a social construct shaped by differing educational and technological exposures rather than immutable cognitive differences.

Several studies underscore the importance of leadership in mediating these disparities. Leadership models that emphasize empathy, collaboration, and continuous learning particularly e-leadership and adaptive leadership, are consistently associated with successful digital transformation across age groups [26]. For instance, (Xueying et al., 2025) and (Xueying et al., 2025) demonstrate that leaders who promote open communication and knowledge-sharing environments foster stronger digital engagement among teachers. Applying Ferrari's Digital Competence Framework (2013), these leadership approaches strengthen teachers' capacities in information management, communication, and content creation. Professional development and institutional support, rather than age alone, emerge as decisive factors influencing digital readiness. In this sense, leadership serves as the social infrastructure enabling equitable learning and cross-generational collaboration. This aligns with the argument that generational gaps stem from unequal learning opportunities rather than inherent generational limitations.

Beyond technical training, digital transformation in schools increasingly depends on relational and cultural adaptability. Studies on reverse mentoring demonstrate that bidirectional learning, where younger teachers share technological skills and senior teachers provide pedagogical wisdom can significantly enhance mutual growth. However, existing frameworks such as e-leadership and reverse mentoring, while effective in specific contexts, do not fully capture the cultural negotiation required to harmonize generational perspectives in schools.

The synthesis underscores that generational differences in teachers' digital literacy are not merely technical but deeply sociocultural. Younger teachers, born and raised within digital ecosystems, tend to approach technology as a natural medium of learning and communication. In contrast, senior teachers who entered the profession before the digital era often perceive technology as disruptive to established pedagogical values. This divergence creates a subtle cultural tension in schools, where technology adoption intersects with professional identity and pedagogical beliefs.

The findings of (Marrero Galván et al., 2023) and (Sanchez-Prieto et al., 2020) confirm that age and length of service are key determinants of digital readiness. Yet, (Fazis et al., 2024) highlight that access to professional development and institutional support play an equally decisive role. Hence, generational gaps should not be viewed as immutable differences but as products of unequal opportunities for digital learning. Leadership, in this regard, becomes the social infrastructure that ensures equitable access and shared learning among teachers of different age groups.

Recent studies by (Xueying et al., 2025) and (Tran et al., 2020) introduce the concept of e-leadership and adaptive leadership as frameworks capable of managing these intergenerational dynamics. Both approaches emphasize flexibility, emotional intelligence, and dialogic communication—qualities that enable leaders to foster digital inclusion and psychological safety during transformation. Similarly, the reverse mentoring initiative discussed by (Raberger et al., 2024) demonstrates that structured intergenerational collaboration can yield mutual growth: senior teachers gain digital confidence while younger teachers develop pedagogical maturity.

The synthesis indicates that leadership plays a transformative role in bridging intergenerational digital divides. Drawing from Bass and Avolio's Transformational Leadership Theory (1994), leaders who display inspirational motivation, intellectual stimulation, and individualized consideration can foster psychological safety and innovation among both younger and older teachers. These strategies enable schools to build collaborative cultures that support digital competence and intergenerational learning.

The synthesis further reveals that generational differences in teachers' digital literacy are deeply sociocultural rather than purely technical. Younger teachers tend to view technology as integral to teaching identity, while senior teachers often perceive it as a disruption to established pedagogical traditions [16]. This cultural tension reflects differences in epistemic beliefs between innovation-oriented digital natives and experience-oriented digital immigrants.

Applying Mannheim's framework, these tensions stem from divergent formative environments rather than competence deficits. Consequently, leadership strategies that acknowledge cultural identity and professional values are more effective in fostering digital inclusion than uniform training programs. Leaders must therefore act as cultural translators aligning differing value systems through communication and empathy.

However, as (OKunlola & Naicker, 2025) suggest, there is still no comprehensive model that fully explains how leadership mediates generational gaps in digital literacy while sustaining organizational performance. Most frameworks remain descriptive, lacking integration between leadership style, generational interaction, and school innovation outcomes. This theoretical gap opens the opportunity to conceptualize an Adaptive Intergenerational Leadership (AIL) model, an emergent synthesis grounded in flexibility, inclusivity, and shared vision. The AIL model envisions school leadership as a dynamic process

where leaders orchestrate bidirectional learning: younger teachers contribute technological insights, while senior teachers transmit pedagogical wisdom and institutional memory.

Figure 3 Adaptive Intergenerational Leadership (AIL) Framework

(Source: Authors)

CONCLUSION

This systematic literature review demonstrates that bridging the generational gap in teachers' digital literacy remains a critical and multidimensional challenge in 21st-century education. Synthesizing evidence from fifteen international studies, the review reveals that younger teachers, often characterized as digital natives, exhibit higher levels of digital fluency and innovative pedagogical practices. In contrast, senior teachers, typically digital immigrants, tend to face barriers in technical adaptation, digital confidence, and pedagogical transformation.

Leadership consistently emerges as the most decisive factor in mitigating this divide. Effective school leaders act as mediators who foster intergenerational collaboration through empathy-based communication, differentiated professional learning, and mentoring initiatives. Leadership approaches such as e-leadership and shared leadership are particularly significant in advancing digital inclusivity and sustaining innovation across generational groups.

Furthermore, this review underscores that digital transformation in education should be viewed not merely as a technological shift but as a social, cultural, and human-centered process. The success of digital schooling depends largely on how leaders cultivate a culture of trust, mutual respect, and collective learning among teachers of diverse generations.

Future research is encouraged to develop empirically tested models that integrate leadership dimensions, generational diversity, and digital competence frameworks. Such integration could provide actionable insights for policymakers and educational institutions in designing leadership development programs that promote sustainable, inclusive, and human-centered digital transformation within schools.

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