

Higher Education Digital Leadership in Transition from Technical Adoption to Cultural Transformation

Makna Ani Marlia^{a,*}, Rahmat Hidayat^b, & Zalik Nuryana^c

^aDepartment of Business Administration, Politeknik Negeri Padang, Padang, Indonesia

^bDepartment of Information Technology, Politeknik Negeri Padang, Padang, Indonesia

^cDepartment of Islamic Education, Universitas Ahmad Dahlan, Indonesia

Abstract

This study aims to systematically map the intellectual landscape of digital leadership in higher education through a comprehensive bibliometric analysis. As higher education institutions undergo accelerated digital transformation, understanding of how digital leadership has evolved, which themes dominate scholarly discourse, and where research gaps lie becomes crucial for both academic and institutional development. Using the Scopus database, 158 relevant documents from 2016 to mid-2025 were analyzed through Biblioshiny, VOS viewer, and Biblioplot to identify research trends, influential authors and institutions, and emerging thematic clusters. The results indicate that digital leadership is an increasingly relevant yet fragmented field, with dominant themes such as digital transformation, e-leadership, digital literacy, and emotional intelligence. Influential contributions have come from scholars and institutions in Europe and Southeast Asia, with the University of Patras and the University of Malaya emerging as key knowledge hubs. Thematic evolution analysis reveals a gradual shift from technology-focused leadership to more human-centered frameworks that prioritize organizational culture, emotional intelligence, and sustainability. Co-occurrence and overlay visualizations further highlight promising but underexplored areas such as principal digital leadership, digital citizenship, and regional perspectives, particularly in Africa and Asia. This study recommends that future research expands its focus to include interdisciplinary approaches and more diverse cultural contexts.

Keywords: Digital leadership; higher education; educational transformation; emerging research trends: e-leadership

Received: 20 May 2026

Revised: 11 July 2026

Published: 31 August 2026

1. Introduction

In recent years, the higher education landscape has been heavily impacted by digital transformation. The widespread adoption of digital technologies has transformed traditional educational models, demanding significant changes in the way institutions operate and deliver value (Nuryana, Xu, Lu, Li, et al., 2023; Zulherman et al., 2021). This rapid change has created a critical problem: higher education leaders often struggle to strategically leverage digital tools to achieve educational excellence and organizational resilience. Many institutions struggle to effectively integrate technology, overcome barriers to change, and ensure that staff and faculty possess adequate digital competencies (Ghamrawi & M. Tamim, 2023; Shen et al., 2025).

Existing solutions to this problem typically focus on developing digital literacy among leaders, implementing technology-enhanced learning systems, and adopting frameworks for strategic digital transformation. This approach has helped some universities improve administrative efficiency, increase student engagement, and support flexible learning environments (Anwar & Saraih, 2024a; Pu et al., 2025). However, these solutions often fail because they emphasize technical implementation rather than the broader cultural and leadership transformation needed to sustain innovation. Leaders may become technologically competent but still lack the strategic vision and change management capabilities necessary to build an inclusive and adaptive digital culture (Kiula et al., 2018; Quezada-Sarmiento et al., 2018).

* Corresponding author.

E-mail address: makna@pnp.ac.id

The most promising digital leadership models are those that combine technical expertise with transformational leadership skills (Temelkova, 2018). These models encourage collaboration, knowledge sharing, and innovation while aligning digital strategies with institutional missions (Anwar & Saraih, 2024a; Zabalawi et al., 2024). However, its main limitation lies in its limited empirical validation in various higher education contexts, making it challenging to generalize best practices. Furthermore, existing research often lacks a systematic picture of the intellectual landscape, including the research themes, influential authors, and emerging directions in the field.

Given these gaps, this study aims to advance the understanding of digital leadership in higher education through comprehensive bibliometric analysis. By systematically mapping the research landscape, the research can answer critical questions about the status of knowledge, identify influential works, and highlight unexplored areas that deserve further investigation. Given these gaps, this study aims to advance the understanding of digital leadership in higher education through comprehensive bibliometric analysis. By systematically mapping the research landscape, the study identifies the current state of knowledge, influential contributions, thematic developments, and underexplored areas that warrant further investigation. Rather than proposing a new leadership framework, this study provides an evidence-based overview of the intellectual structure and evolution of digital leadership research, offering insights that can inform future empirical studies and support the continued development of digital leadership scholarship in higher education (Ahlquist, 2014; Ganga-Contreras et al., 2024; Karakose et al., 2024).

Although several bibliometric studies have examined digital leadership in educational contexts, most have focused on school leadership, educational technology, or digital transformation in education more broadly. Existing reviews have generally emphasized publication performance, collaboration patterns, or conceptual overviews, with limited attention to the evolving intellectual structure of digital leadership specifically within higher education. Moreover, previous studies have rarely integrated thematic evolution, Enhanced Strategic Diagram, and overlay visualization to identify thematic maturity, emerging research directions, and conceptual transitions within this domain. Therefore, this study extends previous work by providing a comprehensive mapping of the intellectual landscape of digital leadership in higher education through the integration of performance analysis and science mapping techniques, offering a more nuanced understanding of thematic development and future research opportunities.

Thus, this study aims to explore the bibliometric landscape of digital leadership in higher education, which aims to provide a comprehensive overview of the field; therefore, the research questions in this study are:

- RQ1: What are the main research themes explored in the literature on digital leadership in higher education?
- RQ2: Who are the most influential authors, institutions, and journals contributing to this field?
- RQ3: How has the publication trend on digital leadership in higher education evolved?
- RQ4: What are the emerging trends and underexplored topics within this domain?

2. Research Method and Materials

2.1. The Design of the Study

This study employs a bibliometric analysis design to systematically map the intellectual landscape of digital leadership in higher education. Bibliometric analysis offers a quantitative method to examine publication patterns, authorship structures, collaboration networks, and thematic developments within a research domain (Donthu et al., 2021). The rationale for selecting a bibliometric approach stems from the fragmented yet growing nature of research on digital leadership in higher education. As institutions face increasing demands for digital transformation, scholarly output in this area has expanded, yet remains highly dispersed across diverse disciplines such as educational technology, organizational leadership, and higher education policy (Díaz-Noguera et al., 2022).

The study utilized the Scopus database, which is recognized for its extensive coverage of peer-reviewed literature and robust citation indexing (Maisonobe et al., 2016). Scopus was chosen because of its compatibility with bibliometric software and its wide acceptance in academic research evaluations. The search strategy targeted publications with the following query: TITLE-ABS-KEY ("digital leadership" OR "e-leadership" OR "technology leadership") AND TITLE-ABS-KEY ("higher education" OR "university" OR "college"). Inclusion criteria focused on documents that explicitly discussed digital leadership within the higher education context, while studies outside of this educational level or not addressing leadership constructs were excluded. This strategy aligns with best practices in bibliometric study designs that aim for high recall while maintaining relevance (van Eck & Waltman, 2014).

2.2. Data Analysis

This study uses the VOSViewer (van Eck & Waltman, 2010) and Biblioshiny (Aria & Cuccurullo, 2017), software application for network visualization and amplified using Enhanced Strategic Diagrams (Shafin et al., 2022; Wijaya & Hermawan, 2025) as an analysis tool. The ESD was employed to extend the interpretation of the conventional keyword co-occurrence network generated by VOSviewer. While standard co-occurrence analysis visualizes relationships among keywords, ESD classifies these keywords into eight thematic quadrants according to their relative centrality and density. This approach enables a more comprehensive identification of motor themes, emerging themes, basic themes, and declining or isolated themes, thereby facilitating a clearer interpretation of thematic maturity and future research opportunities. To ensure data quality and replicability, the search was performed on 30/06/2025, and all records were exported in .CSV format for further cleaning and standardization. Therefore, the term "mid-2025" refers to all publications that had already been indexed in the Scopus database up to the retrieval date (30 June 2025), rather than future or predicted publications. Duplicate entries were removed, and missing metadata were cross-checked where possible. This rigorous data-preparation process follows recommendations for transparency in bibliometric analyses (Nuryana, Xu, Lu, Tasir, et al., 2023; Zupic & Čater, 2015). The initial descriptive analysis included calculating publication counts by year, document type, and country of origin to understand the temporal and geographical distribution of research efforts (Rørstad & Aksnes, 2015). This step provides an overview of how interest in digital leadership has evolved and highlights regions or countries with significant contributions.

Network visualization and clustering analyses were performed using VOSviewer version 1.6.20. The analysis employed the co-occurrence of author keywords, co-authorship, and citation networks. Following the default recommendation of VOSviewer, the minimum occurrence threshold was set to five, meaning that only keywords or authors appearing at least five times were included in the network analysis. Full counting was applied to ensure that each occurrence contributed equally to the network construction. The visualization and clustering process used the association strength normalization method and the smart local moving (SLM) algorithm, which automatically detects clusters by maximizing modularity within the bibliometric network (van Eck & Waltman, 2010).

Furthermore, the results were synthesized and interpreted using science mapping techniques, including co-occurrence analysis, co-authorship analysis, thematic mapping, thematic evolution, citation analysis, and collaboration network visualization. These complementary analyses enabled the identification of intellectual structures, emerging research themes, influential contributors, and future research directions within the digital leadership literature. Visualization tools such as VOSViewer, Biblioshiny, and Biblioplot were used to create network maps and thematic evolution diagrams that facilitate deeper insights into the research landscape (Chiou et al., 2012). This comprehensive data analysis framework ensures a robust, replicable, and insightful exploration of digital leadership in higher education, providing valuable guidance for academics, policymakers, and practitioners (D. Chen et al., 2016). This study included a total of 158 documents identified through bibliometric search, comprising 105 journal articles, 30 conference papers, 12 book chapters, seven review papers, three books, and one note.

3. Results and Discussion

3.1. Key Research Themes in Digital Leadership for Higher Education

The exploration of digital leadership in higher education has gained momentum in response to the sweeping impact of digital transformation on academic institutions worldwide. As universities adopt increasingly complex digital infrastructures to support teaching, learning, and administrative processes, scholars have sought to conceptualize and define what digital leadership entails within this context (Ehlers, 2020; Msila, 2022; Sapta et al., 2023; Suryadi et al., 2024). Research themes have spanned the development of leadership competencies, strategies for implementing digital learning technologies, and the cultivation of innovation-oriented institutional cultures (Arham et al., 2023). Moreover, scholars have investigated the organizational change processes triggered by digital transformation, including the challenges of building trust, overcoming resistance to change, and fostering collaboration across diverse stakeholder groups (Aldawood et al., 2019).

Figure 1 explains the intellectual structure of research keywords clustered around the core concept of digital leadership. The largest and most connected cluster revolves around digital leadership, higher education, e-leadership, and digital transformation, highlighting the central role of these topics in academic discourse. These keywords emphasize the strategic application of digital tools to support institutional transformation, innovation, and educational

excellence. Surrounding this cluster are themes such as change management, knowledge sharing, and technology-enhanced learning, reflecting leadership practices required to build a resilient, adaptable academic environment.

This interpretation is supported by the bibliometric network, in which digital leadership exhibited the highest occurrence frequency and total link strength within the co-occurrence network, indicating its central role in connecting related concepts such as higher education, digital transformation, and e-leadership. In contrast, keywords including digital literacy, digital citizenship, and emotional intelligence showed lower occurrence frequencies but appeared predominantly in the most recent overlay visualization, suggesting their emergence as developing research themes.

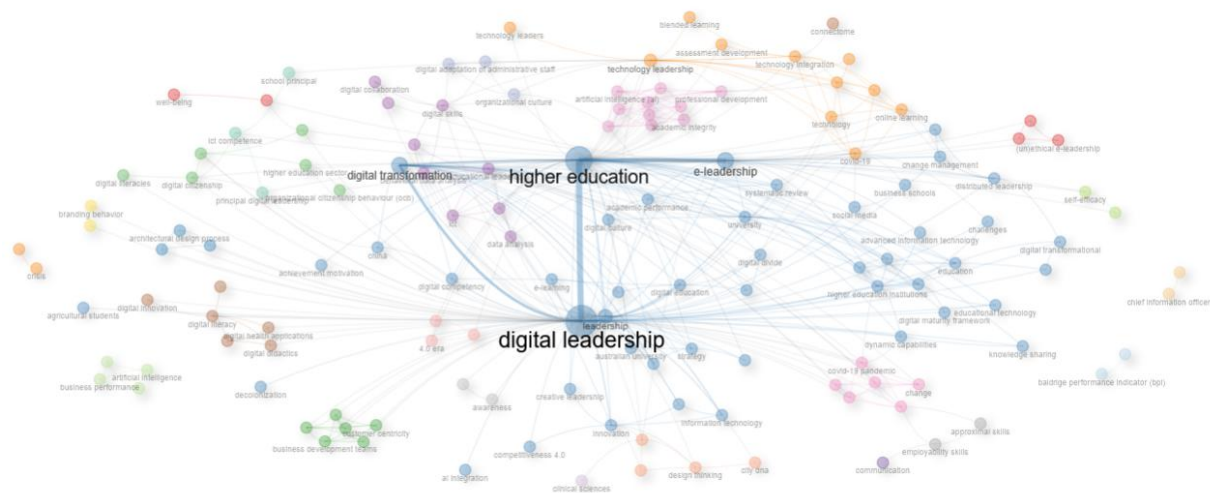


Figure 1. Thematic map of digital leadership in higher education

Other distinct clusters capture emerging research interests, including technology leadership, linked to technology integration, online learning, and COVID-19 as an accelerant of digital adoption. The digital citizenship cluster explores ethical and behavioral perspectives, such as emotional intelligence and digital literacy, while professional development and self-efficacy clusters point to leadership skill-building in a rapidly changing landscape. This data is also supported by co-occurrence analysis based on author keywords shown in Figure 2.

Figure 2 highlights the thematic structure of digital leadership research in higher education. Cluster 1 (red) is centered on digital leadership and higher education, surrounded by related keywords such as e-leadership, digital transformation, emotional intelligence, digital citizenship, and innovation. This cluster emphasizes the dominant discourse that digital leadership is not only a matter of technological adoption but also a complex socio-cultural transformation within academic institutions (Antonopoulou et al., 2020; Jameson et al., 2022a; Jing et al., 2025). Terms like emotional intelligence and well-being highlight how leadership skills must incorporate empathy, inclusivity, and a human-centered vision to drive digital change effectively (Ortega & Sonder, 2024).

In contrast, cluster 2 (blue) focuses on technology leadership and educational leadership, with co-occurring terms including behavioral data analysis, digital skills, and organizational and leadership culture. This suggests a more technical and managerial approach to leadership that prioritizes skill-building, data-driven decision-making, and digital literacy to integrate technologies in higher education successfully (L. Zhang et al., 2018; Y. Zhang et al., 2021). Meanwhile, the green cluster integrates topics such as professional development, sustainable development, employability skills, and change. This points to a growing recognition that digital leadership needs to align with broader institutional goals, including lifelong learning, sustainability, and workforce preparedness (Birasnav et al., 2023; L. Mishra et al., 2024; N. Mishra & Aithal, 2023). Additionally, references to online learning and COVID-19 in this cluster illustrate how global crises have accelerated the necessity for technology-oriented school and leadership practices (Adedoyin & Soykan, 2023; Nuryana et al., 2022; Nuryana, Xu, Kurniawan, et al., 2023).

Recent studies have further expanded the scope of digital leadership by addressing its ethical, cultural, and sustainability dimensions, arguing that digital leaders in higher education must balance technological competence with a strong human-centered approach (Chalkiadakis & Noguera, 2024). These thematic groupings demonstrate that digital leadership research in higher education is multidimensional, integrating technical, cultural, ethical, and

professional development perspectives to advance a holistic understanding of leadership in a digitally transformed educational ecosystem.

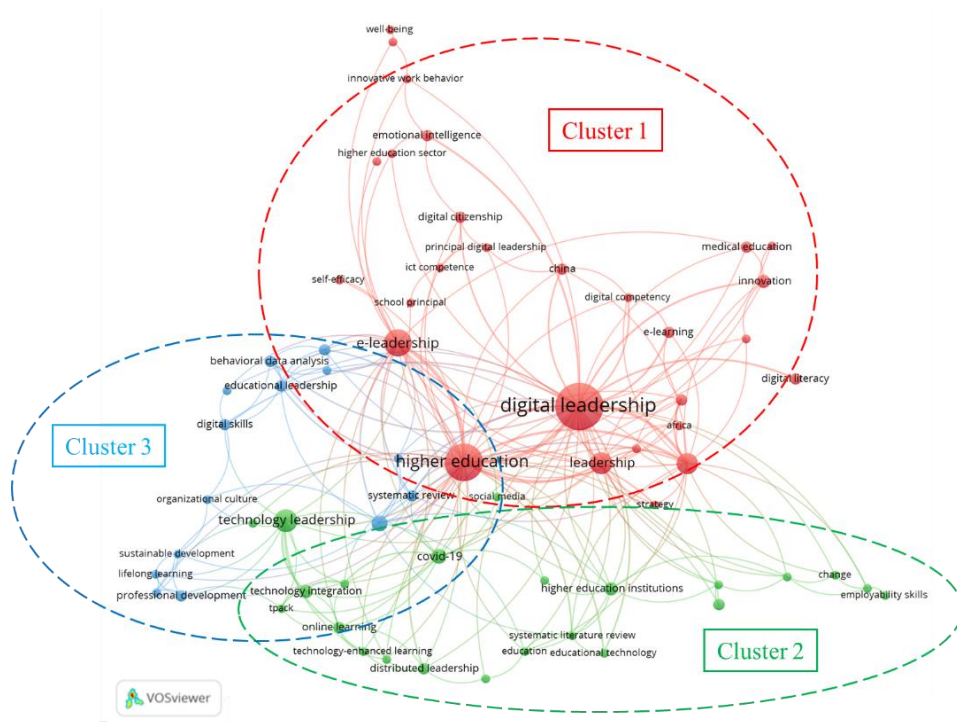


Figure 2. Co-occurrence network of digital leadership research in higher education

3.2. Influential Scholars, Institutions, and Publication Venue

Figure 3, mapping the flow between leading authors (AU), their affiliated institutions (AU_UN), and the publication outlets (SO) that have contributed to the development of digital leadership in higher education. This visualization makes clear that authors such as Alias BS, Hamzah MIM, and Anwar S have been significant contributors, with high publication counts connected to notable universities, the University of Malaya, the University of Greenwich, and Universitas Pendidikan Indonesia. Their work often appears in reputable journals such as the International Journal of Evaluation and Research in Education and the Emerging Science Journal.

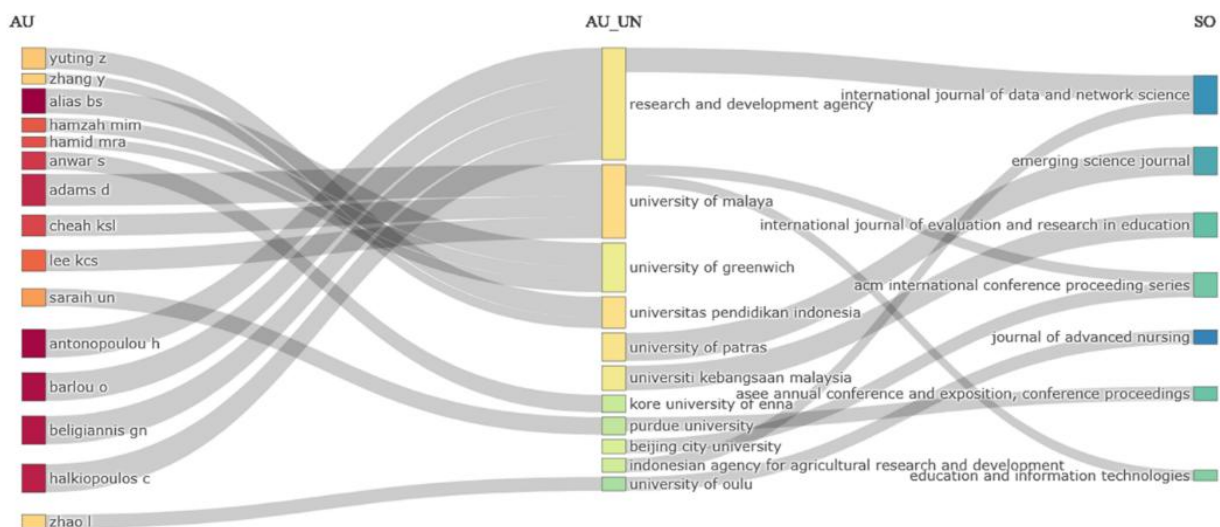


Figure 3. Sankey diagram of influential authors, institutions, and publication outlets

Figure 3 also reveals that institutions such as the University of Greenwich and Universiti Kebangsaan Malaysia are closely linked to influential authors publishing in outlets like the ACM International Conference Proceeding Series and the ASEE Annual Conference and Exposition Proceedings. This suggests an emerging bridge between educational technology, engineering education, and leadership scholarship, where interdisciplinary collaborations are encouraged to address the challenges of implementing digital transformation in higher education (Fawns, 2019; Jandrić & Knox, 2022).

Meanwhile, Author and Affiliation (including departments) can be seen in Tables 1 and 2. Table 1 presents the most productive authors contributing to the field of digital leadership in higher education, based on total publications (TD), total citations (TC), and total link strength (TLS), which reflects collaboration intensity and influence in the co-authorship network. The most prolific authors, with four publications each, include Alias Bity Salwana, Antonopoulou Hera, Barlou Olympia, Beligiannis Grigorios, and Halkiopoulos Constantinos. Notably, while Alias has the same number of documents (TD = 4), her total citations (TC = 2) and link strength (TLS = 6) are lower compared to the other group (Antonopoulou, Barlou, Beligiannis, and Halkiopoulos), each of whom has 264 citations and a TLS of 12. This suggests that while Alias is productive, her impact and network centrality are relatively modest in comparison.

Table 1. Most productive authors in digital leadership in higher education research

No.	Author	TD	TC	TLS
1	Alias, Bity Salwana	4	2	6
2	Antonopoulou, Hera	4	264	12
3	Barlou, Olympia	4	264	12
4	Beligiannis, Grigorios	4	264	12
5	Halkiopoulos, Constantinos	4	264	12
6	Adams, Donnie	3	28	5
7	Ahlquist, Josie	2	6	0
8	Anwar, Sadia	2	7	2
9	Arifin, Viva	2	1	10

Antonopoulou et al. (Antonopoulou et al., 2020) emerge as highly influential not only due to productivity but also due to their citation impact and collaborative network, indicating a strong presence in the scholarly conversation. Their works likely reflect co-authored, highly cited contributions within leadership or educational technology domains. In contrast, authors such as Adams Donnie (TD = 3, TC = 28, TLS = 5) and Anwar Sadia (TD = 2, TC = 7, TLS = 2) demonstrate growing influence, albeit at a smaller scale, suggesting their research is gaining visibility, possibly in specific regional or thematic niches.

As previously discussed in Table 1, several authors emerge as productive and influential contributors to the field of digital leadership in higher education. Meanwhile, Table 2 provides a closer look at the institutional affiliations of these key authors, offering insights into the academic environments supporting this growing body of research. From the table, it is evident that the Faculty of Education at the University of Malaya leads in total documents (TD = 4), with a moderate citation count (TC = 34) and a total link strength of 5.

A deeper look reveals that the University of Patras (Greece) plays a major role in the field. Although represented by three different departments, namely the Department of Business Administration of Food & Agricultural Enterprises, the Department of Management Science and Technology, and the general University of Patras, this institution collectively accumulates a substantial volume of citations (TC = 164 + 164 + 100 = 428) and 6 total documents.

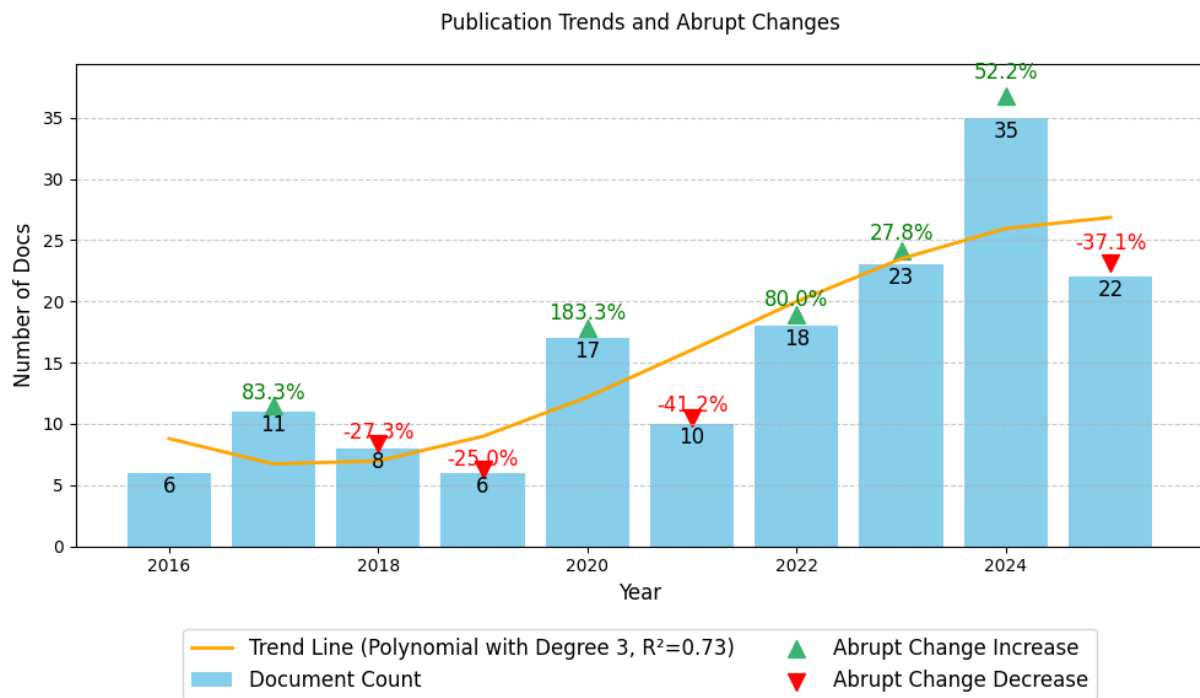
Other institutions, such as Universiti Kebangsaan Malaysia, Florida State University, and Daffodil International University, also appear in Table 2 with consistent publication activity but varying levels of citation impact. Notably, State Islamic Syarif Hidayatullah University (Indonesia) and ABFI Institute of Perbanas show emerging engagement in this field, indicating growing interest in digital leadership within Southeast Asian academic settings. However, most of these institutions show modest citation metrics, reflecting either relatively recent contributions or localized publication reach.

Table 2. Most productive affiliations in digital leadership in higher education

No	Affiliation	TD	TC	TLS
1	Faculty of Education, University of Malaya, Kuala Lumpur, Malaysia	4	34	5
2	Department of Business Administration of Food & Agricultural Enterprises, University of Patras, Patras, Greece	2	164	2
3	Department of Business Administration, Daffodil International University, Dhaka, Bangladesh	2	7	4
4	Department of Management Science and Technology, University of Patras, Patras, Greece	2	164	2
5	Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Malaysia	2	0	3
6	Florida State University, Leadership Learning Research Center, United States	2	6	0
7	State Islamic Syarif Hidayatullah, Dept of Informatic, Jakarta, Indonesia	2	1	4
8	University of Granada, Granada, Spain	2	5	3
9	University of Patras, Patras, Greece	2	100	0
10	Abfi Institute of Perbanas, Indonesia	1	6	2

3.3. Publication Trends and Evolution of the Field

A bibliometric study underscores that higher education institutions are undergoing an ongoing digital transformation, which demands new forms of leadership that blend strategic direction with technological awareness (Antonopoulou et al., 2020; Peterson & Jordansson, 2022). In line with that, other research highlights global diversification in publication outcomes, with a surge in studies focusing on institutional strategies, leadership frameworks, and academic governance in digital contexts (Obied, 2025; Olabiya et al., 2025). Figure 4 illustrates the annual number of publications on digital leadership in higher education from 2016 to 2025, including the percentage change between years and a polynomial trend line ($R^2 = 0.73$) that represents the overall growth pattern. The data shows a fluctuating trajectory, with several periods of decline followed by sharp increases. Notably, the years 2019–2021 saw a significant surge, with 183.3% growth from 2019 to 2020 (6 to 17 documents), suggesting an inflection point where interest in the topic began accelerating. This was followed by continued momentum in 2022 and 2023, culminating in a peak of 35 publications in 2024, the highest in the observed range.

**Figure 4.** Publication trends and abrupt changes in digital leadership

Despite the positive trajectory, the field also shows instability, as seen in the -41.2% drop in 2021 and the -37.1% decrease from 2024 to 2025. These declines may not necessarily indicate reduced scholarly interest, but rather fluctuations in indexing, database updates, or delays in publication. The trend line suggests that despite year-to-year volatility, digital leadership research has followed a long-term upward trend. These patterns align with prior observations that the field remains emergent and dynamic, shaped by shifting institutional priorities and evolving conceptual frameworks (Jameson et al., 2022b). The polynomial regression (degree 3) reinforces the notion of gradual maturation in this research domain. The publication burst between 2020 and 2024 may reflect the broadening scope of digital leadership studies, including themes like educational innovation, digital ethics, and institutional change management (Karakose et al., 2022; Tigre et al., 2023; Wollscheid et al., 2025; Zeike et al., 2019). The slight decline projected in 2025 should be interpreted cautiously, as it reflects incomplete data collection for the current year.

Meanwhile, Figure 5 shows the thematic and structural evolution of the digital leadership research field over time, based on longitudinal bibliometric data. This evolution is not only reflected in the quantity of publications, but also in the deepening complexity and interdisciplinary nature of the research. Early publications between 2016 and 2019 were predominantly conceptual or exploratory, often focusing on definitions of digital leadership and its distinction from conventional leadership models in education (Erhan et al., 2022; Wang et al., 2022).

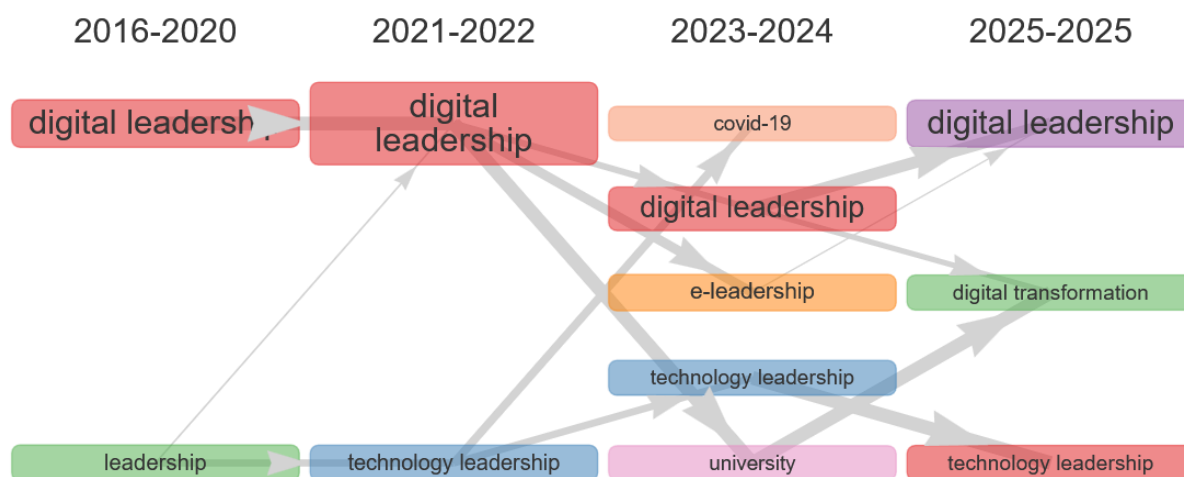


Figure 5. Evolution of the digital leadership research field

From 2020 to 2024, the field evolved into a more empirical and application-oriented domain, with studies increasingly addressing digital leadership practices, competencies, and institutional strategies. Research expanded into new thematic areas such as educational innovation, organizational culture, and leadership capability within digitally transforming institutions (Aboobaker & KA, 2021). In the most recent period (2024–2025), the field shows signs of diversification and fragmentation. Studies increasingly focus on subtopics such as ethics in digital governance, sustainable transformation, and professional development, indicating that digital leadership is evolving into a broader academic ecosystem (Cortellazzo et al., 2019; Müller et al., 2024).

The thematic evolution analysis further demonstrates that earlier studies were primarily associated with technology-oriented concepts, whereas more recent themes exhibit stronger connections with organizational culture, emotional intelligence, sustainability, and digital literacy. This shift is evidenced not only by the thematic evolution diagram but also by the overlay visualization, where recently emerging keywords are represented by brighter colors, indicating increasing scholarly attention during the latest publication period.

3.4. Emerging Research Frontiers and Underexplored Areas

Identifying emerging research frontiers and developing research themes is essential for advancing the maturity and relevance of any academic field, including digital leadership in higher education. Unlike the conventional co-occurrence network, which primarily illustrates relationships among keywords, the Enhanced Strategic Diagram provides a strategic perspective by positioning research themes according to their conceptual importance and developmental maturity. Consequently, the ESD enables a more systematic identification of well-developed, emerging, peripheral, and declining research themes. Figure 6 visualizes the thematic evolution of research on digital

leadership in higher education using a dual-map quadrant layout. The left panel shows themes based on novel publication years (recent research), while the right panel depicts older, more established themes. Each quadrant represents thematic positioning along two axes: centrality (relevance within the research network) and density (development level). In the recent-year quadrant (left), core themes like digital leadership, higher education, and digital transformation occupy Quadrant 1 (Q1), signaling both high centrality and conceptual development. Meanwhile, themes in Quadrant 2 (Q2), such as COVID-19, represent emerging but still developing research areas, whereas Quadrant 3 (Q3) contains comparatively lower-density and peripheral themes, including digital skills, digital citizenship, and digital literacy. Although these topics have received increasing scholarly attention in recent years, their thematic positioning indicates that they remain less conceptually mature and less interconnected within the present bibliometric network than the dominant themes in Quadrant 1.

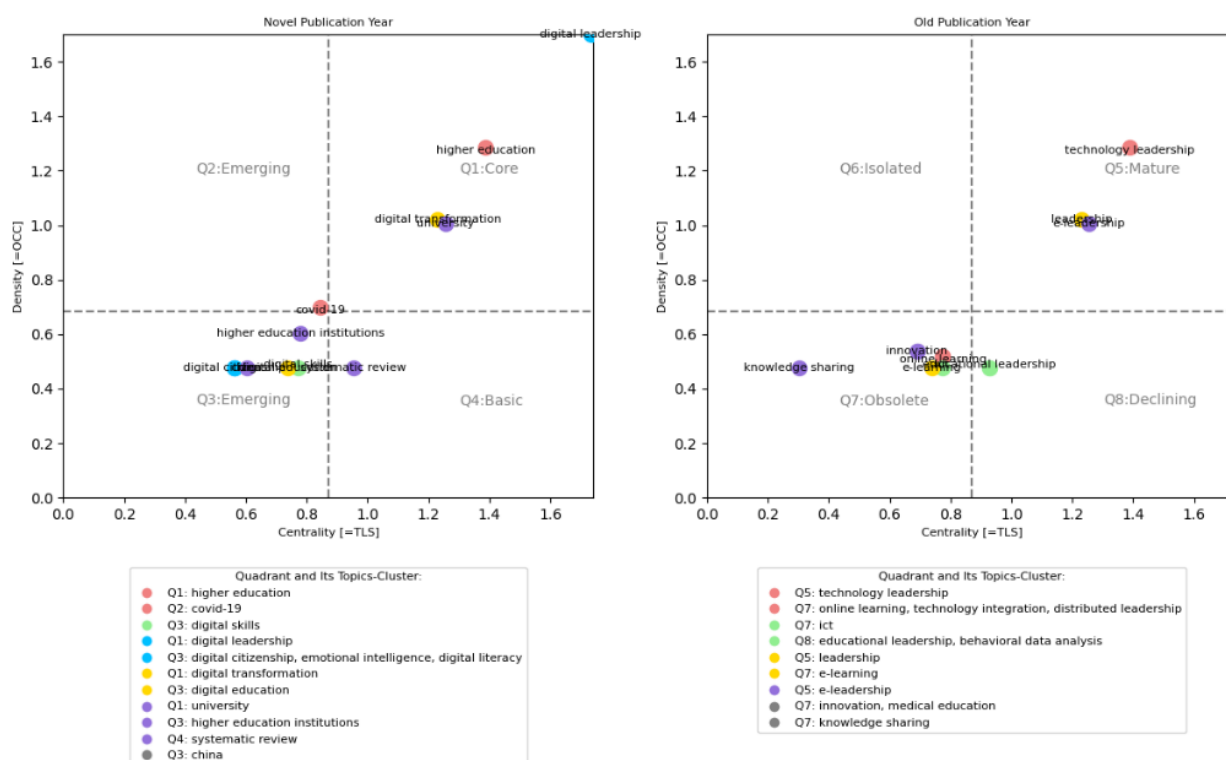


Figure 6. Quadrant plot of thematic evolution

In contrast, the older-year quadrant (right) shows that technology leadership, leadership, and e-leadership are mature themes located in Quadrant 5 (Q5). However, several topics like educational leadership, behavioral data analysis, and e-learning appear in Quadrants 7 and 8 (obsolete or declining), indicating a decrease in scholarly attention or lack of conceptual renewal. Knowledge sharing, although still relevant, appears isolated (Q6), suggesting it may need reintegration into contemporary frameworks to maintain relevance. The shift from classic leadership frameworks toward more digitally nuanced topics reflects a transformation in scholarly priorities.

From the emerging and peripheral themes identified in the Enhanced Strategic Diagram and supported by the overlay visualization, several research topics demonstrate relatively lower thematic density while exhibiting increasing recent occurrences. These characteristics suggest that digital skills, digital citizenship, emotional intelligence, and digital literacy represent developing research directions that warrant further empirical investigation rather than fully established research domains. Meanwhile, from the emerging and peripheral topics in Q2 and Q3 (novel quadrant), several research frontiers show strong potential for future development. For instance, digital skills (Gilli et al., 2024), emotional intelligence (Anwar & Saraih, 2024c), and digital citizenship (Calen et al., 2021), currently underdeveloped, are increasingly recognized as critical to effective digital leadership but lack sustained theoretical or empirical investigation. Additionally, the integration of digital literacy into leadership frameworks is still fragmented, despite growing institutional relevance (Ben Ghrbeia & Alzubi, 2024).

Building upon the overlay visualization analysis, Figure 7 explicitly marks the most recent and potentially emerging research themes in digital leadership in higher education. These terms appear in bright yellow and are highlighted with red rectangles to signify their novelty and increasing relevance in the last two years (2024–2025). The keywords include education, digital education, digital literacy, principal digital leadership, emotional intelligence, higher education sector, organizational culture, sustainable development, Africa, and China.

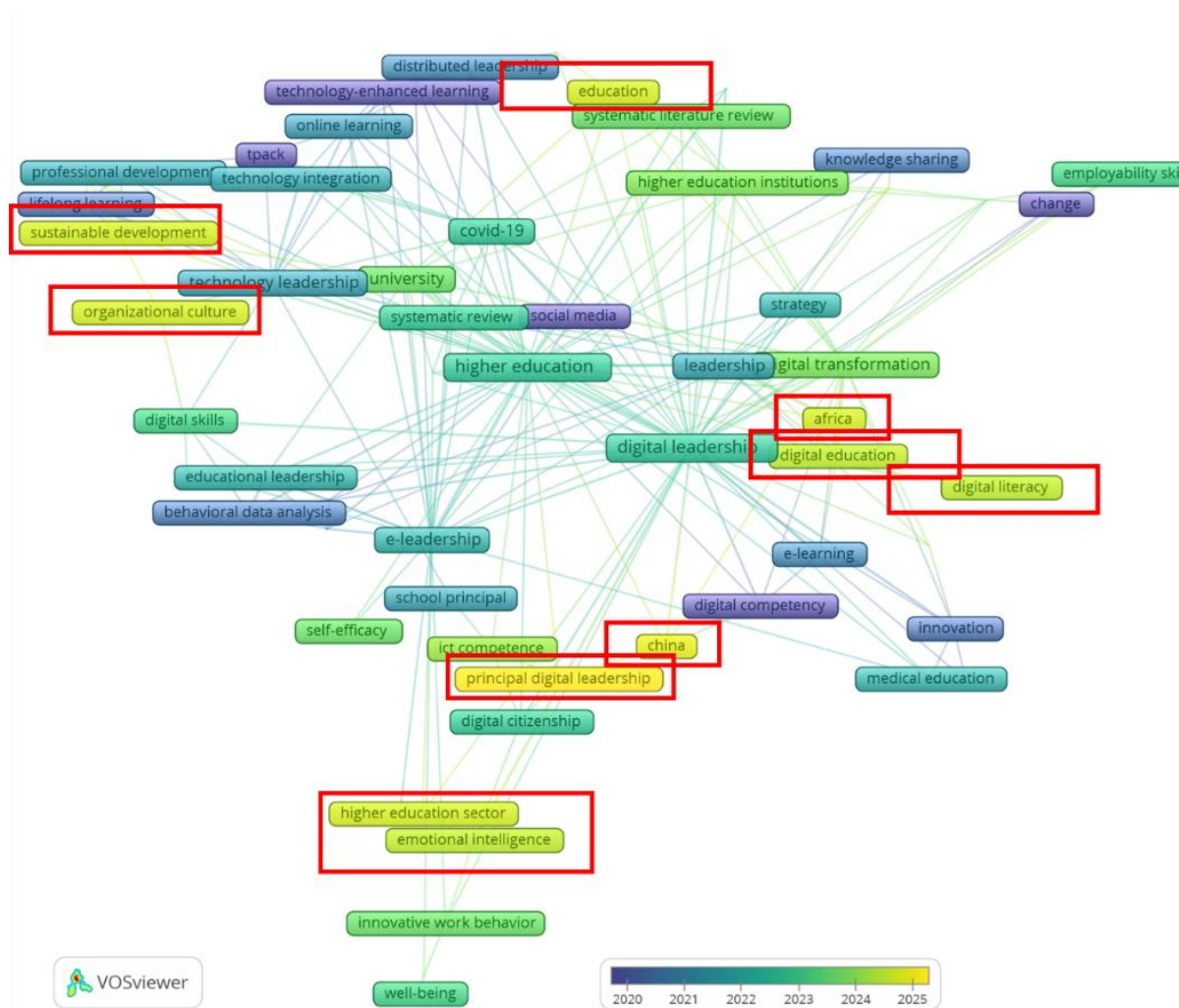


Figure 7. Co-occurrence overlay visualization of emerging keywords

The emerging keywords identified in the co-occurrence overlay visualization, such as digital literacy, emotional intelligence, principal digital leadership, organizational culture, and regional contexts like Africa and China- reflect a shift in digital leadership research toward more human-centered, contextual, and skill-based themes. For instance, emotional intelligence has been shown to impact instructional strategy and leadership behavior in Chinese schools significantly (J. Chen & Guo, 2020). While in South African and African settings, it has been linked to improved social skills and leadership program effectiveness (Shaikh et al., 2018).

At the same time, digital literacy and principal-level leadership have been shown to enhance teacher performance and institutional readiness for digital change (Setyawan et al., 2022; Tongli et al., 2024), while emerging frameworks in other countries incorporate these dimensions into broader digital transformation strategies (Anwar & Saraih, 2024b). Moreover, the integration of sustainability, organizational culture, and transformational leadership into digital strategies reflects a systemic shift toward long-term, values-based innovation in education (Hargitai & Bencsik, 2023; Retnowati & Santosa, 2023; Saputra & Saputra, 2020). Compared with previous bibliometric studies, this study contributes by focusing specifically on higher education and integrating multiple complementary bibliometric

techniques to reveal not only publication patterns but also thematic maturity, conceptual evolution, and emerging research directions. This integrated perspective provides a more comprehensive understanding of how digital leadership research has evolved and where future investigations should be directed.

4. Conclusion

Higher education institutions face a persistent challenge in strategically integrating digital technologies amid rapid transformation and evolving leadership demands. This bibliometric study reveals that while digital leadership in higher education is gaining scholarly traction, it remains a developing and fragmented field marked by diverse themes such as digital transformation, emotional intelligence, digital literacy, and organizational change. The analysis highlights a growing shift toward more holistic leadership models that blend technical skills with cultural, ethical, and sustainability-oriented competencies. Influential scholars and institutions have begun shaping this evolving discourse. Yet, critical gaps remain, particularly in underexplored areas like principal digital leadership, regional leadership dynamics (e.g., Africa and China), and the integration of emotional intelligence into digital strategies. These findings emphasize the need for more interdisciplinary, context-aware research to support the development of adaptive and inclusive digital leadership frameworks that can drive resilient innovation across global academic environments.

Acknowledgements

The authors would like to express their sincere gratitude to the Department of Business Administration and the Department of Information Technology, Politeknik Negeri Padang, Padang, Indonesia, as well as the Department of Islamic Education, Universitas Ahmad Dahlan, Indonesia, for the institutional support and academic contributions provided throughout the completion of this study.

References

- Aboobaker, N., & KA, Z. (2021). Digital learning orientation and innovative behavior in the higher education sector: effects of organizational learning culture and readiness for change. *International Journal of Educational Management*. <https://doi.org/10.1108/IJEM-09-2019-0345>
- Adedoyin, O. B., & Soykan, E. (2023). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments*, 31(2), 863–875. <https://doi.org/10.1080/10494820.2020.1813180>
- Ahlquist, J. (2014). Trending Now: Digital Leadership Education Using Social Media and the Social Change Model. *Journal of Leadership Studies*, 8(2), 57–60. <https://doi.org/10.1002/jls.21332>
- Aldawood, H., Alhejaili, A., Alabadi, M., Alharbi, O., & Skinner, G. (2019). Integrating Digital Leadership in an Educational Supervision Context: A Critical Appraisal. *2019 International Conference on Engineering Applications, ICEA 2019 - Proceedings*. <https://doi.org/10.1109/CEAP.2019.8883484>
- Antonopoulou, H., Halkiopoulou, C., Barlou, O., & Beligiannis, G. N. (2020). Leadership Types and Digital Leadership in Higher Education: Behavioural Data Analysis from University of Patras in Greece. *International Journal of Learning, Teaching and Educational Research*, 19(4), 110–129. <https://doi.org/10.26803/ijlter.19.4.8>
- Anwar, S., & Saraih, U. N. (2024a). Digital leadership in the digital era of education: enhancing knowledge sharing and emotional intelligence. *International Journal of Educational Management*, 38(6), 1581–1611. <https://doi.org/10.1108/IJEM-11-2023-0540>
- Anwar, S., & Saraih, U. N. (2024b). Digital leadership in the digital era of education: enhancing knowledge sharing and emotional intelligence. *International Journal of Educational Management*, 38(6), 1581–1611. <https://doi.org/10.1108/IJEM-11-2023-0540>
- Anwar, S., & Saraih, U. N. (2024c). Exploring the abilities of emotional intelligence in psychological empowerment: digital leadership as mediator. *Journal of Applied Research in Higher Education*. <https://doi.org/10.1108/JARHE-06-2023-0245>
- Arham, A. F., Norizan, N. S., Arham, A. F., Hasbullah, N. N., Malan, I. N. B., & Alwi, S. (2023). Digital Leadership in Education: A Meta-analysis Review. In *Lecture Notes in Networks and Systems* (pp. 849–857).

https://doi.org/10.1007/978-3-031-26956-1_79

- Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975.
- Ben Ghrbeia, S., & Alzubi, A. (2024). Building Micro-Foundations for Digital Transformation: A Moderated Mediation Model of the Interplay between Digital Literacy and Digital Transformation. *Sustainability*, 16(9), 3749. <https://doi.org/10.3390/su16093749>
- Birasnav, M., Gantasala, S. B., Gantasala, V. P., & Singh, A. (2023). Total quality leadership and organizational innovativeness: the role of social capital development in American schools. *Benchmarking*. <https://doi.org/10.1108/BIJ-08-2021-0470>
- Calen, C., Tarigan, S. A., Rosita, R., Susanto, S., & Alimin, E. (2021). The role of transformational leadership, leader member exchange, digital transformation on organizational citizenship behaviour and work innovation capabilities in during Covid-19 pandemic. *JPPI (Jurnal Penelitian Pendidikan Indonesia)*, 7(2), 203–216. <https://doi.org/10.29210/020211163>
- Chalkiadakis, L., & Noguera, I. (2024). K-12 Teacher's Appropriation of Digital Technologies and Innovative Instruction Across EU: A Scoping Review. *International Journal of Instruction*, 17(1), 415–436. <https://doi.org/10.29333/iji.2024.17122a>
- Chen, D., Liu, Z., Luo, Z., Webber, M., & Chen, J. (2016). Bibliometric and visualized analysis of emergy research. *Ecological Engineering*, 90, 285–293. <https://doi.org/10.1016/j.ecoleng.2016.01.026>
- Chen, J., & Guo, W. (2020). Emotional intelligence can make a difference: The impact of principals' emotional intelligence on teaching strategy mediated by instructional leadership. *Educational Management Administration and Leadership*. <https://doi.org/10.1177/1741143218781066>
- Chiou, C.-W., Chen, W.-M., Liu, C.-M., & Wu, M.-C. (2012). A genetic algorithm for scheduling dual flow shops. *Expert Systems with Applications*, 39(1), 1306–1314. <https://doi.org/10.1016/j.eswa.2011.08.008>
- Cortellazzo, L., Bruni, E., & Zampieri, R. (2019). The role of leadership in a digitalized world: A review. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2019.01938>
- Díaz-Noguera, M. D., Hervás-Gómez, C., De la Calle-Cabrera, A. M., & López-Meneses, E. (2022). Autonomy, Motivation, and Digital Pedagogy Are Key Factors in the Perceptions of Spanish Higher-Education Students toward Online Learning during the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, 19(2), 654. <https://doi.org/10.3390/ijerph19020654>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Ehlers, U. D. (2020). Digital Leadership in Higher Education. *Journal of Higher Education Policy and Leadership Studies*. <https://doi.org/10.29252/johepal.1.3.6>
- Erhan, T., Uzunbacak, H. H., & Aydin, E. (2022). From conventional to digital leadership: exploring digitalization of leadership and innovative work behavior. *Management Research Review*. <https://doi.org/10.1108/MRR-05-2021-0338>
- Fawns, T. (2019). Postdigital Education in Design and Practice. *Postdigital Science and Education*. <https://doi.org/10.1007/s42438-018-0021-8>
- Ganga-Contreras, F., Suarez-Amaya, W., Alarcón-Henríquez, N., Viancos-González, P., Henríquez-Fuentes, F., & Abello-Romero, J. (2024). Scientific production of the relationship between leadership, higher education and digital transformation: A bibliometric analysis. *Interciencia*, 49(1), 8–18.
- Ghamrawi, N., & M. Tamim, R. (2023). A typology for digital leadership in higher education: the case of a large-scale mobile technology initiative (using tablets). *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-11483-w>
- Gilli, K., Lettner, N., & Guettel, W. (2024). The future of leadership: new digital skills or old analog virtues? *Journal of Business Strategy*. <https://doi.org/10.1108/JBS-06-2022-0093>

- Hargitai, D. M., & Bencsik, A. (2023). The Role of Leadership in Digital Learning Organizations. *Emerging Science Journal*, 7, 111–124. <https://doi.org/10.28991/ESJ-2023-SIED2-09>
- Jameson, J., Rumyantseva, N., Cai, M., Markowski, M., Essex, R., & McNay, I. (2022a). A systematic review and framework for digital leadership research maturity in higher education. *Computers and Education Open*, 3, 100115. <https://doi.org/10.1016/j.cao.2022.100115>
- Jameson, J., Rumyantseva, N., Cai, M., Markowski, M., Essex, R., & McNay, I. (2022b). A systematic review and framework for digital leadership research maturity in higher education. *Computers and Education Open*, 3, 100115. <https://doi.org/10.1016/j.cao.2022.100115>
- Jandrić, P., & Knox, J. (2022). The postdigital turn: Philosophy, education, research. *Policy Futures in Education*. <https://doi.org/10.1177/14782103211062713>
- Jing, M., Guo, Z., Wu, X., Yang, Z., & Wang, X. (2025). Higher Education Digital Academic Leadership: Perceptions and Practices from Chinese University Leaders. *Education Sciences*, 15(5), 606. <https://doi.org/10.3390/educsci15050606>
- Karakose, T., Kocabas, I., Yirci, R., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2022). The Development and Evolution of Digital Leadership: A Bibliometric Mapping Approach-Based Study. *Sustainability (Switzerland)*. <https://doi.org/10.3390/su142316171>
- Karakose, T., Polat, H., Tülübaş, T., & Demirkol, M. (2024). A Review of the Conceptual Structure and Evolution of Digital Leadership Research in Education. *Education Sciences*, 14(11), 1166. <https://doi.org/10.3390/educsci14111166>
- Kiula, M., Waiganjo, E., & Kihoro, J. (2018). Influence of the leader as a developer on E-readiness accession in higher education institutions in Kenya. *2018 IST-Africa Week Conference, IST-Africa 2018*.
- Maisonobe, M., Eckert, D., Grossetti, M., Jégou, L., & Milard, B. (2016). The world network of scientific collaborations between cities: domestic or international dynamics? *Journal of Informetrics*. <https://doi.org/10.1016/j.joi.2016.06.002>
- Mishra, L., Gupta, T., & Shree, A. (2024). Effective Academic Leadership Development in Higher Education Institutions. In *Academic Leadership in Higher Education in India* (pp. 74–86). Routledge India.
- Mishra, N., & Aithal, P. S. (2023). Academic Leadership in Higher Education. *International Journal of Philosophy and Languages (IJPL)*, 85–97. <https://doi.org/10.47992/IJPL.2583.9934.0020>
- Msila, V. (2022). Higher Education Leadership in a Time of Digital Technologies: A South African Case Study. *International Journal of Information and Education Technology*, 12(10), 1110–1117. <https://doi.org/10.18178/ijiet.2022.12.10.1728>
- Müller, S. D., Konzag, H., Nielsen, J. A., & Sandholt, H. B. (2024). Digital transformation leadership competencies: A contingency approach. *International Journal of Information Management*. <https://doi.org/10.1016/j.ijinfomgt.2023.102734>
- Nuryana, Z., Xu, W., Kurniawan, L., Sutanti, N., Makruf, S. A., & Nurcahyati, I. (2023). Student stress and mental health during online learning: Potential for post-COVID-19 school curriculum development. *Comprehensive Psychoneuroendocrinology*, 14, 100184. <https://doi.org/10.1016/j.cpnec.2023.100184>
- Nuryana, Z., Xu, W., Lu, S., Li, Y., Zhang, Y., & Ni, X. (2023). Exploring the Current Landscape of Educational Technology in China. *2023 XIII International Conference on Virtual Campus (JICV)*, 1–4. <https://doi.org/10.1109/JICV59748.2023.10565705>
- Nuryana, Z., Xu, W., Lu, S., Pranolo, A., & Ma'Arif, A. (2022). Dynamics of Online Learning during COVID-19 in Indonesia: Bibliometric Analysis and Future Research Agenda. *2022 XII International Conference on Virtual Campus (JICV)*, 1–6.
- Nuryana, Z., Xu, W., Lu, S., Tasir, Z., & Suyadi, S. (2023). Mapping global research on shadow education: Trends and future agenda. *International Journal of Evaluation and Research in Education (IJERE)*, 12(2), 1105. <https://doi.org/10.11591/ijere.v12i2.24667>
- Obied, A. S. (2025). Digital leadership in the academic environment: A systematic literature review. *Social Sciences*

- & *Humanities Open*, 11, 101542. <https://doi.org/10.1016/j.ssaho.2025.101542>
- Olabiyyi, O. J., Vuuren, C. J. van, Du Plessis, M., Xue, Y., & Zhu, C. (2025). Digital Academic Leadership in Higher Education Institutions: A Bibliometric Review Based on CiteSpace. *Education Sciences*, 15(7), 846. <https://doi.org/10.3390/educsci15070846>
- Ortega, M., & Sonder, N. (2024). Promoting Innovation and Creativity through Human-Centered Leadership. In *Brilliant Leadership* (pp. 42–60). Productivity Press.
- Peterson, H., & Jordansson, B. (2022). Managing and leading gender equality change in academia. In *Research Handbook on Academic Careers and Managing Academics* (pp. 165–174). Edward Elgar Publishing Ltd. <https://doi.org/10.4337/9781839102639.00021>
- Pu, R., Dong, R. K., & Jiang, S. (2025). Toward the Education for Sustainable Development (ESD): Digital leadership and knowledge-sharing behavior on the higher education institutional change. *Education and Information Technologies*, 30(8), 10567–10589. <https://doi.org/10.1007/s10639-024-13247-0>
- Quezada-Sarmiento, P. A., Chamba-Eras, L., & Luna-Briceno, T. S. (2018). Digital benchmarking for higher education center. *2018 13th Iberian Conference on Information Systems and Technologies (CISTI)*, 1–5. <https://doi.org/10.23919/CISTI.2018.8399373>
- Retnowati, C. N., & Santosa, B. (2023). Digital Leadership, Culture & Employee Capabilities: Sustainable Organizational Performance in Education - A Case Study. *Enrichment: Journal of Multidisciplinary Research and Development*. <https://doi.org/10.55324/enrichment.v1i5.36>
- Rørstad, K., & Aksnes, D. W. (2015). Publication rate expressed by age, gender and academic position – A large-scale analysis of Norwegian academic staff. *Journal of Informetrics*, 9(2), 317–333. <https://doi.org/10.1016/j.joi.2015.02.003>
- Sapta, F. Y., Rahmatika, D. N., & Suliyanto, S. (2023). E-Leadership: Unveiling the Role of Digital Era Leadership in Enhancing Employee Performance in Higher Education Institution. *International Journal of Current Science Research and Review*. <https://doi.org/10.47191/ijcsrr/v6-i7-09>
- Saputra, N., & Saputra, A. M. (2020). Transforming into Digital Organization by Orchestrating Culture, Leadership, and Competence in Digital Context. *GATR Global Journal of Business Social Sciences Review*. [https://doi.org/10.35609/gjbssr.2020.8.4\(2\)](https://doi.org/10.35609/gjbssr.2020.8.4(2))
- Setyawan, F. G., Dwi Widayani, A. A., & Suardhika, I. N. (2022). Model of Digital Literacy and Organizational Support in Determining Teacher Performance: An Empirical Study. *International Journal of Multidisciplinary Research and Analysis*. <https://doi.org/10.47191/ijmra/v5-i11-11>
- Shafin, N., Ismail, C. A. N., Mustafa, M. Z., Ghani, N., Ahmad, A. H., Othman, Z., Wijaya, A., & Zakaria, R. (2022). Thematic analysis of multiple sclerosis research by enhanced strategic diagram. *Multiple Sclerosis Journal*, 28(14), 2160–2170. <https://doi.org/10.1177/13524585221075542>
- Shaikh, A., Bisschoff, C. A., & Botha, C. J. (2018). Measuring management and leadership competencies of business school educated managers in South Africa. *Journal of Business & Retail Management Research*. <https://doi.org/10.24052/jbrmr/v13is02/art-14>
- Shen, Y., Deng, Y., Xiao, Z., Zhang, Z., & Dai, R. (2025). Driving green digital innovation in higher education: the influence of leadership and dynamic capabilities on cultivating a green digital mindset and knowledge sharing for sustainable practices. *BMC Psychology*, 13(1), 288. <https://doi.org/10.1186/s40359-025-02552-z>
- Suryadi, Muslim, A. Q., & Setyono, L. (2024). Exploring the Nexus of Digital Leadership and Digital Literacy on Higher Education Performance: The Role of Digital Innovation. *European Journal of Educational Research*. <https://doi.org/10.12973/eu-jer.13.1.207>
- Temelkova, M. (2018). Skills for digital leadership-Prerequisite for developing high-tech economy. *International Journal of Advanced Research in Management and Social Sciences*, 7(12), 50–74.
- Tigre, F. B., Curado, C., & Henriques, P. L. (2023). Digital Leadership: A Bibliometric Analysis. *Journal of Leadership & Organizational Studies*, 30(1), 40–70. <https://doi.org/10.1177/15480518221123132>
- Tongli, B., Zurweni, Z., Martodiryo, S., Tuasikal, M. A., Harnoko, A. D., Rozak, A., & Mulyono, M. (2024).

- Investigating the correlation digital literacy, instructional leadership, and intelligence on work performance. *Journal of Infrastructure, Policy and Development*, 8(10), 6356. <https://doi.org/10.24294/jipd.v8i10.6356>
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- van Eck, N. J., & Waltman, L. (2014). Visualizing Bibliometric Networks. In *Measuring Scholarly Impact* (pp. 285–320). Springer International Publishing. https://doi.org/10.1007/978-3-319-10377-8_13
- Wang, T., Lin, X., & Sheng, F. (2022). Digital leadership and exploratory innovation: From the dual perspectives of strategic orientation and organizational culture. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2022.902693>
- Wijaya, A., & Hermawan, B. (2025). *BiblioPlot: Enhanced Data Visualization for Bibliometric Analysis*. <https://biblioplot.metlit.net/>
- Wollscheid, S., Tømte, C. E., Egeberg, G. C., Karlstrøm, H., & Fossum, L. W. (2025). Research trends on digital school leadership over time: Science mapping and content analysis. *Education and Information Technologies*, 30(1), 747–778. <https://doi.org/10.1007/s10639-024-12909-3>
- Zabalawi, I., Kordahji, H., & Aftimos, S. (2024). Digital Transformation in Universities: Strategic Framework, Implementation Tools, and Leadership. In *Higher Education in the Arab World* (pp. 145–210). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-70779-7_8
- Zeike, S., Bradbury, K., Lindert, L., & Pfaff, H. (2019). Digital Leadership Skills and Associations with Psychological Well-Being. *International Journal of Environmental Research and Public Health*, 16(14), 2628. <https://doi.org/10.3390/ijerph16142628>
- Zhang, L., Cao, T., & Wang, Y. (2018). The mediation role of leadership styles in integrated project collaboration: An emotional intelligence perspective. *International Journal of Project Management*. <https://doi.org/10.1016/j.ijproman.2017.08.014>
- Zhang, Y., Zheng, Y., Zhang, L., Xu, S., Liu, X., & Chen, W. (2021). A meta-analytic review of the consequences of servant leadership: The moderating roles of cultural factors. *Asia Pacific Journal of Management*. <https://doi.org/10.1007/s10490-018-9639-z>
- Zulherman, Nuryana, Z., Pangarso, A., & Zain, F. M. (2021). Factor of zoom cloud meetings: Technology adoption in the pandemic of COVID-19. *International Journal of Evaluation and Research in Education*. <https://doi.org/10.11591/ijere.v10i3.21726>
- Zupic, I., & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, 18(3), 429–472. <https://doi.org/10.1177/1094428114562629>