

# Digital Leadership in Higher Education: A Bibliometric Mapping of Empirical Research (2015–2025)

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## Abstract

Digital leadership has emerged as a strategic capability that enables higher education institutions to navigate digital transformation, technological disruption, and sustainability challenges. Despite the growing body of literature, the intellectual structure and thematic evolution of digital leadership research remain fragmented. This study aims to systematically map the intellectual landscape, research trends, and emerging themes of empirical studies on digital leadership in higher education through a bibliometric approach. Data were retrieved from the Dimensions database, yielding 233 publications published between 2015 and 2025. After applying predefined inclusion and exclusion criteria—restricting the dataset to English-language empirical studies while excluding review articles, conceptual papers, and previous bibliometric studies—a final corpus of 203 publications was analyzed. Bibliometric analysis was conducted using VOSviewer, incorporating publication trend analysis, co-authorship analysis, citation and source analysis, bibliographic coupling, and keyword co-occurrence analysis. The findings demonstrate a substantial increase in scholarly output after 2021, reflecting the growing importance of digital leadership within higher education research. Keyword co-occurrence analysis identifies five major research themes: (1) digital leadership and leadership practices, (2) digital competence and individual capabilities, (3) higher education systems, educational technology, and student outcomes, (4) organizational management, performance, and sustainability, and (5) artificial intelligence, crisis management, and strategic adaptation. Citation and collaboration analyses further reveal a globally distributed but conceptually fragmented research landscape characterized by limited international collaboration and uneven knowledge integration. By linking these thematic developments to the education-related Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), SDG 16 (Peace, Justice and Strong Institutions), and SDG 17 (Partnerships for the Goals), this study demonstrates the strategic role of digital leadership in advancing sustainable higher education governance. Furthermore, the study proposes a structured future research agenda and a set of research propositions to encourage more integrative, interdisciplinary, and outcome-oriented investigations. Overall, this study enriches the understanding of digital leadership by providing a comprehensive bibliometric synthesis that serves as a valuable reference for researchers,

policymakers, and higher education leaders seeking to strengthen institutional transformation and sustainability in the digital era.

**Keywords:** Digital Leadership, Higher Education, Digital Governance, Sustainable Development Goals, Bibliometric Analysis

## 1. Introduction

Leadership is widely acknowledged as a key determinant of organizational effectiveness, influencing strategic decision-making, adaptability, and long-term performance. Recent leadership studies emphasize that contemporary leaders are required to navigate increasing complexity, uncertainty, and rapid environmental change, particularly in knowledge-intensive organizations such as higher education institutions ([Chughtai et al., 2024](#); [Singh et al., 2023](#); [Williams, 2023](#)). In the higher education context, leadership has become increasingly critical in addressing digital transformation, global competition, and institutional sustainability ([Trevisan et al., 2023](#)).

In the digital era, leadership practices are reshaped by the pervasive use of digital technologies, data-driven decision-making, and platform-based organizational processes. As a result, digital leadership has emerged as a strategic capability that integrates technological understanding with organizational vision and human-centered change management ([Ali & Amin, 2025](#); [Türk, 2023](#)). Digital leadership extends beyond the adoption of digital tools and focuses on leaders' ability to align digital technologies with organizational strategy, culture, and value creation ([van Roekel et al., 2025](#)).

Recent literature defines digital leadership as the capability of leaders to drive organizational transformation by aligning digital technologies, digital competencies, and strategic objectives ([Müller et al., 2024](#); [Tagscherer & Carbon, 2023](#)). Within higher education, digital leadership has been associated with institutional agility, innovation capacity, service quality, and sustainable performance, particularly in post-pandemic contexts ([Antonopoulou et al., 2020](#); [OKunlola & Naicker, 2025](#)). This fragmentation underscores the need for a systematic bibliometric mapping to consolidate existing evidence, identify dominant research clusters, and propose future research directions to advance digital leadership scholarship in higher education.

Despite the growing body of empirical studies on digital leadership in higher education ([Adriantoni et al., 2025](#); [Indarta, 2025](#)), the literature remains theoretically fragmented and thematically dispersed, with limited consolidation of dominant research streams and insufficient integration between leadership capabilities, digital competence, and organizational outcomes ([Hanelt et al., 2021](#); [Indarta, 2025](#); [Rizki & Suwadi, 2024](#)).

Prior research tends to examine isolated relationships—such as leadership practices or technology adoption—without systematically mapping the field's intellectual structure and thematic evolution. Moreover, emerging themes related to artificial intelligence, crisis-driven leadership, and institutional resilience have not yet been comprehensively synthesized within a unified framework for higher education ([İbrahimov et al., 2025](#)). Addressing these gaps, this study aims to systematically map research trends, thematic clusters, and intellectual structures of digital leadership in higher education using bibliometric analysis. The study further proposes an integrated conceptual framework, research agenda, and propositions to guide future empirical investigations.

## 2. Literature Review

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### *2.1 Definition of Digital Leadership*

Digital leadership refers to the leadership practice that guides an organization through digital transformation by strategically integrating digital technologies, fostering digital culture, and enabling organizational change to achieve competitive advantage and value creation. It emphasizes the leader's ability to steer transformation processes, align technology with strategy, and adapt mental models to digital realities ([López-Figueroa et al., 2025](#); [Phakamach et al., 2023](#)). In higher education, digital leadership specifically involves institutional leaders developing visions and practices that enable universities and colleges to navigate digital disruptions in governance, teaching, and administrative processes ([Onan, 2024](#)).

### *2.2 Objectives, Principles, and Targets of Digital Leadership*

The primary objective of digital leadership is to ensure that digital transformation efforts are aligned with institutional goals, stakeholder expectations, and sustainability imperatives. Core principles include setting a clear digital vision, promoting data-informed decision-making, fostering collaboration across units, and investing in digital competencies among staff and faculty ([Rizki & Suwadi, 2024](#)). Targets and performance measures for digital leadership in higher education often focus on enhancements in digital maturity, institutional agility, quality of academic services, and the capacity to respond to environmental shifts ([Mohamed Hashim et al., 2022](#)).

### *2.3 Expected Outputs for Institutions, Stakeholders, and Followers*

Effective digital leadership in higher education leads to improved institutional outcomes such as enhanced organizational performance, innovation in teaching and learning, and better service quality for students and other stakeholders. It also fosters higher levels of engagement, knowledge sharing, and digital competence among faculty and staff, which in turn supports broader organizational transformation ([Onan, 2024](#)). For followers, digital leadership contributes to a culture that values continuous learning, adaptability, and collaborative innovation ([Phakamach et al., 2023](#)).

### *2.4 Future Development of Digital Leadership in Higher Education*

The development of digital leadership in higher education is increasingly shaped by strategic concerns, such as the adoption of artificial intelligence, digital governance, and crisis resilience. As institutions move beyond immediate technology adoption toward long-term digital strategies, leaders must proactively cultivate digital literacy, cross-disciplinary collaboration, and sustainable innovation practices ([Obied, 2025](#)). To effectively meet future challenges, higher education institutions should integrate structured leadership development programs, strengthen digital infrastructure, and embed digital leadership within organizational policies.

### *2.5 Digital Leadership in Higher Education and the Sustainable Development Goals (SDGs)*

Digital leadership in higher education plays a strategic role in advancing the Sustainable Development Goals (SDGs), particularly those related to education quality, equity, innovation, and institutional sustainability. As higher education institutions are recognized as key actors in knowledge creation and human capital development, their leadership capacity directly influences the contribution of education systems to global sustainability agendas ([UNESCO, 2020](#)).

One of the most direct linkages between digital leadership and the SDGs is observed in SDG 4 (Quality Education). Digital leadership facilitates the integration of digital technologies to

expand access to learning, improve instructional quality, and enhance lifelong learning opportunities. Empirical studies indicate that digitally enabled leadership supports the development of flexible learning models, data-informed academic governance, and technology-enhanced pedagogy, which collectively strengthen educational equity and learning outcomes ([Azarshab et al., 2024](#); [Peng et al., 2024](#)). By fostering digital competence among academic staff and students, digital leadership helps narrow digital divides and promote inclusive education.

Beyond educational quality, digital leadership also contributes to SDG 9 (Industry, Innovation, and Infrastructure) and SDG 16 (Strong Institutions) by strengthening institutional capacity, innovation ecosystems, and governance structures. Digital leaders promote evidence-based decision-making, transparency, and organizational agility through the strategic use of digital platforms and analytics ([Akhmad, 2025](#)). These practices enhance institutional accountability and resilience, particularly in times of crisis such as the COVID-19 pandemic, where digitally led institutions demonstrated greater adaptability and continuity of operations ([Kaul et al., 2020](#); [Weaver et al., 2022](#)).

Furthermore, digital leadership supports SDG 17 (Partnerships for the Goals) by enabling cross-sectoral collaboration and global knowledge exchange. Digital platforms and networks facilitate partnerships between universities, industry, government, and international organizations, amplifying the impact of higher education on sustainable development initiatives ([Trevisan et al., 2023](#)). Consequently, digital leadership in higher education should be viewed not merely as a technological or managerial function, but as a strategic enabler of sustainable development. Strengthening digital leadership capabilities among higher education leaders is therefore essential to maximize the sector's contribution to the SDGs and to ensure that digital transformation aligns with long-term societal and environmental goals.

### 3. Research Method

This study employed a bibliometric research design to systematically map and analyze the intellectual structure and research trends of digital leadership in higher education. Bibliometric analysis was selected for its ability to quantitatively synthesize large bodies of scientific literature and identify patterns of knowledge production, thematic evolution, and scholarly influence. The data were retrieved from the Dimensions database, which provides comprehensive coverage of peer-reviewed journals in education, management, and social sciences. A structured search strategy was applied using combinations of relevant keywords such as “digital leadership” and “higher education”, limited to journal articles published between 2015 and 2025 and written in English. The initial search yielded 233 documents, which formed the preliminary dataset for further screening.

Following data retrieval, a screening process was conducted in Microsoft Excel to assess the dataset's relevance and quality. Inclusion criteria consisted of (1) empirical journal articles focusing on digital leadership within the context of higher education, (2) publications written in English, and (3) studies presenting original research findings. Exclusion criteria included (1) non-English publications, (2) studies addressing leadership styles other than digital leadership, and (3) secondary studies such as systematic literature reviews, bibliometric analyses, scoping reviews, and conceptual or theoretical papers. During this screening process, 30 documents were excluded, leaving a final dataset of 203 eligible articles for bibliometric analysis.

Table 1. Dataset Identification and Screening Process

| Screening stage                           | Number of documents | Explanation                                                                                                                                                             |
|-------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial records retrieved from Dimensions | 233                 | Records identified using the search keywords related to “digital leadership” and “higher education” for 2015–2025                                                       |
| Documents excluded                        | 30                  | Non-English, non-empirical, conceptual papers, reviews, bibliometric studies, scoping reviews, or papers not directly focused on digital leadership in higher education |
| Final bibliometric corpus                 | 203                 | Eligible empirical articles used for publication trend analysis and VOSviewer visualization                                                                             |

The final dataset of 203 eligible articles constituted the bibliometric corpus of this study. This number should be distinguished from the number of references listed at the end of the manuscript. The bibliometric corpus refers to all records retrieved, screened, and analyzed quantitatively using Microsoft Excel and VOSviewer, whereas the reference list contains only the publications directly cited in the manuscript to support the theoretical background, methodological explanation, and discussion. Therefore, the number of bibliometric records analyzed in Figures 1 and 2 is not expected to be identical to the number of references cited in the manuscript.

#### 4. Findings and Discussions

This section presents and discusses the results of the bibliometric analysis on digital leadership in higher education based on the final dataset of eligible publications. Using VOSviewer, the analysis explores publication trends, collaboration patterns, influential sources, and thematic structures within the field. The findings provide a comprehensive overview of the evolution, intellectual landscape, and emerging research directions of digital leadership in higher education, serving as a foundation for identifying research gaps and formulating future research agendas.

##### 4.1 Publication Trends

Figure 1 below illustrates the annual publication trend of research on digital leadership in higher education from 2015 to 2025, providing an overview of the growth and evolution of scholarly attention to this topic over time.

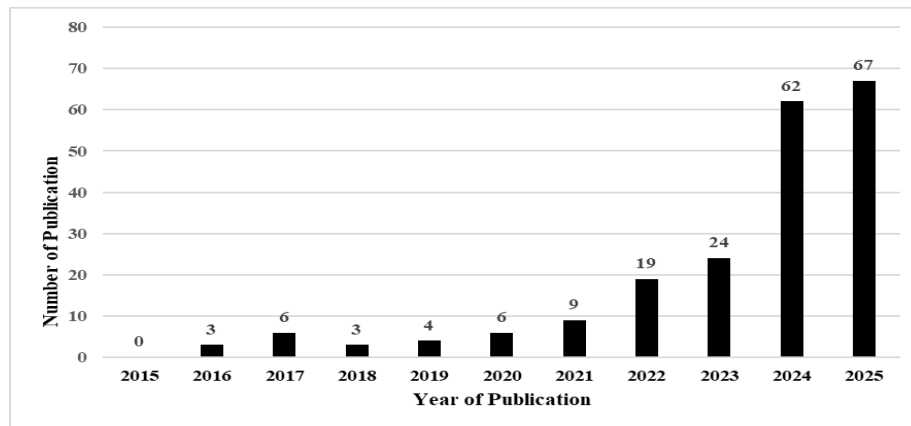


Figure 1. Publication Trend 2015-2025

*Source: Author's analysis, 2026*

Note: Annual publication counts sum to 203 articles, representing the final bibliometric corpus.

Specifically, the annual distribution consists of 0 articles in 2015, 3 in 2016, 6 in 2017, 3 in 2018, 4 in 2019, 6 in 2020, 9 in 2021, 19 in 2022, 24 in 2023, 62 in 2024, and 67 in 2025, resulting in a total of 203 articles.

The publication trend indicates clear, accelerating growth in research on digital leadership in higher education over the period 2015–2025. From 2015 to 2019, scholarly output remained relatively low and sporadic, suggesting that digital leadership remained an emerging and underexplored topic during this period. A noticeable increase began in 2020, coinciding with the rapid digital transformation of higher education, particularly driven by the COVID-19 pandemic. The number of publications rose substantially from 9 articles in 2021 to 19 in 2022 and continued to grow in 2023. A sharp surge is observed in 2024 and 2025, with 62 and 67 publications respectively, reflecting heightened academic attention and the consolidation of digital leadership as a critical research domain in higher education. This trend highlights the growing recognition of digital leadership as a strategic capability for managing institutional transformation, resilience, and sustainability in the digital era.

#### *4.2 Co-Authorship by Document Analyses*

The co-authorship analysis reveals a fragmented authorship structure in digital leadership research within higher education. Most authors contribute only a single publication to the field, indicating that research activities are largely conducted by individual scholars or small research teams. Although several authors exhibit high citation counts, their contributions to digital leadership in higher education remain limited in volume, suggesting cross-disciplinary engagement rather than sustained thematic specialization. This pattern reflects the emerging and interdisciplinary nature of the field. This condition is depicted in Figure 2 below.

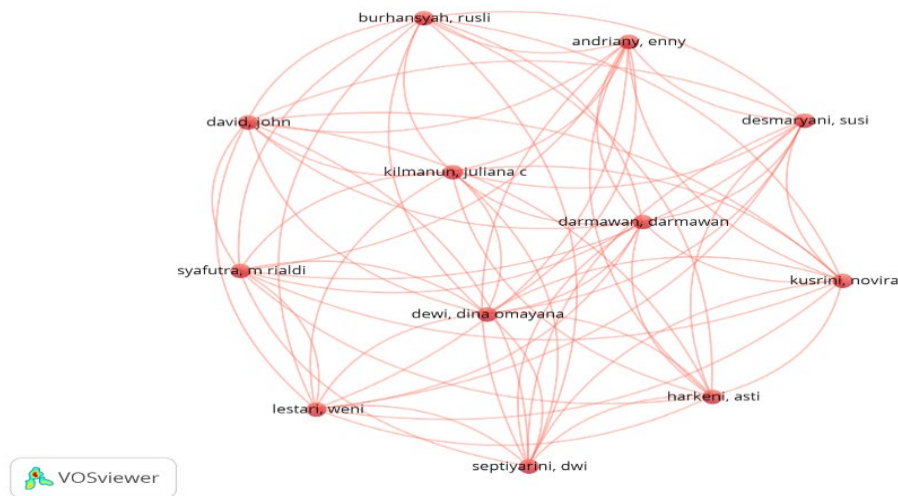


Figure 2. Network Visualization of Co-authorship by Documents

*Source: Author's bibliometric analysis using VOSviewer, 2026*

Note: Generated from the 203-article corpus; only linked authors meeting the VOSviewer threshold are displayed.

Figure 2 was generated using the final bibliometric corpus of 203 eligible articles exported from Dimensions into VOSviewer. However, the number of visible nodes in the network does not represent the total number of articles in the corpus. In VOSviewer, network visualizations display only items that meet the selected threshold and have link strength with other items. Therefore, Figure 2 should be interpreted as a co-authorship network derived from the 203-article corpus, not as a visual list of all 203 articles.

The co-authorship network visualization was generated using a small collaboration structure within digital leadership research in higher education. The network is characterized by a single dominant cluster, indicating that collaborative activities are dispersed across multiple independent research communities. Most authors in the network are connected through multiple co-authorships, despite each contributing relatively few publications to the field.

The dense but compact nature of the co-authorship network reflects the emerging and interdisciplinary character of digital leadership research in higher education. While the presence of numerous links indicates active collaboration, the absence of multiple large clusters suggests that the field has not yet developed distinct schools of thought or stable research consortia. This fragmentation may be attributed to the cross-cutting nature of digital leadership, which intersects educational leadership, information technology, organizational management, and policy studies. Consequently, researchers may engage with the topic episodically rather than as a sustained core research agenda. From a governance and educational administration perspective, this finding highlights an opportunity for stronger international and inter-institutional research partnerships to consolidate knowledge development and advance theoretical and empirical maturity in digital leadership within higher education.

#### 4.3 Co-Authorship by Country Analyses

To supplement the co-authorship analysis by taking documents into consideration, we also ran a co-authorship analysis by author nation to gain an overview of the countries that publish the most studies on digital leadership in higher education. This distribution is depicted in Figure 3

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below.

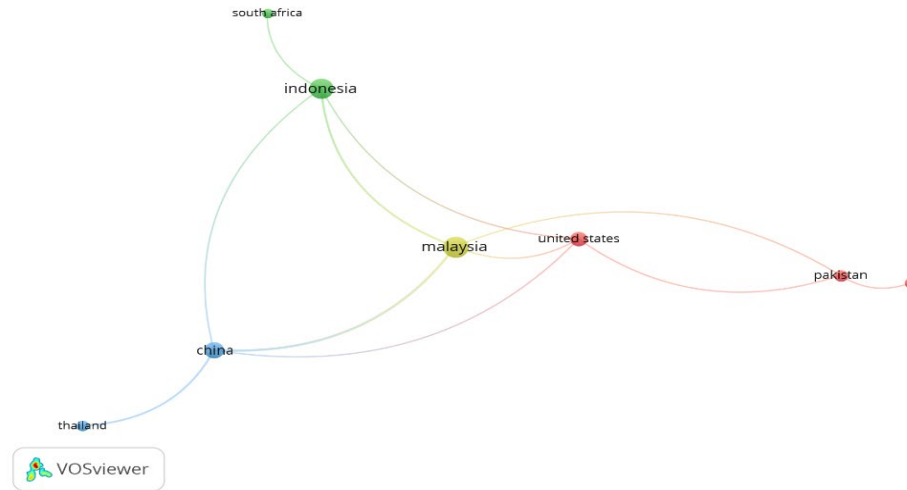


Figure 3. Network Visualization of Co-authorship by Country

*Source: Author's bibliometric analysis using VOSviewer, 2026*

Note: Generated from the 203-article corpus; only linked countries meeting the VOSviewer threshold are displayed.

The co-authorship analysis by country reveals an uneven and regionally concentrated pattern of scholarly collaboration in digital leadership research within higher education. As shown in VOSviewer network visualization, research output is dominated by a limited number of countries, primarily from Asia, with Malaysia (19 documents), Indonesia (18 documents), and China (11 documents) emerging as the most productive contributors. This indicates that digital leadership in higher education has gained particular academic attention in developing and emerging economies, where digital transformation in educational institutions is often driven by policy reform, infrastructure development, and post-pandemic adaptation.

In terms of scholarly influence, Malaysia (133 citations) and Indonesia (113 citations) show relatively high citation counts per publication, suggesting that studies from these countries are not only prolific but also impactful within the field. The United Kingdom presents an interesting case: despite producing a moderate number of documents (5), it records a high citation count (115), indicating strong international visibility and theoretical influence. This pattern suggests that research from developed countries may play a conceptual or foundational role, even when empirical output is limited.

The VOSviewer network visualization further confirms that international collaboration remains relatively sparse and clustered, with only a few cross-country links connecting Asia, North America, and Europe. The network's limited density suggests that research on digital leadership remains fragmented across national contexts and lacks a globally integrated research agenda. This fragmentation presents a clear opportunity for future studies to promote cross-national collaboration, comparative research designs, and shared theoretical frameworks, particularly between high-citation but low-collaboration countries and emerging research hubs in Asia.

#### 4.4 Citation Analysis by Author

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Citation analysis is a fundamental technique in bibliometric studies that identifies influential publications, authors, and intellectual structures within a research field. By examining citation relationships, this analysis highlights seminal works that shape theoretical foundations, methodological approaches, and research directions over time. In the context of digital leadership in higher education, citation analysis helps reveal dominant scholarly contributions, knowledge diffusion patterns, and the extent to which certain studies function as central references across related research streams. The citation network visualization generated using VOSviewer is presented below to illustrate these relationships and influence patterns among key publications.

The results of the citation analysis can be seen in Figure 4 below.

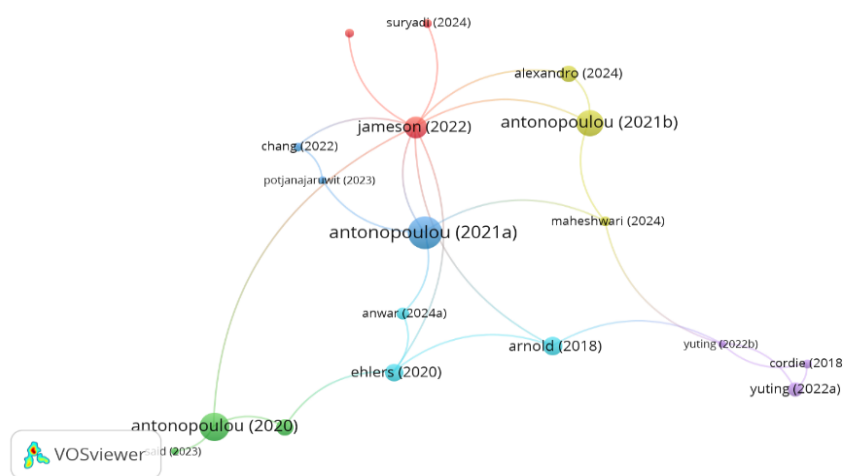


Figure 4. Network Visualization of Citation Analysis by Author

*Source: Author's bibliometric analysis using VOSviewer, 2026*

Note: Generated from the 203-article corpus; only cited authors/documents meeting the VOSviewer threshold are displayed.

The citation network visualization reveals a structured yet moderately fragmented pattern of knowledge development in digital leadership research within higher education. A small number of publications occupy central positions in the network, indicating their strong influence and frequent citation by subsequent studies. These central nodes serve as intellectual anchors, connecting multiple citation paths across the network, while several other publications appear as peripheral nodes with few citation links.

The configuration of the citation network suggests that digital leadership research in higher education has evolved through the influence of a limited set of seminal and bridging studies rather than through a tightly integrated theoretical tradition. Highly cited publications appear to serve as reference points selectively adopted by later research, reflecting the interdisciplinary nature of the field, which draws on educational leadership, digital transformation, and organizational studies. However, the relatively sparse interconnections among citation clusters indicate that theoretical integration remains partial, with studies often building on specific conceptual lenses rather than converging toward a unified framework. This pattern underscores the need for cumulative and theory-driven empirical research to strengthen coherence and advance digital leadership as a mature domain within higher education scholarship.

#### 4.5 Citation Analysis by Source

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After mapping the citation analysis by Author, we proceeded to citation analysis by Source, examining the relationships between journals cited by authors in the field of digital leadership in higher education. The results of this analysis are shown in Figure 5 below.

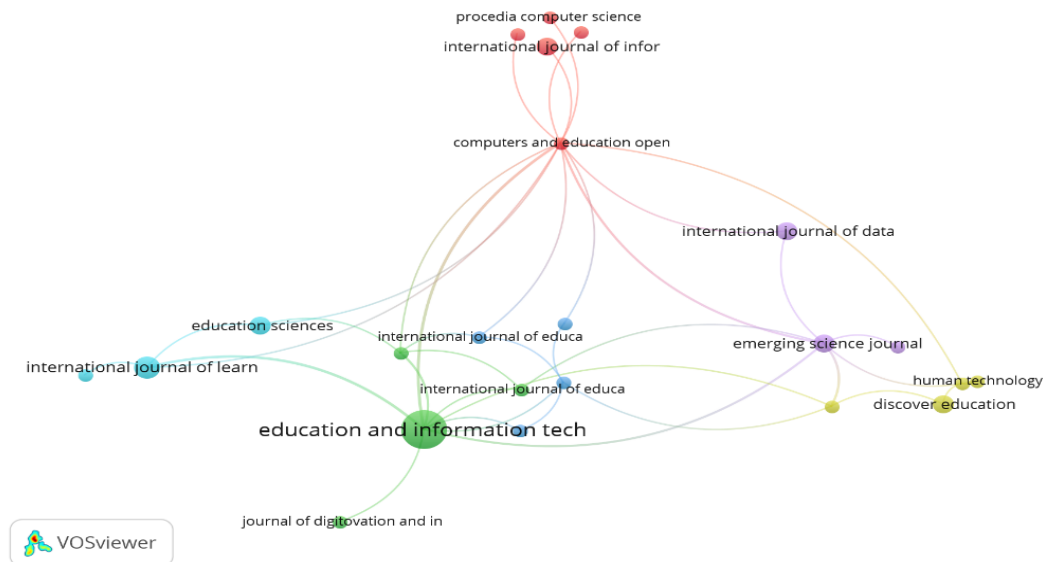


Figure 5. Network Visualization of Citation Analysis by Source

*Source: Author's bibliometric analysis using VOSviewer, 2026*

Note: Generated from the 203-article corpus; only cited sources meeting the VOSviewer threshold are displayed.

The source-based citation network visualization illustrates the structural relationships among journals contributing to digital leadership research in higher education. The network is organized around a small number of central sources that act as major knowledge hubs, most notably journals focusing on education technology and information systems in education. These central nodes demonstrate stronger link strengths and denser citation connections with multiple surrounding journals, indicating their pivotal role in disseminating influential research. In contrast, several peripheral sources exhibit weaker connections and fewer citation links, suggesting more specialized or occasional contributions to the field rather than sustained thematic engagement.

The source network shows that digital leadership research in higher education is interdisciplinary, with educational technology journals acting as key bridges between education, management, and technology fields. This indicates that the topic is strongly connected to digital transformation, learning technologies, and institutional innovation, rather than being limited to traditional leadership studies. However, citations remain spread across many sources, suggesting that the field is still emerging and lacks a dominant publication venue. Greater cross-citation and more consistent publication streams are needed to strengthen theoretical coherence and support the maturation of digital leadership research.

#### 4.6 Bibliometric Coupling Analysis

A bibliometric method called bibliometric coupling is used to determine whether two articles are intellectually similar based on the number of references they share. Bibliometric coupling is especially helpful for mapping current research streams and growing intellectual

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communities, as it captures the current alignment of authors and documents, whereas citation analysis reflects past influence. This study uses bibliometric coupling analysis to investigate the connections between empirical research on digital leadership in higher education based on shared theoretical underpinnings, methodological techniques, and reference bases. The structure of these intellectual connections, derived from the 203-article bibliometric corpus, is presented in the VOSviewer network visualization in Figure 6.

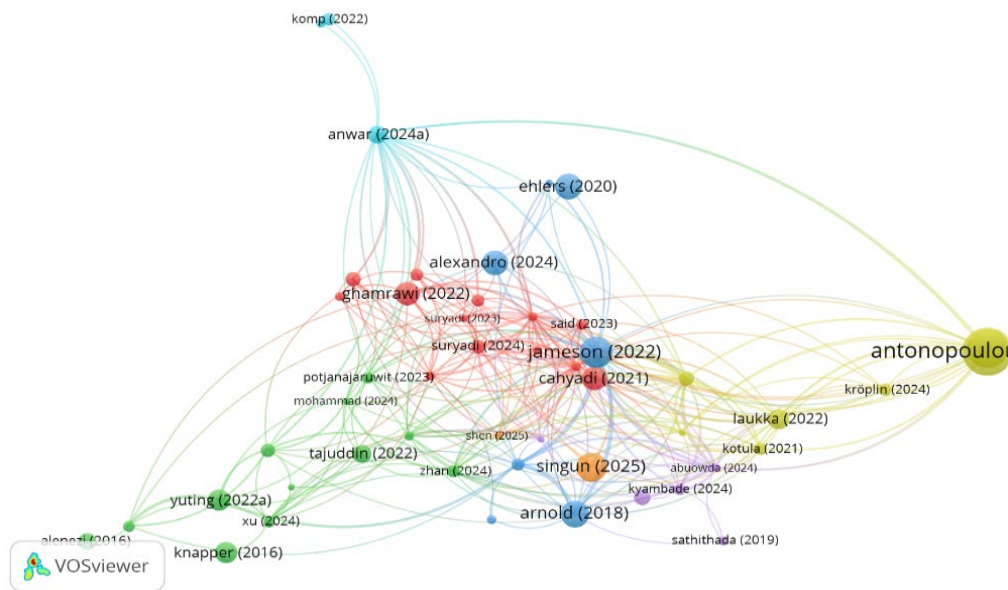


Figure 6. Bibliometric Coupling Network of Digital Leadership Research in Higher Education

*Source: Author's bibliometric analysis using VOSviewer, 2026*

Note: Generated from the 203-article corpus; only documents with shared-reference links meeting the VOSviewer threshold are displayed.

The bibliometric coupling map reveals several distinct yet interconnected clusters of authors, indicating the presence of multiple intellectual streams within digital leadership research in higher education. Central nodes such as [Jameson et al. \(2022\)](#), [Ehlers \(2020\)](#), [Anwar & Saraih \(2024a, 2024b\)](#), [Antonopoulou et al. \(2020, 2025\)](#) and [Singun \(2025\)](#) exhibit relatively large node sizes and dense linkages, suggesting that these works share substantial reference overlap with numerous other studies and function as intellectual anchors within the field. The proximity of nodes within each cluster reflects strong thematic similarity, while inter-cluster connections indicate shared conceptual or methodological foundations across different research perspectives.

Several clusters appear to be organized around specific emphases, including digital leadership models and competencies, organizational and management perspectives, innovation and performance outcomes, and the integration of digital leadership with sustainability and transformation agendas in higher education. The presence of both mature and recently published works within the same clusters suggests an ongoing accumulation of knowledge rather than isolated or fragmented research efforts.

Research on digital leadership in higher education is organized around a number of related but thematically distinct intellectual clusters, according to the bibliometric coupling analysis. A convergence around comparable theoretical underpinnings and empirical concerns is suggested

by the significant overlap of references among highly connected authors like [Jameson et al. \(2022\)](#), [Ehlers \(2020\)](#), [Anwar & Saraih \(2024b\)](#), and Antonopoulou et al. (2020, 2025). This pattern illustrates the field's increasing coherence, especially in research on organizational transformation, performance- related outcomes in higher education institutions, and digital leadership competencies.

However, the partial separation between clusters shows that important subjects, like innovation, sustainability, and institutional management, are frequently studied separately rather than using integrated analytical frameworks. Future research has the opportunity to connect these thematic domains and develop more comprehensive models of digital leadership that link leadership practices to stakeholder outcomes, institutional performance, and long-term sustainability. Overall, the bibliometric coupling results show that although the area is developing, further theoretical integration and cross-cluster empirical study are still required

#### *4.7 Keyword Co-occurrence and Thematic Clusters*

Co-occurrence analysis is a bibliometric technique that examines the frequency and co-occurrence of keywords or concepts in publications to determine the conceptual structure of a research field. By mapping the frequency with which particular terms co-occur in the same papers, this analysis helps identify emerging subjects, prevailing themes, and connections between fundamental concepts. Co-occurrence analysis in the context of digital leadership in higher education reveals thematic clusters and research emphases that characterize the field's intellectual landscape by illuminating the connections between leadership, technology, organizational change, and educational outcomes. To show these thematic linkages, the network visualization of keyword co-occurrence created with VOSviewer is shown in figure 7 below.

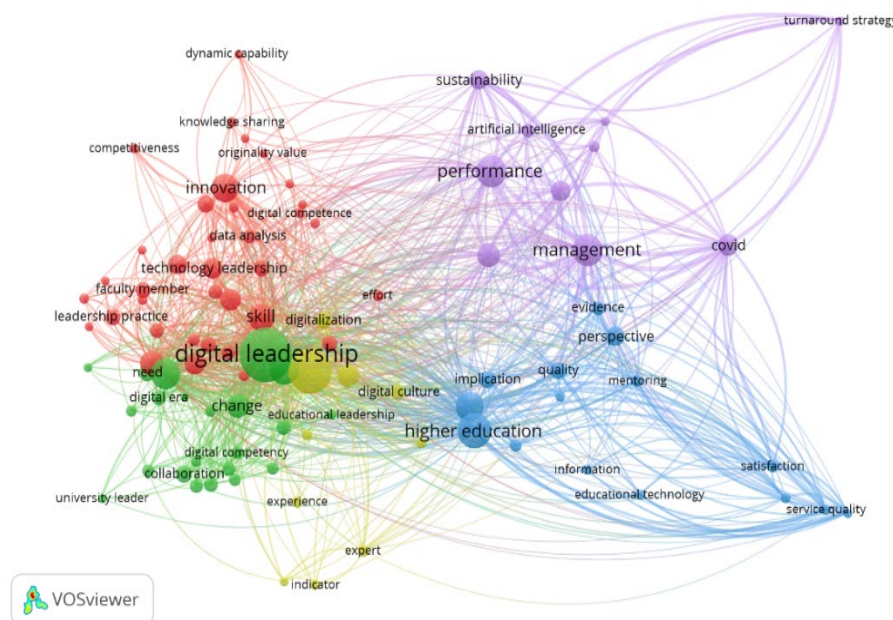


Figure 7. Co-occurrence Network Visualization Analysis

*Source: Author's bibliometric analysis using VOSviewer, 2026*

Note: Generated from the 203-article corpus; only keywords meeting the VOSviewer occurrence threshold are displayed.

The keyword co-occurrence analysis shows that digital leadership research in higher education is organized around several connected themes. Digital leadership appears as the central concept, closely linked to innovation, digital competence, technology leadership, and change. This indicates that the field mainly focuses on leadership capabilities needed to guide digital transformation. Other clusters highlight managerial, educational, and capability-related themes, such as performance, sustainability, educational technology, service quality, digital culture, and collaboration. Overall, the strong links among these clusters suggest that digital leadership is an integrative concept that connects leadership practices, technological innovation, and institutional performance.

The thematic structure highlighted by the co-occurrence network reflects the evolving and multidimensional nature of digital leadership research in higher education. The prominence of innovation-, competence-, and change-related keywords underscores the field's strong orientation toward capability development and adaptive leadership in response to rapid digitalization. At the same time, the close linkage between digital leadership and performance-oriented themes—such as management effectiveness, service quality, and stakeholder satisfaction—indicates an increasing emphasis on measurable organizational outcomes. The presence of sustainability, artificial intelligence, and post-pandemic terms further suggests a recent shift toward strategic and long-term perspectives, positioning digital leadership as a critical enabler of institutional resilience and transformation. Overall, these findings confirm that digital leadership research is transitioning from an exploratory phase toward a more outcome-driven, strategic discourse, while retaining thematic diversity that reflects its interdisciplinary foundations.

An overlay visualization analysis was also performed on the VOS viewer to observe variations in co-occurrence over a number of years; the mapping findings are displayed in figure 8 below.

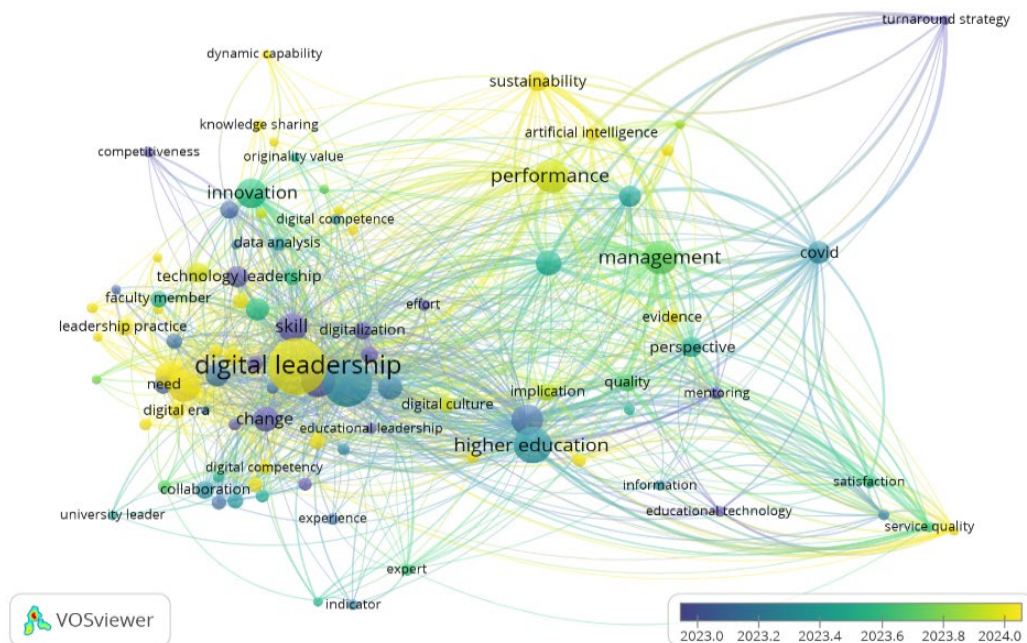


Figure 8. Overlay Visualization of Co-occurrence Analysis

Source: Author's bibliometric analysis using VOSviewer, 2026

Note: Generated from the 203-article corpus; colors indicate the average publication year of

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keywords meeting the VOSviewer threshold.

The overlay visualization reveals a clear temporal evolution of research themes in digital leadership within higher education. Earlier studies (indicated by darker blue tones, around 2023) are predominantly concentrated on foundational concepts such as higher education, educational technology, service quality, satisfaction, and educational leadership. These themes reflect an initial focus on institutional adaptation, teaching–learning processes, and quality assurance during and immediately after the COVID-19 period. Core constructs such as digital leadership and change appear as transitional nodes, bridging earlier pedagogical and organizational concerns with more recent strategic and performance-oriented discussions.

More recent publications, shown in green to yellow tones (2023.8–2024), indicate a shift toward strategic themes such as performance, sustainability, artificial intelligence, innovation, digital competence, and dynamic capability. This pattern suggests that digital leadership research is moving beyond technology adoption and instructional concerns toward institutional transformation, resilience, and evidence-based management in higher education. Overall, the overlay visualization reflects the maturation of the field toward more integrative, outcome-oriented, and future-focused leadership perspectives.

The co-occurrence map shows that research on digital leadership forms five major thematic clusters that strongly overlap, with digital leadership and higher education as central nodes. The first and largest cluster focuses on digital leadership practices in higher education institutions, encompassing terms such as digital leadership, technology leadership, educational leadership, leadership practice, and faculty member. This cluster represents the conceptual and empirical foundation of the research, where digital leadership is understood as a response to the needs of educational organizational change in the digital age. The close association with the terms "change," "digital era," and "digital culture" suggests that digital leadership is positioned more as a mechanism for institutional adaptation rather than simply the adoption of technology.

The remaining clusters extend the discussion toward broader impacts and outcomes, linking digital leadership with performance, management, innovation, dynamic capability, sustainability, service quality, and stakeholder satisfaction. The emergence of artificial intelligence, digitalization, and data analysis in recent publications (2023–2024) indicates a shift in research from pedagogical and operational concerns toward strategic, data-driven, and managerial perspectives. Overall, the interconnected clusters suggest that although digital leadership research remains spread across education, management, technology, and performance domains, it is increasingly converging toward an outcome-oriented model emphasizing organizational performance, innovation, and sustainability.

Five highly related primary clusters were found in the co-occurrence analysis results, suggesting that research on digital leadership in higher education is evolving as a multifaceted discipline rather than a single subject. The interdependence of the clusters demonstrates that digital leadership does not function in a vacuum; rather, it is influenced by external contextual factors like AI and crises (COVID-19) as well as person talents, corporate culture, managerial methods, and institutional consequences. The following is an explanation of the five clusters:

- *Cluster 1: Digital Leadership & Leadership Practices (Core Cluster):* This cluster includes key terms such as digital leadership, leadership practice, technology leadership, academic leader, digital era, digital literacy, and educational leadership. It represents the conceptual core of the map, positioning digital leadership as a strategic capability of academic leaders in responding to digital transformation. The cluster highlights how

leaders in higher education shape digital vision, governance, and change management. However, many existing studies remain descriptive and context-specific, with limited integration between leadership practices, institutional outcomes, and theoretical models. Future research should examine how digital leadership contributes to governance quality, strategic alignment, ethical decision-making, institutional effectiveness, and accountability, particularly in relation to SDG 4 and SDG 8.

- *Cluster 2: Digital Competence, Skills & Individual Capability:* This cluster highlights the importance of individual-level capabilities, including digital competence, leadership skills, and professional readiness among academic leaders, faculty, and administrators. Bibliometric findings indicate fragmented research focusing on isolated competencies rather than systemic capability development. Future studies should investigate how digital leadership fosters continuous professional development, reskilling, and upskilling within higher education institutions. Research examining the mediating role of digital competence between leadership practices and educational outcomes would provide deeper insight into how leadership-driven capability building contributes to lifelong learning and workforce readiness, aligning strongly with SDG 4 and SDG 8.
- *Cluster 3: Higher Education System, Educational Technology & Student Outcomes:* This cluster emphasizes the systemic role of digital leadership in shaping educational technology adoption and student-related outcomes. While existing studies frequently address technology integration, fewer examine how leadership decisions affect learning quality, student engagement, and equity. Future research should focus on the relationship between digital leadership, pedagogical innovation, and inclusive education, particularly in diverse and resource-constrained contexts. Investigating how leadership-driven digital strategies reduce educational inequalities and improve student success would strengthen the empirical linkage between digital leadership and SDG 4 and SDG 10.
- *Cluster 4: Organizational Management, Performance & Sustainability:* This cluster shifts the focus from individuals to organizational-level outcomes. Digital leadership is associated with organizational performance, service quality, and sustainability. The bibliometric analysis reveals increasing attention to organizational performance and sustainability, yet the coupling results indicate limited integration between leadership practices and long-term sustainability indicators. Future research should explore how digital leadership influences organizational performance, innovation capacity, and sustainable resource management in higher education institutions. Empirical models examining digital leadership as a driver of sustainable institutional transformation would provide valuable insights into how higher education can contribute to responsible governance and innovation, supporting SDG 9, SDG 12, and SDG 4.
- *Cluster 5: Artificial Intelligence, Crisis Context & Strategic Adaptation:* This emerging cluster reflects recent scholarly attention to artificial intelligence, crisis leadership, and strategic adaptation in response to disruptions such as the COVID-19 pandemic. Bibliometric findings suggest that research in this area is still nascent and weakly connected to core digital leadership theories. Future studies should examine how digital leadership enables higher education institutions to strategically adopt AI technologies, manage crises, and build institutional resilience. Research on ethical AI governance, adaptive leadership, and crisis preparedness would strengthen digital leadership's contribution to resilient educational systems and effective institutional governance, in line with SDG 4 and SDG 16.

When combined, these five clusters show that research on digital leadership in higher education spans the human, organizational, and systemic levels, each of which makes a unique contribution to achieving the SDGs related to education. Future studies should progressively use multi-level, integrative methodologies that link institutional performance, digital capabilities, leadership practices, and social effects. This strategy will improve the practical contribution of digital leadership scholarship to inclusive and sustainable higher education systems in addition to advancing theoretical progress.

#### *4.8 Research Gaps and Future Research Agenda*

The identification of research gaps and the formulation of a future research agenda in this study are explicitly grounded in the findings of the bibliometric analysis rather than subjective interpretation. Following established bibliometric research guidelines, gaps are derived from patterns observed in publication trends, citation structures, co-occurrence networks, bibliometric coupling, source impact, and country-level collaboration maps. Such an evidence-based approach enables scholars to systematically identify underexplored themes, fragmented research streams, and emerging topics that lack theoretical integration or empirical depth.

Prior bibliometric studies emphasize that research gaps should be inferred from structural voids, weakly connected clusters, temporal shifts in thematic emphasis, and dominance imbalances among influential publications or regions. Accordingly, the future research agenda proposed in this study is synthesized from the convergence of keyword co-occurrence clusters, citation influence patterns, source distribution, and international collaboration structures identified through VOSviewer analysis, ensuring that the proposed directions are firmly anchored in the empirical intellectual landscape of digital leadership research in higher education.

Based on the five clusters presented above, the literature shows that digital leadership operates through digital competencies and organizational culture, building institutional capabilities that ultimately influence the performance, quality of service, and sustainability of higher education—with AI and crisis as the main moderating contexts.

The following are the future research agendas and propositions, specifically:

- *Toward an Integrated Research Agenda on Digital Leadership in Higher Education:* The bibliometric mapping reveals that research on digital leadership in higher education has evolved into a multicluster yet weakly consolidated domain. Although strong interconnections exist among clusters, particularly between digital leadership, digital competence, organizational performance, and higher education outcomes, the literature remains fragmented across theoretical traditions, levels of analysis, and methodological approaches.

Co-occurrence and bibliometric coupling analyses indicate that most empirical studies focus on isolated relationships, such as digital leadership and technology adoption or leadership practices and digital competence, without embedding these relationships within a coherent explanatory framework. Furthermore, citation and source analyses suggest that influential studies are dispersed across education, management, and technology journals, reinforcing disciplinary silos.

Based on these findings, a future research agenda should prioritize theoretical integration, causal modeling, and contextualization, particularly in relation to emerging technologies (e.g., artificial intelligence) and post-pandemic institutional transformation.

- *Research Agenda by Thematic Cluster:*

Published by:

- a) *Digital Leadership as a Strategic Capability (Cluster)* : Existing studies predominantly conceptualize digital leadership as a set of individual leader behaviors or practices, often measured through perceptual indicators. However, bibliometric evidence shows limited theorization of digital leadership as a strategic organizational capability. Research agenda proposed on the future studies should reconceptualize digital leadership beyond leadership style and explore its role as a strategic capability that enables institutional transformation, particularly in higher education systems facing digital disruption. Future studies should empirically examine the mechanisms through which digital leadership competencies influence governance effectiveness, accountability, and decision-making quality in higher education institutions and also how higher education, thereby supporting the achievement of SDG 4 and SDG 16.
- b) *Digital Competence as a Micro-Foundation (Cluster 2)*: Co-occurrence patterns highlight digital competence and skills as central bridging concepts between leadership and organizational outcomes. Nevertheless, digital competence is often treated as a homogeneous construct, neglecting role- specific and hierarchical differences. The proposed research agenda is further research should examine digital competence as a multi-dimensional and role-contingent capability, distinguishing between leaders, faculty members, and administrative staff, and exploring its mediating or moderating role in leadership effectiveness. Future research should investigate the longitudinal impact of digital leadership on organizational performance and sustainability outcomes, including innovation capacity and resource efficiency. Is important to understand enhances organizational performance and innovation capability in higher education institutions, contributing to sustainable institutional development in line with SDG 9 and SDG 12.
- c) *Institutional Outcomes and Educational Quality (Cluster 3)*: The higher education cluster emphasizes outcomes such as service quality, student satisfaction, and educational technology use. However, citation analysis indicates that leadership variables are often peripheral rather than central explanatory factors. The proposed research agenda is that future research should develop integrated models that explicitly link digital leadership to educational outcomes through institutional processes such as digital culture, governance, and mentoring systems.
- d) *Organizational Performance and Sustainability (Cluster 4)*: The management and performance cluster reveals a growing interest in organizational performance and sustainability. Despite this, sustainability remains largely normative and under-operationalized, particularly in higher education contexts. For future research, proposed empirical models that position digital leadership as a driver of sustainable organizational performance, incorporating measurable indicators aligned with ESG and institutional resilience.
- e) *Artificial Intelligence and Crisis-Driven Leadership (Cluster 5)*: Overlay visualization identifies artificial intelligence and crisis contexts (e.g., COVID-19) as emerging and rapidly growing themes. However, AI is typically framed as a technological tool rather than a leadership context. Future studies should investigate digital leadership under AI-enabled and crisis-driven conditions, focusing on ethical governance, strategic adaptation, and decision-making under

uncertainty.

Collectively, these propositions suggest that future research should move beyond descriptive studies and adopt theory-driven, multilevel, and longitudinal designs. Advanced analytical techniques such as structural equation modeling, multilevel analysis, and mixed-method approaches are particularly well suited to test the proposed relationships.

By aligning empirical inquiry with the integrated framework derived from bibliometric evidence, future studies can contribute to a more cumulative, coherent, and policy-relevant body of knowledge on digital leadership in higher education.

## 5. Conclusion

A thorough bibliometric mapping of empirical research on digital leadership in higher education from 2015 to 2025 is presented in this paper. The results show a rapidly growing body of literature, especially after 2021, that reflects the increasing strategic significance of digital leadership in managing technological disruption, digital transformation, and post-pandemic issues in higher education institutions. This study analyzes important publication trends, significant authors and sources, patterns of collaboration, and the intellectual framework influencing the area through VOSviewer-based studies.

Five interrelated thematic clusters, including digital leadership practices, individual digital competency, higher education systems and student outcomes, organizational performance and sustainability, artificial intelligence, and crisis-driven strategic adaptation, are revealed by the co-occurrence analysis. These clusters show that governance quality, institutional performance, inclusivity, resilience, and sustainable development are all aspects of digital leadership education-related to Sustainable Development Goals, specifically SDG 4 (Quality Education), SDG 9 (Innovation), SDG 16 (Strong Institutions), and SDG 17 (Partnerships). The paper suggests a systematic future research agenda and testable hypotheses to direct integrative, longitudinal, and outcome-oriented studies based on the gaps found. All things considered, this bibliometric analysis increases academic knowledge of digital leadership in higher education and offers a solid basis for next studies, the creation of policies, and leadership practices in support of sustainable and technologically advanced educational institutions.

Despite its contributions, this study has several limitations. First, the analysis is based on a single bibliographic database, which may limit the coverage of relevant publications. Second, only English-language empirical studies were included, potentially excluding valuable insights from non-English contexts. Third, bibliometric analysis relies on metadata and keyword structures, which may not fully capture the depth of theoretical or methodological nuances within individual studies. Future research may address these limitations by incorporating multiple databases, expanding language coverage, and combining bibliometric techniques with qualitative or systematic review approaches.

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