

The Evolving Landscape of Virtual Leadership Research: A Decadal Bibliometric Mapping and Future Directions (2015–2025)

Yuliana Ramawati^{1*}

¹ Department of Management, Universitas Muhammadiyah Yogyakarta. Indonesia.

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*Corresponding Author:

Yuliana Ramawati

Email:
ana@umy.ac.id

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Abstract: The rapid shift to remote work and digital collaboration has left the consolidation of virtual leadership theories behind, so that the concept structure, research collaboration patterns, and direction of development of this field are still fragmented in various studies that run separately. Previous bibliometric research has only mapped publication trends or theme clusters separately, no one has yet combined the collaborative network of authors, institutions, and countries with theme mapping in one complete analysis, so it is difficult to see how contributors and research themes develop along with this gap is answered by this study by analyzing 688 Scopus indexed articles for the period 2015–2025 using *Biblioshiny* to analyze the performance of publications and VOSviewer to map collaboration networks as well as keyword co-occurrences. As a result, the number of publications jumped sharply from 12 articles in 2015 to 252 articles in 2025, and this field is divided into four main theme clusters: communication and remote work management; digital leadership, organizational innovation, and sustainable performance; digital leadership competencies and employee welfare; and digital transformation and artificial intelligence. The chronological mapping shows a clear shift from operational issues in virtual teams to strategic issues such as digital maturity, organizational culture, and innovation capabilities, indicating that virtual leadership is now a multidimensional strategic capability rather than merely a technology-assisted leadership practice. Further research is suggested using longitudinal and multilevel designs to examine how trust, psychological safety, and digital fatigue affect the effectiveness of virtual leadership across various cultural and sectoral contexts, and to integrate these bibliometric results with systematic reviews and meta-analyses to validate the structure of the identified themes.

Keywords: Bibliometric Analysis, Digital Transformation, E-Leadership, Knowledge Mapping, VOSviewer.



1. Introduction

The development of digital technology has brought significant changes to almost all aspects of organizational life, from work patterns, communication systems, to leadership practices. Organizations must adapt to digital transformation to remain competitive in the global economy. These changes have accelerated since the pandemic, when work, communication, and decision-making activities increasingly rely on digital technology [1] [2] [3]. This condition means leadership can no longer be run with a traditional approach oriented toward control and supervision; it must evolve into a flexible, adaptive, collaborative, and technology-based leadership [4] [5] [6]. Digital transformation is not only about the use of technology but also involves changes in organizational culture, mindset, and human resources' ability to adapt to the digital work environment [7] [8] [9]. In this context, leadership plays a strategic role in guiding organizations to face change, build effective communication, and integrate technology with organizational needs.

These changes in work patterns have given rise to a new leadership concept known as virtual or digital leadership, also called e-leadership [10] [11]. Virtual leadership is not merely an extension of traditional leadership but rather demands a fundamental change in how leaders carry out their roles and interact with team members through technology [12] [13] [14]. This concept is understood as the process of influencing individuals, groups, or organizations by utilizing information technology to shape attitudes, thoughts, behaviors, and performance [15]. In practice, e-leadership effectively combines electronic communication and conventional communication, especially when leaders and team members are in different locations and interact through digital media [16].

Interest in virtual leadership research has continued to increase in recent years. However, the available literature remains partial and does not provide a comprehensive picture of the field's development. Most research focuses on leaders' competence in using digital technology, communicating through online media, and managing virtual teams, without situating these findings within the broader scientific development [17] [18]. Several studies have also found that implementing digital leadership plays an important role in increasing the effectiveness of teams working virtually [11] [19] [20]. However, the results of this research are still scattered across various disciplines, so they have not yet been able to fully describe the intellectual structure of the field of virtual leadership. As a result, the development of this field, including the most influential scientific actors, the patterns of research collaboration, and the evolution of research themes, remains incompletely understood [20] [21]. In addition, the concepts and focus of virtual leadership studies continue to evolve with the rapid advancement of digital technology, so the mapping needs to be updated regularly [22].

Mapping efforts using a bibliometric approach have indeed been conducted, but there are still some limitations. Banker, Garg, and Maggon combined a bibliometric analysis with a systematic literature review, using the Antecedents, Decisions, and Outcomes (ADO) and Theories, Contexts, and Methods (TCM) frameworks to classify the virtual leadership literature [23]. This approach provides a systematic conceptual synthesis, but it has not yet visualized how the network of collaboration between authors, institutions, and the state shapes the intellectual structure of this field. Meanwhile, Alkoud and Majeed analyzed global publication trends, influential contributors, and virtual leadership research theme groups during the period 2000–2024 [24]. Although it provides a broad overview of the field's development, the analysis remains descriptive and lacks a thematic map that could show the level of maturity, centrality, and potential for development of each research theme. The two studies have also not linked the pattern of scientific collaboration to the evolution of the research theme, so it is not possible to determine whether changes in research focus are driven by the emergence of new research groups or by shifts in the research agendas of existing groups.

These limitations indicate two important research gaps. First, there has been no research that integrates the analysis of scientific collaboration networks with thematic map visualization within a comprehensive bibliometric framework, so the relationship between scientific actors and the development of research themes has not been fully depicted. Second, no study has traced the chronological evolution of the theme of virtual leadership to explain how the focus of research shifts from operational issues, such as managing virtual teams, to strategic issues, such as digital maturity, organizational culture, and innovation capabilities. In fact, understanding these developments is very important so that future research not only repeats established themes but also identifies new research opportunities with greater scientific contribution.

To fill this gap, this study offers three main contributions. First, this study integrates the analysis of the collaborative network of authors, institutions, and countries using VOSviewer with Biblioshiny-based thematic map visualization in one complementary analysis framework. Second, this study

presents a chronological mapping of the research theme's evolution, showing a shift in focus from operational to strategic issues, such as digital maturity, organizational culture, and innovation capabilities. Third, this study extends the analysis period to 2025 to capture the latest developments in publications that have not been covered in previous bibliometric studies. Thus, this research is expected to provide a more comprehensive understanding of intellectual structures, patterns of scientific collaboration, and the direction of development of virtual leadership research.

Based on these urgency, gaps, and objectives, the research questions are formulated as follows:

- 1) RQ1: How is the trend of research publications on virtual leadership at the global level during the period 2015–2025?
- 2) RQ2: Who are the authors, journals, and most influential countries in research on virtual leadership?
- 3) RQ3: What is the pattern of scientific collaboration between authors, institutions, and countries in research on virtual leadership?
- 4) RQ4: What are the main themes that are developing, and what is the direction of virtual leadership research in the future based on bibliometric analysis?

2. Literature Review

2.1. Virtual Leadership Concept

Virtual leadership is a form of leadership carried out through digital information and communication technology, especially when leaders must direct, coordinate, and nurture team members in different geographical locations without face-to-face interaction [25]. This concept has its roots in the idea of e-leadership introduced by Avolio and Kahai, which refers to leadership in a technology-based work environment mediated by digital communication [26]. In contrast to traditional leadership that relies on physical proximity, virtual leadership requires the ability to build relationships, convey vision, and maintain team commitment through digital media [27].

Conceptually, e-leadership is not just a technical adaptation of conventional leadership. Technology fundamentally changes the pattern of interaction between leaders and team members so that the effectiveness of leadership is not only determined by the ability to use technology, but also by the ability to build trust, maintain engagement, and create a sense of community in a virtual work environment [26] [28]. Therefore, trust is the main foundation of the success of a virtual team because it must be built through consistent, open, and transparent communication [28].

2.2. Virtual Leadership in a Digital Work Environment

In the post-pandemic digital work environment, virtual leadership is becoming increasingly important as organizational coordination no longer relies on face-to-face interactions. Chouhan and Shukla show that the emotional intelligence of leaders plays an important role in transforming digital communication into effective leadership [29]. On the other hand, Pinto, Figueiredo, and Rodrigues emphasized that leaders need to play the role of facilitators who are able to reduce information fragmentation and social isolation in geographically dispersed teams [30].

The success of virtual leadership in crisis situations depends on the leader's ability to maintain social connections, commitment, and performance through a digital work ecosystem [31]. Thus, virtual leadership can be understood as a strategic capability that integrates technology, human relations, and organizational governance so that communication, coordination, and decision-making remain effective [27].

2.3. Virtual Leadership Dimension

Various interrelated dimensions determine the effectiveness of virtual leadership. Syaefullah, Sari, and Ahmed show that implementing digital leadership contributes to the effectiveness of remote team collaboration [32], while Munawaroh et al. emphasize the importance of leaders' digital capabilities in improving the performance of Generation Z workers [33].

In addition to digital competencies, clear and timely communication is the main foundation of working relationships in virtual teams [34]. Caputo et al. added that effective coordination, clear division of tasks, and hybrid team management are prerequisites for the success of virtual work [35]. Sperry et al. also show that team chartering can increase role clarity and reduce conflict in virtual teams [36]. Meanwhile, Abdurrahim emphasized that virtual engagement, through motivation, active participation, and continuous feedback, is an important dimension for maintaining team member engagement in the long term [37].

2.4. Digital Leadership and Organizational Innovation

The latest literature shows that the focus of virtual leadership research has shifted from virtual team management to the strategic role of leaders in driving organizational innovation. Transformational leadership has been shown to enhance employees' innovative behavior through psychological empowerment and work engagement, making a supportive work environment an important factor in encouraging innovation [38]. In addition, digital leadership plays a role in building digital capabilities, green innovation, and an organizational learning culture that supports sustainable transformation [39]. Other research also shows that dynamic capabilities and digital culture are important prerequisites for leaders to direct digital transformation and generate innovation effectively. Thus, the success of digital leadership depends not only on the leader's individual capabilities but also on the organizational culture and learning capabilities that support change.

2.5. Digital Leadership Competencies and Employee Welfare

The increasing adoption of remote and hybrid work has made employee well-being an important concern in digital leadership research. Research shows that digital fatigue can reduce concentration, motivation, and work engagement if the use of technology is not managed in a balanced manner [40]. In line with that, studies on virtual and hybrid teams show that leaders who prioritize well-being, build psychological safety, and maintain a work-life balance can significantly improve team performance [41]. Mohase, Donald, and Israel also found that inclusive leadership improves psychological safety, which encourages employees to be more open in sharing ideas, inputs, and problems in the work environment [42]. In addition, the success of digital organizations requires alignment between digital transformation strategies and welfare and inclusion policies so that productivity can be maintained in the long term. In addition, the success of digital organizations requires alignment between digital transformation strategies and welfare and inclusion policies so that productivity can be maintained in the long term [43]. Therefore, digital leadership competencies include not only the ability to utilize technology, but also the ability to maintain psychological well-being and the quality of working relationships in virtual teams.

2.6. Digital Transformation, Artificial Intelligence, and the Future of Virtual Leadership

Digital transformation and artificial intelligence (AI) are two of the most rapidly developing themes in virtual leadership research. Bevilacqua et al. explained that AI has changed managerial processes and decision-making, so leaders need to be able to integrate AI technology into organizational strategies effectively [44]. These findings are in line with the fourth cluster in the study that links digital transformation, AI, digital maturity, business model innovation, and competitive advantage as an ever-evolving theme. AI-based digital leadership capabilities are determined by the ability of leaders to adapt, integrate technology, and make decisions responsive to changing business environments [45]. However, Cyfert et al. emphasized that the success of digital transformation is not only influenced by technology, but also by organizational culture, leadership, and human resource competence as the foundation of sustainable digital excellence [46]. Therefore, the future of virtual leadership depends on the ability of leaders to integrate AI with leadership values, such as trust, empathy, psychological safety, and collaboration, so that digital transformation is able to create an adaptive, innovative, and sustainable organization.

3. Methodology

This study uses a descriptive quantitative approach with a bibliometric analysis method. Bibliometric analysis was used to map the development of scientific publications, author productivity, institutional and state contributions, citation patterns, and the relevance of research themes in virtual leadership studies at the global level. In general, bibliometric analysis is a quantitative method used to evaluate and describe the characteristics of scientific literature based on bibliographic data, such as the number of publications, citations, keywords, author names, affiliations, countries, and publication sources [20] [22] [47]. Through this approach, research can identify trends in scientific development, influential academic actors, patterns of scientific collaboration, and clusters of key themes that develop in a field of study. Thus, bibliometric analysis not only serves to measure the performance of publications but also helps to understand the intellectual structure and direction of the development of virtual leadership research in the future.

3.1 Data Sources and Search Strategies

This study uses a bibliometric research design to map publication trends, intellectual structures, collaboration patterns, and theme developments in virtual leadership research. Bibliometric analysis was chosen because it can describe the development of a field of study using scientific publication data, such as the number of publications, citations, authors, institutions, countries, journal sources, and keywords [48]. The bibliographic data in this study were obtained from the Scopus database because it covers a wide range of scientific publications, especially in reputable journals in management, social sciences, economics, and related fields [49] [50] [51].

Data search was carried out in the title, abstract, and keyword sections using queries tailored to the research topic, namely:

TITLE-ABS-KEY (("Virtual Leadership" OR "Digital Leadership" OR "Remote Leadership" OR "Online Leadership" OR "E-Leadership" OR "Virtual Team Leadership")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (SRCTYPE , "j")) AND PUBYEAR > 2014 AND PUBYEAR < 2026

The 2015–2025 publication period restriction was chosen deliberately because the term e-leadership has actually been conceptualized since the early 2000s by Avolio and Kahai [26], while large-scale empirical and bibliometric attention to virtual leadership has only begun to increase rapidly since 2015, along with the growing adoption of cloud-based collaboration platforms and distributed team structures, before the disruption of the COVID-19 pandemic occurred. By limiting the corpus to this ten-year span, the research can capture the growth phase of the field in its entirety, while avoiding the influx of sparse early publications that are still based on digital pre-platforms, which have the potential to obscure the thematic and collaborative patterns that this research focuses on, rather than clarify them.

The filter subject area is limited to Business, Management and Accounting (BUSI), Social Sciences (SOCI), and Economics, Econometrics and Finance (ECON) because the four research questions in this study highlight virtual leadership as an organizational and managerial phenomenon i.e. how leaders coordinate, motivate, and influence team members in a virtual work environment rather than the technical design or computational properties of the digital device itself. Computer Science and Decision Sciences were deliberately excluded from the main query because preliminary searches showed that the articles indexed in both subject areas mostly addressed topics that intersect with virtual leadership from a technical perspective, such as algorithm-based decision support systems, human-computer interaction design, or computational modeling of organizational networks, which were outside the managerial and behavioral scope of the four questions research. This restriction is consistent with previous bibliometric studies of leadership constructs, which also limited searches to management- and social science-oriented subject categories in order to maintain construct validity [23] [24]. The authors recognize that this restrictive decision narrows the corpus compared to full cross-disciplinary search, and this limitation is discussed again in the direction of future research.

Based on search queries, publication data is obtained from the Scopus database for the period 2015–2025. After searching and filtering according to the criteria that have been set, as many as 688 documents were obtained, which were used as the main data in this study. The selection of data in this study follows the PRISMA stage so that the screening process can be carried out transparently and replicatively, as shown in Figure 1.

The stages in this study are adapted from the PRISMA diagram to ensure that the data selection process is carried out in a systematic, transparent, and replicable manner [52] [53] [54]. Based on Figure 1, the initial data obtained from the Scopus database amounted to 2,053 documents. The data was then selected through several criteria, such as the year of publication, the type of document, language, subject area, and publication sources relevant to the focus of the research. After the entire screening process was carried out, 688 documents were obtained, which were used as the main data in this study.

3.2 Data Cleaning and Validation

Before being analyzed, 688 documents that passed the PRISMA stage were first manually verified through the reading of titles and abstracts to ensure their substantive relevance to the topic of virtual leadership, in order to get rid of documents that passed the Scopus automatic filter but were not content relevant to the focus of the research. Furthermore, a data cleaning process is carried out using a

thesaurus file in VOSviewer to maintain data validity and avoid bias due to term inconsistencies [48]. This is necessary because search queries combine several synonymous terms (virtual leadership, digital leadership, remote leadership, online leadership, e-leadership, virtual team leadership), so that author keywords and index keywords that refer to the same construct are combined into one standard label. This process is applied consistently before keyword co-occurrence analysis and cluster mapping are carried out, so that the four thematic clusters produced in this study reflect the actual grouping of concepts, not just the differences in terms used between authors.

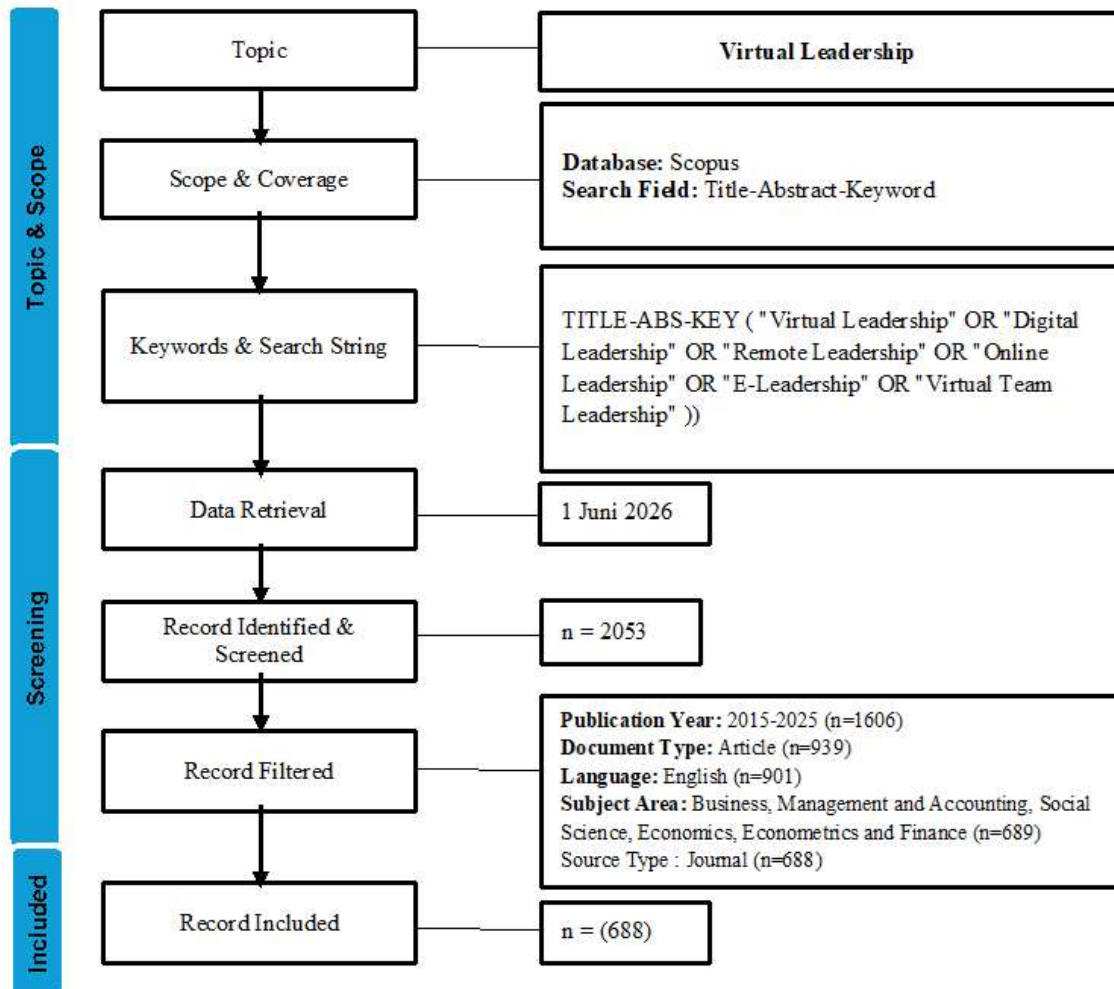


Figure 1. Search Strategy using the PRISMA diagram

3.3. Data Analysis

Data collection in this study was carried out systematically through the Scopus database, and then publication data relevant to the theme of virtual leadership were exported in CSV format for further analysis. This study uses a bibliometric analysis approach with the help of VOSviewer and Biblioshiny, which are part of the Bibliometrix package in R. The combination of VOSviewer and Biblioshiny is used because both have complementary functions in bibliometric analysis, so that it is able to provide a more comprehensive picture of the development of a field of study [48] [55] [56]. Biblioshiny is used to analyze the performance of publications, such as annual publication trends, authors, institutions, journals, and influential countries [57]. Meanwhile, VOSviewer is used to visualize bibliometric networks, such as collaboration between authors, institutions, and countries, as well as the co-emergence of keywords to identify key theme clusters in virtual leadership research [58]. Through this analysis, the research aims to determine the development of global publication trends, the most

The findings from the analysis of the dominant keywords in Figure 3 and Table 1 further strengthen these findings. The dominance of the term digital leadership by 310 occurrences compared to e-leadership (73 occurrences) and virtual leadership (33 occurrences) not only reflects a change in terminology but also shows a shift in the focus of the study. The attention of the research is no longer limited to leadership in the context of physically separated work (virtual), but rather shifts to the capabilities of leaders in managing organizations operating in the digital ecosystem as a whole. This shift is in line with the development of contemporary leadership literature, which assesses that the classical transformational leadership framework has not been fully able to explain the dynamics of leadership when interactions, communication, and decision-making processes are mediated by digital technologies. Therefore, digital leadership is developing as a more comprehensive and relevant construct because it includes not only virtual team management but also leadership in digital transformation, organizational innovation, and continuous development of digital capabilities.

Table 1. Most Frequent Words

Words	Occurrences
digital leadership	310
leadership	119
digital transformation	110
e-leadership	73
innovation	35
virtual leadership	33
artificial intelligence	27
covid-19	26
higher education	25
human	22

Based on Table 1, the emergence of artificial intelligence (27 occurrences) and covid-19 (26 occurrences) in adjacent frequencies is also worth reading critically, both function as two external triggers that are different but have the same impact: COVID-19 as a temporary emergency trigger, and AI as a permanent structural driver. Implicitly, virtual leadership research risks being caught up in the crisis response cycle if it does not immediately shift from simply documenting the impact of the pandemic to building theories that anticipate more long-term and non-temporary AI transformation.

4.2. Who Are the Authors, Journals, and Most Influential Countries in Research on Virtual Leadership

4.2.1. Most Prolific Authors

The author's impact analysis was carried out to find out the researchers who have the greatest contribution to the development of virtual leadership studies. The assessment was carried out through two approaches, namely productivity based on the number of publications and scientific impact based on the number of citations and the bibliometric index. The first analysis shows the authors who are most actively producing the document, as presented in Figure 4.

Based on Figure 4, Van Wart M and Wang X became the most prolific writers with 6 documents each. Furthermore, Alias BS, Li Y, Liu C, Malik M, Raziq MM, and Zhang Y produced 5 documents each, while Al-Romeedy BS and Chen J produced 4 documents each. The difference in the number of publications between authors is relatively small, namely only 1 to 2 documents. This shows that research on virtual leadership was developed by several authors with a relatively balanced level of productivity and was not dominated by just one researcher. However, the number of publications has not fully illustrated the magnitude of an author's scholarly influence. Therefore, the analysis is continued by looking at the values of h-index, g-index, m-index, number of citations, and number of publications as presented in Table 2.

The relatively small difference in productivity between the main authors, which is only about 1–2 documents, shows that virtual leadership research has not been dominated by one main figure, as is commonly found in mature fields of science. In established fields, there are generally some founding scholars who have much higher productivity and influence than other researchers. In contrast, the pattern of virtual leadership research shows that the field is still in the consolidation stage, with

contributions coming from various disciplines, such as management, education, and organizational psychology, without a single truly dominant theoretical perspective.

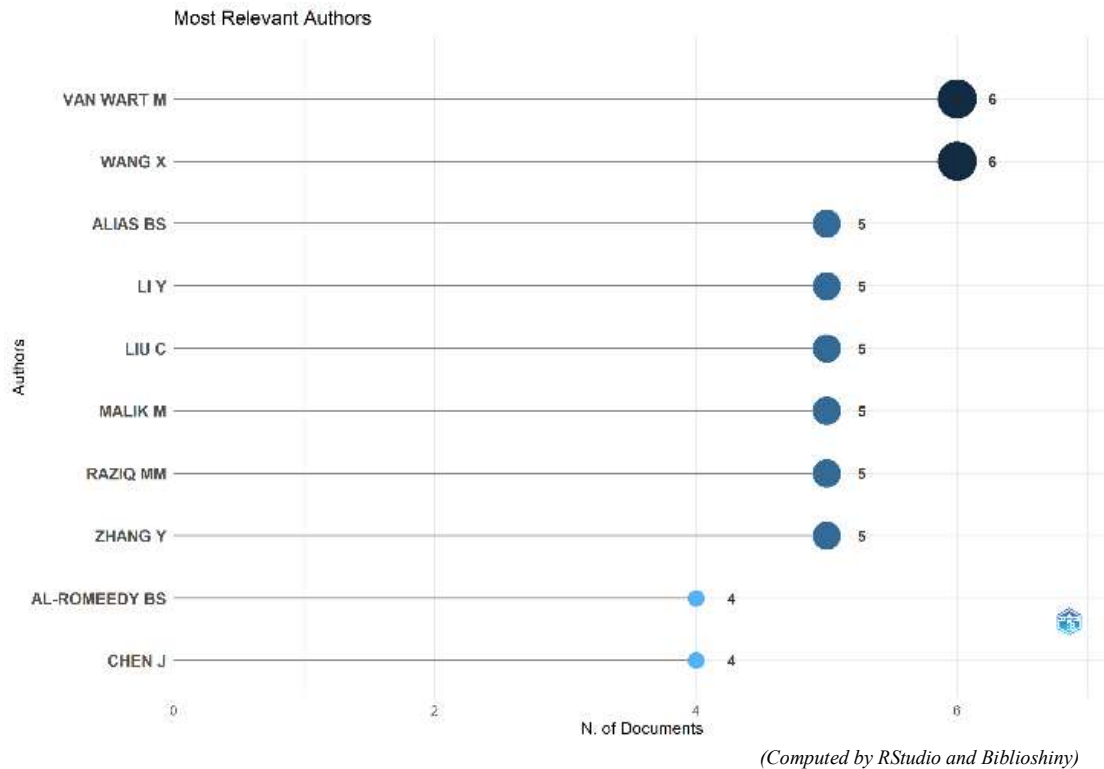


Figure 4. Most Relevant Authors

Table 2 presents the results of the bibliometric performance analysis. The analysis is then continued by examining the h-index, g-index, m-index, the number of citations, and the number of publications.

Table 2. Most Cited Authors

Author	h_index	g_index	m_index	TC	NP
Van Wart M	6	6	0,545	572	6
Wang X	6	6	0,667	764	6
Liu C	5	5	0,556	551	5
Gazit T	4	4	0,667	65	4
Ghamrawi N	4	4	1,000	61	4
Kim S	4	4	0,444	332	4
Malik M	4	5	2,000	149	5
Mccarthy A	4	4	0,444	332	4
Mihardjo Lww	4	4	0,500	259	4
Raziq Mm	4	5	2,000	149	5

This finding is also reinforced by the highest m-index values of Malik M and Raziq Mm (2,000), although the number of citations is lower than that of Wang X and Van Wart M. This indicates that in a still developing field, scientific influence is not only determined by the accumulation of citations, but also by the ability of research to present new ideas that are quickly adopted by the academic community. Thus, even relatively new researchers can make a significant contribution to the development direction of virtual leadership research.

4.2.2. The Most Productive Journal Sources

The development of *virtual leadership* studies can be traced through journals that are the main channels for disseminating research results. The number of articles published by each journal shows the level of attention each source pays to the topic. This mapping also provides an overview of the scope of fields of science involved in the development of *virtual leadership research*. The list of the ten journals with the largest publication contributions is shown in Table 3.

Table 3. Top 10 Most Productive Journals Related

Sources	Articles
Sustainability (Switzerland)	24
International Journal of Data and Network Science	13
Leadership and Organization Development Journal	10
Education and Information Technologies	9
International Journal of Learning, Teaching, and Educational Research	9
Business Horizons	8
Management Decision	8
Behavior and Information Technology	6
Benchmarking	6
Polish Journal of Management Studies	6

(Computed by RStudio and Biblioshiny)

The dominance of Sustainability (Switzerland) as the journal with the highest number of publications (24 articles), almost double that of the journal in second place, shows more than just high publication productivity. These findings indicate a shift in academic perspectives on virtual leadership. The increase in publications in sustainability journals, compared to leadership journals such as the Leadership and Organization Development Journal, which ranks only third with 10 articles, shows that virtual leadership is increasingly positioned as a strategic factor in supporting organizational sustainability, rather than solely as a leadership study. This shift in perspective aligns with the second cluster in the research, which connects digital leadership with innovation, knowledge management, and sustainable organizational performance.

4.2.3. Country's Scientific Production

The geographical distribution of publications provides an overview of the countries that are most actively contributing to the development of *virtual leadership research*. The level of contribution to this analysis is evident in the frequency of each country's scientific output in the dataset. The darker the blue on the map, the higher the number of publications produced, while lighter colors indicate a lower number of publications. The map of the distribution of scientific production is presented in Figure 5.

Country Scientific Production

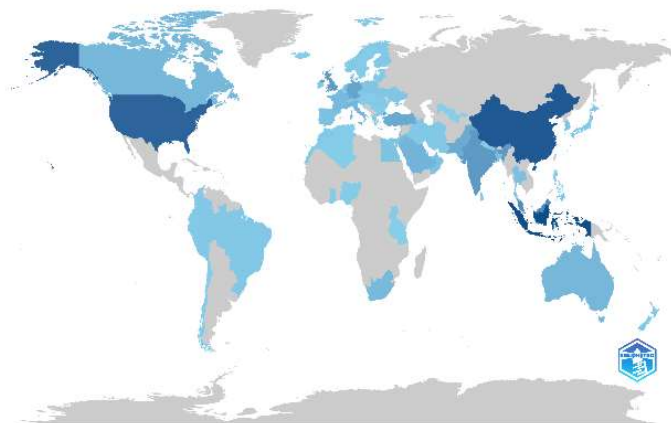


Figure 5. The Country's Scientific Production

Note: Dark blue indicates the country with the highest number of publications, while reduced color intensity indicates a lower number of publications. The gray color indicates a country that has not yet contributed.

The dominance of Indonesia, China, and the United States as the three main producers of virtual leadership research indicates a theoretically interesting pattern. These three countries represent very different organizational contexts: Indonesia, with its large small- and medium-sized business base and education sector; China, with its ecosystem of giant tech corporations; and the United States, with its well-established tradition of organizational leadership research. This shows that virtual leadership is not only a relevant phenomenon for advanced economies with mature digital infrastructure but also an urgent need for developing countries seeking to accelerate the digital transformation of their organizations. The implication is that the generalization of virtual leadership findings across cultural contexts and digital maturity levels should be done carefully, because the needs and challenges of virtual leadership in Indonesian organizations are likely to differ qualitatively from those faced by multinational corporations in the United States.

4.3. What is the Pattern Of Scientific Collaboration Between Authors, Institutions, and Countries in Research on Virtual Leadership

4.3.1. Author Collaboration Analysis

The author's collaboration pattern is traced through co-authorship relationships in publications about *virtual leadership*. In the network visualization, each circle represents an author, and the connecting lines indicate a publication co-authored by the authors. The similarity of colors indicates that the authors are members of the same collaborative group. The collaboration network is shown in Figure 6.

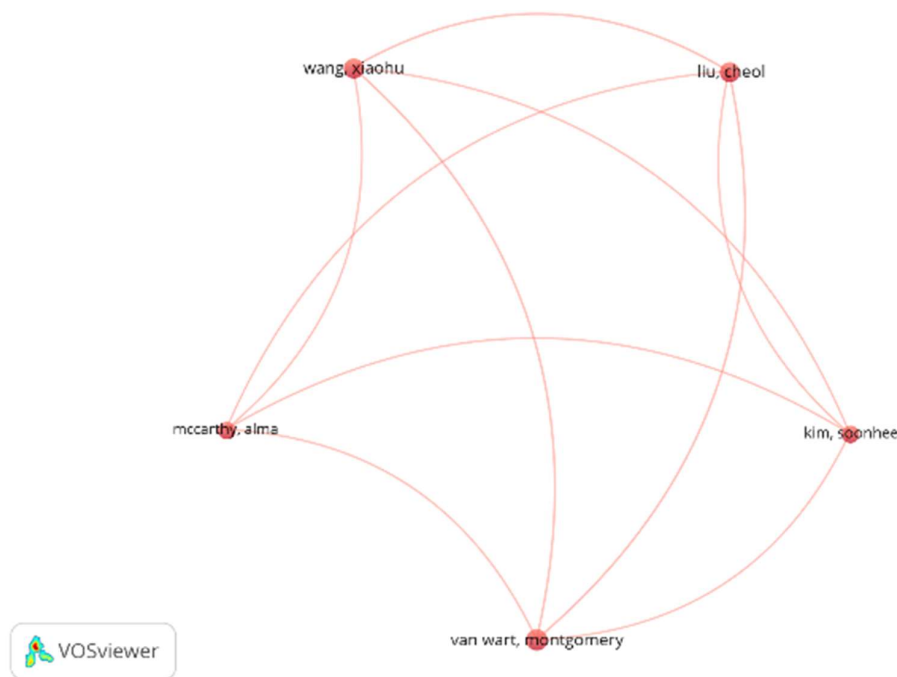


Figure 6. Collaboration Network Between Writers

The authors' collaborative network, which is still limited to a few small groups, such as Wang Xiaohu, Liu Cheol, Kim Sunhee, Van Wart Montgomery, and McCarthy Alma, shows that virtual leadership research is still dominated by research groups that work relatively separately (siloe research groups). This pattern indicates that collaboration among research groups has not developed optimally, so the exchange of ideas and the integration of theoretical perspectives remain limited. This condition has the potential to lead to theoretical fragmentation, in which each group develops its own conceptual framework without strong synthesis with research from other groups. As a result, until now, the field of

Inter-institutional collaboration was analyzed to examine the relationship between institutional cooperation and the production of publications on virtual leadership. In the network visualization, each circle represents an institution, and the circle's size indicates the relative contribution of that institution to the network. The connecting line signifies publication cooperation between institutions, while adjacent positions indicate closer collaborative relationships. The collaboration pattern is shown in Figure 7.

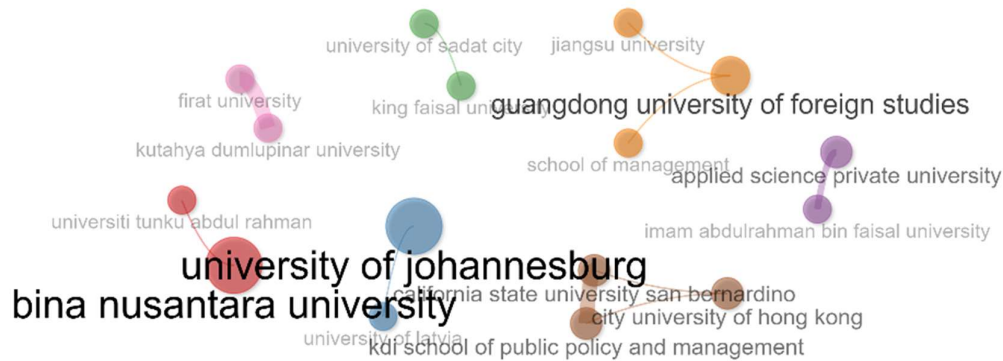


Figure 7. Inter-Institutional Collaboration Network

The finding that the University of Johannesburg and Bina Nusantara University have the largest node size in the institutional collaboration network is an interesting result. In contrast to leadership research centers dominated by universities in North America and Western Europe, both institutions are from developing countries. This condition shows that the development of virtual leadership research is no longer influenced solely by institutions in developed countries, but also by institutions facing the demands of digital transformation and the more intensive implementation of virtual work. These findings indicate that conceptual innovation in virtual leadership is increasingly emerging from the context of organizations undergoing rapid digital change. However, the collaboration network remains concentrated in a few key institutions, indicating that collaboration across institutions has not been evenly distributed. As a result, knowledge exchange and integration of theoretical perspectives remain limited, leaving ample opportunity to build a more comprehensive and global conceptual framework for virtual leadership.

4.3.3. State Collaboration Analysis

To understand how virtual leadership research develops globally, it is necessary to examine the collaborative relationships among countries as reflected in joint publications. This visualization shows the distribution of countries involved in the research, as well as the cooperative relationships among them. This map shows which countries are more active in international collaboration networks and how the direction of these cooperative relations is shaped.

The pattern of collaboration among countries shows that the United States remains the center of a network connecting the United Kingdom, China, India, and Asia-Pacific countries. This suggests that countries with strong traditions of leadership research remain the main drivers of theory development. In contrast, developing countries are contributing more in empirical terms, as they face a more pronounced acceleration of digital transformation. As a result, the development of virtual leadership theory remains largely dominated by Western perspectives, even though much of the latest empirical evidence comes from developing countries. This condition opens up opportunities for further research to develop a more inclusive conceptual framework that reflects diverse global contexts.

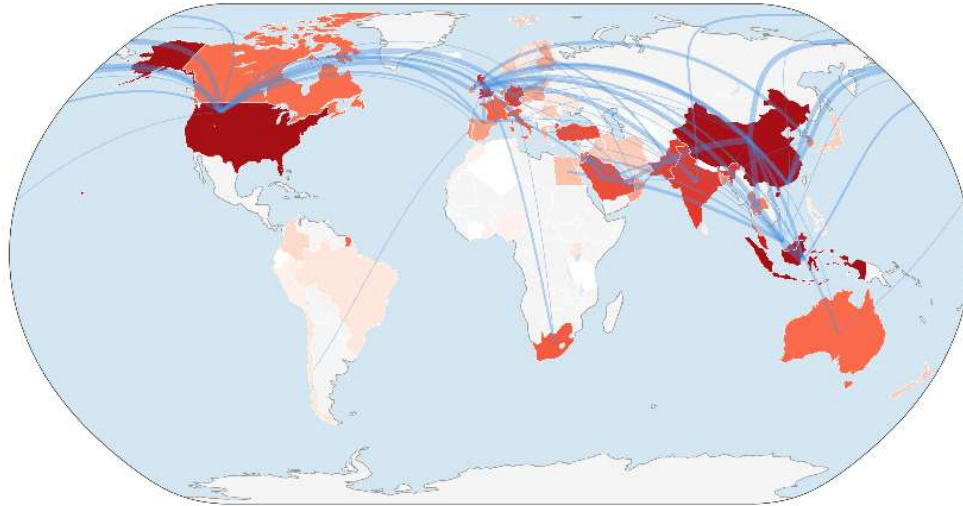


Figure 8. Collaboration Word Map

Note: Dark red indicates a higher level of collaboration, while pink indicates lower engagement. The blue line shows the cooperative relationship between countries.

4.4. What are the Main Themes that Are Developing, and What Is the Direction of Future Research Development Related to Virtual Leadership

4.4.1. Analysis of the Main Theme Clusters

Analysis of the main theme clusters was conducted to identify the conceptual structures and relationships among topics that emerge in virtual leadership research. The mapping was done using keyword co-occurrence analysis on VOSviewer. This analysis shows how often two or more keywords appear simultaneously in the analyzed material. VOSviewer was used in this study to visualize relationships among keywords and group them into several thematic clusters.

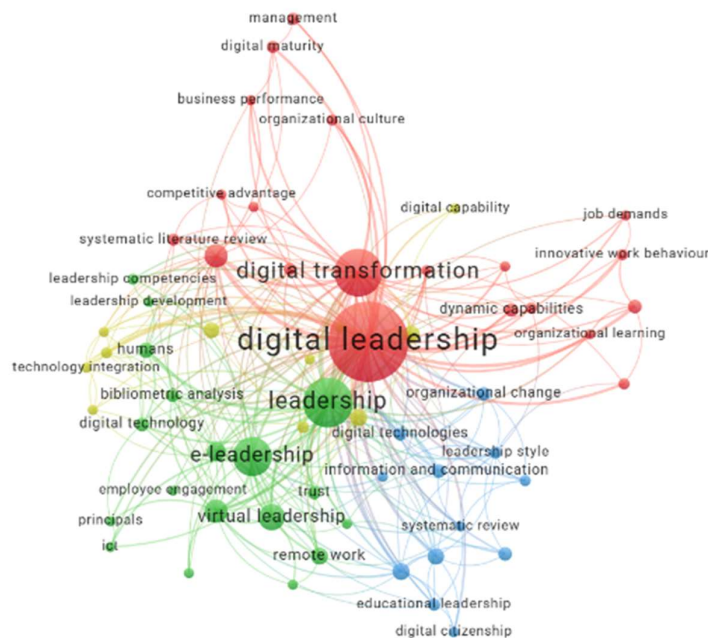


Figure 9. Network Analysis Co-occurrence

In network visualization, each circle or node represents one keyword. The size of the node indicates the frequency with which the keyword appears, so the larger node indicates the most frequently used keywords. The connecting line indicates a co-emergence relationship between keywords, while a closer distance indicates a stronger thematic relationship. Line thickness describes the strength of the relationship between keywords. Meanwhile, the color difference indicates a research group or cluster with a similar theme. The lines in this visualization do not show a cause-and-effect relationship but rather one based on a common occurrence in the analyzed document. The results of the mapping of the virtual leadership research keyword network are presented in Figure 9.

Based on Figure 9, the keyword digital leadership has the largest nodes and is at the center of the network. This shows that digital leadership is the dominant theme and that it links digital transformation, leadership, e-leadership, virtual leadership, organizational learning, and digital capabilities. The density of these relationships shows that virtual leadership research is developing not only in the context of remote leadership but also in the areas of organizational transformation, digital communication, innovation, and performance. The visualization also shows the interconnectedness of the themes of education, human resources, technology, and organization. Keywords such as educational leadership, employee engagement, trust, remote work, technology integration, innovation, and well-being show that this study is multidisciplinary. To clarify the group of themes formed, the results of the keyword clustering are presented in Table 4.

Table 4. Research Thematic Cluster

Cluster	Keywords	Label
Cluster 1	communication, COVID-19, digital, digital citizenship, digital literacy, e-leadership, educational leadership, employee engagement, employee performance, higher education, human resource management, information and communication, job satisfaction, leadership style, organizational commitment, organizational culture, principals, remote leadership, remote work, scale development, self-efficacy, systematic review, technological development, technology, transformational leadership, trust, virtual leadership, virtual team, virtual teams	Virtual Leadership, Communication, and Employee Outcomes in Education and Remote Work
Cluster 2	competitiveness, design/methodology/approach, digital culture, digital leadership, digital organizational culture, dynamic capability, employee creativity, information technology, innovation, innovation capability, innovative work behavior, job resources, knowledge management, knowledge sharing, management practice, market orientation, online leadership, organizational change, organizational learning, organizational performance, personnel, small and medium-sized enterprises, social media, social networking, spatiotemporal analysis, sustainability, sustainable development, sustainable performance	Digital Leadership, Organizational Innovation, and Sustainable Performance
Cluster 3	controlled study, digital innovation, digital leadership capability, digital technology, e-learning, education, educational technology, emotional intelligence, employee, engineering education, Industry 4.0, job demands, leadership, leadership competencies, leadership development, online learning, organizational agility, performance, questionnaire, structural equation modeling, technology integration, well-being, work engagement	Digital Leadership Competencies, Technology Integration, and Employee Well-being
Cluster 4	artificial intelligence, bibliometric analysis, business model innovation, business performance, change management, competitive advantage, digital capability, digital maturity, digital strategy, digital transformation, environmental dynamism, innovation performance, literature review, management, performance assessment, public sector, systematic literature review	Digital Transformation, Artificial Intelligence, and Strategic Business Innovation

Based on Table 4, the analysis identifies four main thematic clusters in virtual leadership research. Cluster 1, namely Virtual Leadership, Communication, and Employee Outcomes in Education and Remote Work, highlights the role of communication, trust, employee engagement, and leadership

effectiveness in the context of education and remote work. This cluster confirms that the success of virtual leadership is determined not only by the use of technology but also by leaders' ability to build relationships, maintain coordination, and sustain team members' performance.

Cluster 2, Digital Leadership, Organizational Innovation, and Sustainable Performance, describes the relationships among digital leadership, organizational culture, knowledge management, organizational learning, creativity, and innovation. This theme shows that digital leaders serve as drivers of change, helping organizations improve adaptability, competitiveness, and sustainable performance in a dynamic business environment.

Cluster 3, Digital Leadership Competencies, Technology Integration, and Employee Well-being, focuses on the competencies leaders need to integrate technology into the work process. In addition to digital capabilities, this cluster also emphasizes emotional intelligence, work engagement, job demands, and employee well-being. The findings show that digital transformation needs to be balanced with attention to the readiness and psychological condition of human resources.

Meanwhile, Cluster 4, Digital Transformation, Artificial Intelligence, and Strategic Business Innovation, shows the development of research in a more strategic direction, such as digital transformation, artificial intelligence, digital maturity, business model innovation, and competitive advantage. This cluster places leadership as a critical factor in directing digital strategy, managing change, and leveraging technology to improve organizational performance.

This reading has direct implications for the current industry reality: organizations that adopt generative AI to support leadership decision-making (in line with Cluster 4) often fail to consider the impact on the trust and psychological well-being of employees identified in Clusters 1 and 3, an implementation gap that exactly reflects the theoretical gaps between clusters found in this mapping. In other words, academic fragmentation between clusters is not just a bibliometric methodological artifact, but reflects the fragmentation of managerial practices that actually occur in the field.

4.4.2. Chronological Trends and Topical Novelty

To trace changes in the focus of virtual leadership research over time, an overlay visualization was created in VOSviewer. The color of the node indicates the average year the keyword appeared, ranging from purple and blue for earlier topics, green for the intermediate period, to yellow for newer topics. The node size indicates how often the keyword appears, while the connecting lines show the relationships between topics. The chronological mapping is presented in Figure 10.

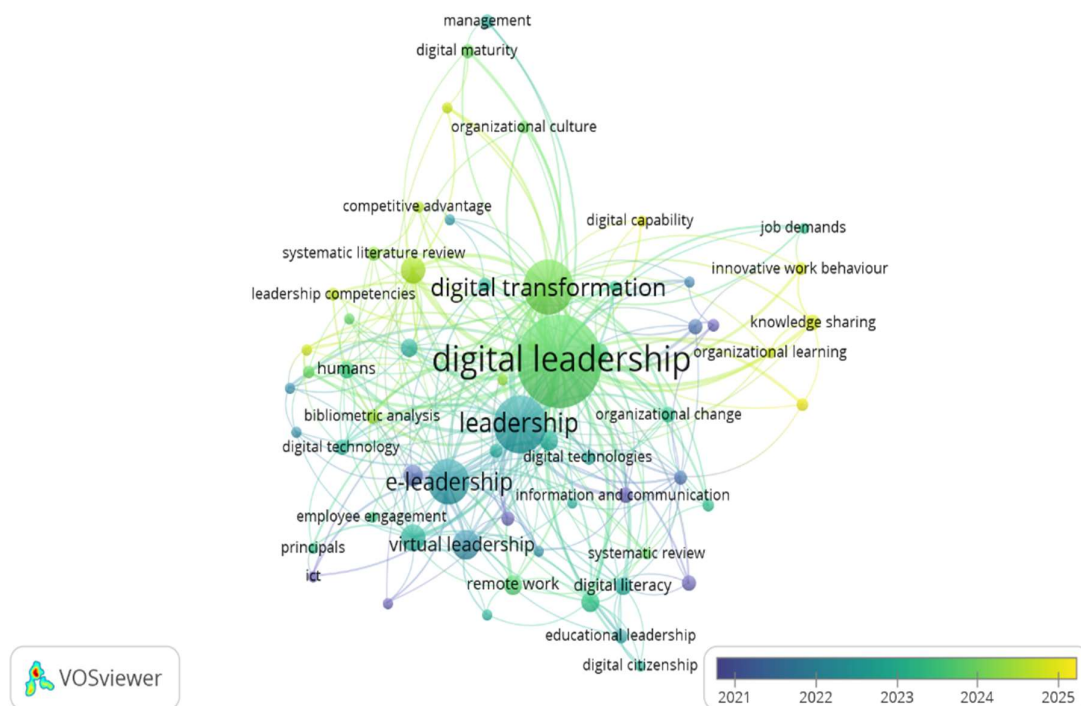


Figure 10. Overlay Visualization

The chronological shift from the operational theme of e-leadership, remote work, educational leadership in the early period, to the broader theme of transformation (digital leadership, digital transformation, technology integration) in the medium period, to the most recent themes (digital maturity, organizational culture, knowledge sharing, innovative work behaviour) shows an evolutionary pattern that can be understood through the lens of field life-cycle theory, emerging fields of study tend to start from The urgent operational technical question is how to lead remotely, then gradually moves to the more abstract and strategic question of how to build long-term organizational capabilities as the collective understanding of the research community matures. This pattern is consistent with the evolution of similar fields of study, such as the adoption of information technology in the 1990s–2000s, which also shifted from focusing on tool use to organizational transformation.

More important to criticize is the implications of this shift for the practical relevance of research: if this trend continues, there is a risk that virtual leadership research will become increasingly abstract and strategic while practitioners in the field, especially middle managers who handle hybrid teams on a day-to-day basis, are still struggling with basic operational issues such as virtual meeting fatigue and cross-time coordination. This gap between academic research directions and practical needs should be an explicit concern in future research agendas.

4.4.3. Quadrant Mapping of Conceptual Structures

To see how the themes in virtual leadership research develop and interconnect, the analysis continues with a thematic map. This map ranks each theme based on its degree of connectivity to other themes (centrality) and the level of maturity of its discussion (density). From this position, themes can be grouped into four categories: main movers, basic themes, themes that develop specifically, and themes that are still emerging or beginning to decline in attention. The results of the mapping are shown in Figure 11.

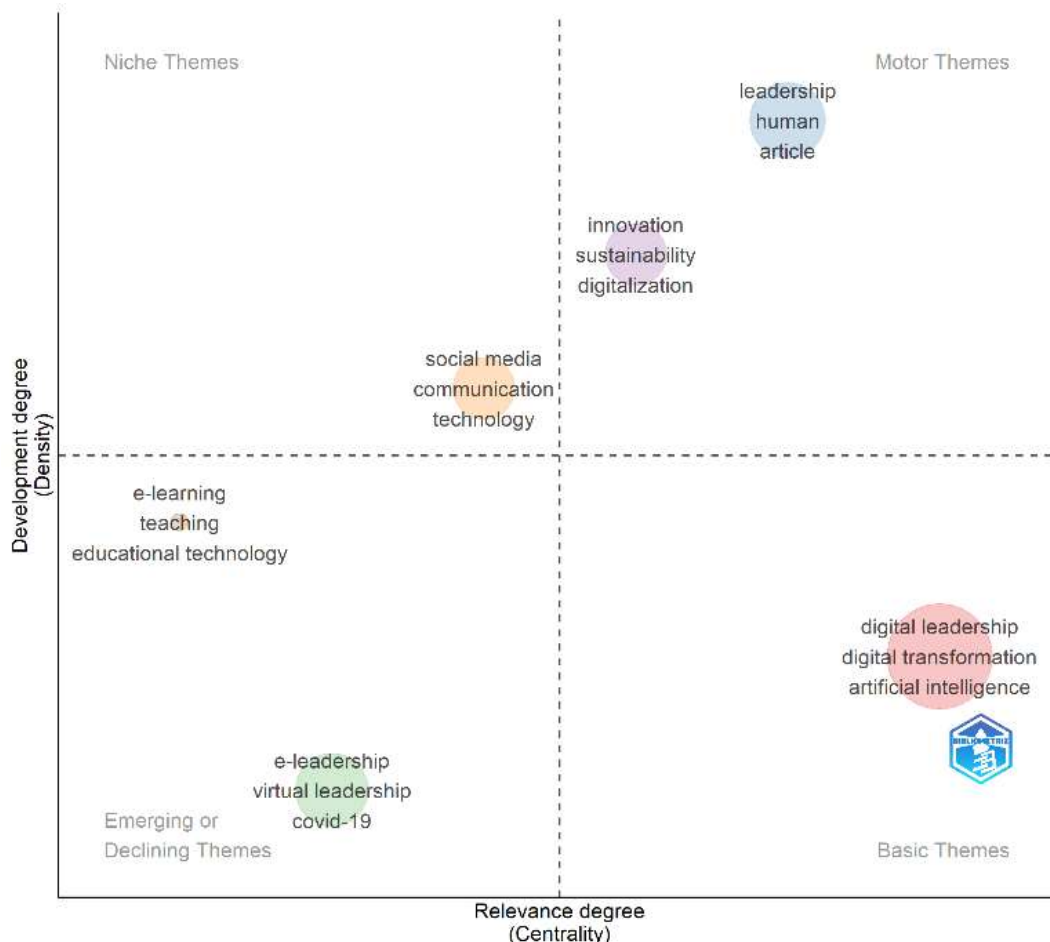


Figure 11. Thematic Map

The position of the themes of digital leadership, digital transformation, and artificial intelligence in the quadrant of basic themes, which means that the connectivity is high to other themes, but the depth of internal development is still limited, is a theoretically crucial finding and has a different meaning from the usual descriptive interpretation. This position suggests that these three themes have become the conceptual infrastructure that underpins almost all other subfields of virtual leadership, but have not yet developed into a stand-alone substantive theory with independently testable propositions. In other words, digital leadership and AI today function more as umbrella terms than as mature theoretical constructs with clear definitional limitations. This conceptual fragility risks hindering the accumulation of cumulative knowledge in this field if not immediately addressed through more serious theoretical consolidation efforts.

In contrast, the positioning of e-leadership, virtual leadership, and COVID-19 in the declining thematic quadrant should not be read as a decline in substantive relevance but rather as a shift in the academic community's terminological preferences. This phenomenon in the sociology of science is referred to as "conceptual rebranding," in which the research community relabels a phenomenon without changing its essence. The risk is that new researchers who want to build cumulative research need to be wary of this pitfall: skipping the "old" literature labeled "virtual leadership" or "e-leadership" because it is considered obsolete can cause them to lose the important conceptual foundation that remains relevant, only to be renamed "digital leadership".

4.4.4. Future Research Agenda and Direction

The results of network mapping, chronological trends, and thematic maps consistently show that virtual leadership research has shifted from remote team communication and management issues to more strategic discussions, including digital transformation, innovation, artificial intelligence, and organizational sustainability. Based on the theoretical gaps identified in the previous subchapter, especially the fragmentation of the level of analysis across clusters and the conceptual fragility of digital leadership as an umbrella term, future research should be guided by several concrete agendas.

First, future research needs to empirically examine how leaders leverage AI-based technology to support communication, coordination, decision-making, and virtual team performance evaluation, while seriously considering issues of ethics, transparency, privacy, technology bias, and the potential for a decline in the quality of human interaction in the leadership process by explicitly linking the impact of AI adoption at the strategic level in Cluster 4 to trust and well-being employees at the micro level in Clusters 1 and 3, instead of examining the two separately as found in the cluster mapping above.

Second, a more human-oriented approach needs more attention. The effectiveness of virtual leadership is determined not only by technological capabilities but also by trust, emotional intelligence, psychological safety, work engagement, and team members' well-being. Future research needs to shed light on how leaders can maintain organizational performance without improving Digital burnout, social isolation, work pressure, and conflicts between work and personal life.

Third, research needs to be expanded through cross-country, cross-cultural, sectoral, and organizational comparisons, given that the findings in RQ2 and RQ3 indicate that the largest research contributions come from developing countries such as Indonesia and China. At the same time, the theoretical framework remains largely shaped by Western scientific traditions. Comparative studies can be conducted across the public sector, education, multinational corporations, small and medium enterprises, and organizations with hybrid work systems to explain how culture, digital readiness, job characteristics, and organizational support influence the effectiveness of virtual leadership in different contexts.

Fourth, future research needs to use a more diverse methodological approach. A longitudinal design can be used to observe changes in leadership practices over time. At the same time, multilevel analysis can simultaneously attribute the influence of virtual leadership at the individual, team, and organizational levels, an approach that directly addresses the fragmentation of analysis levels identified in cluster mapping. Mixed methods, experimental studies, meta-analysis, and integration of bibliometric analysis with systematic review are also needed to strengthen conceptual and empirical findings, while consolidating digital leadership and AI from mere umbrella terms into more mature theoretical constructs that can be tested independently.

Overall, the future research agenda needs to position virtual leadership as a strategic capability that is not only related to the use of technology but also to leaders' ability to manage change, maintain human relations, and build adaptive and innovative organizations. This direction is expected to yield a more comprehensive understanding of leadership effectiveness in a digital work environment.

5. Conclusion

This research shows that virtual leadership has evolved from merely responding to the need for remote work to a strategic capability encompassing multiple organizational dimensions. The analysis identified four interrelated levels: relational (communication and trust), organizational (organizational innovation and learning), individual (employee competence and welfare), and strategic (digital transformation and artificial intelligence). This finding provides a theoretical contribution by showing that the development of virtual leadership research remains fragmented across various levels of analysis, lacking a conceptual framework capable of integrating it fully. On the practical side, the results of the study confirm that the success of virtual leadership is determined not only by the leader's ability to adopt digital technology but also by their ability to build trust, maintain psychological well-being, and align individual needs with the organization's strategic goals.

This research also has some limitations. First, data are obtained only from the Scopus database and are limited to the fields of Business, Social Sciences, and Economics, so research from other disciplines, such as Computer Science and Decision Sciences, has not been included. Second, bibliometric analysis relies on the quality of metadata and the consistency of keyword use, so that the results of co-occurrence only describe the relevance of the theme, not the cause-and-effect relationship. Third, the latest publications in the 2024–2025 period may receive few citations due to time constraints, so their scientific impact has not been fully reflected in the bibliometric indicators used.

Based on these findings and limitations, further research can be directed to several important agendas. First, examining the effect of the application of artificial intelligence (AI) based leadership on employee trust, psychological security, and well-being. Second, examining the role of trust mediation, psychological safety, and digital fatigue in the relationship between digital leadership and virtual team performance in various cultural contexts and organizational sectors. Third, compare the application and effectiveness of virtual leadership in developing and developed countries to produce a more inclusive conceptual framework. Fourth, apply longitudinal and multilevel research designs to more comprehensively understand the dynamics of virtual leadership at the individual, team, and organizational levels. The agenda is expected to strengthen theoretical development and expand understanding of virtual leadership beyond the bibliometric findings presented in this study.

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