

Evaluating the Conceptual Development of Healthcare Leadership Literature with a Network Approach

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Abstract: Analysis of co-word networks can be used in discovering themes that reflect both the cognitive structure of the scientific field and the gap in the field, besides following the conceptual change in the scientific field. This study aims to reveal the development of the "healthcare leadership" literature, which started to attract more attention with the COVID-19 Pandemic. The authors searched for all articles written in English between 2020 and 2023 in Web of Science Core Collection and Scopus databases with the key phrases "healthcare leadership", "healthcare leader", "health care leadership" or "health care leader" as the query to search the following fields within a record: Title, Abstract, and Author Keywords. 134 articles in the Web of Science database and 585 articles in the Scopus database were reached. Duplicate articles (271) were first eliminated, then articles with one keyword (12) were excluded since one keyword is not appropriate for network analysis. Consequently, 1,360 unique keywords of 2,372 keywords from 436 articles were entered into the analysis scope. A network of whole years was constructed based on word frequency co-occurrence matrices with keywords from all years included, besides a network for each year. Descriptive statistics such as network density, connected components, and total number of ties were calculated for the whole network. Centrality measures were calculated for the network of whole years and each year. Network density and number of the connected components were found as 0.012 and 27 respectively. *Leadership*, *COVID-19/Pandemic*, *healthcare*, *healthcare leadership*, *qualitative research*, and *nurse* were the first six concepts with the highest degree centrality, betweenness centrality, and eigenvector centrality for the network of whole years. Thus, it was possible to see both the general view of the cognitive structure of the healthcare leadership literature and conceptual change in the literature over the years. The findings have the potential to provide important clues for trends and future research directions in this field.

Keywords: Healthcare Leadership, Co-word Networks, Co-occurrence Keyword Matrix, Centrality Measures

1. Introduction and Background

Network analysis has been used in the social and behavioral sciences for more than eighty years. However, the increasing popularity of network analysis over the years has also expanded the usage areas of analysis. Disciplines that benefit from the network approach include but are not limited to, anthropology, communication, marketing, political science, organizational research, sociology, as well as clinical, community, and social psychology (Anderson, Wasserman, & Crouch, 1999). Nowadays, network analysis is becoming more important in bibliometric studies (Baskici, Ercil, & Gokmen, 2024).

The definition of bibliometric was first made by (Pritchard, 1969) as "The application of mathematical method to books and other media of communication". With bibliometric studies, it is possible to make predictions about the structure of the scientific field and current areas of interest (Zupic & Čater, 2015). In addition, this approach has the potential to provide more objective results regarding the evolution of the scientific field.

Within the scope of bibliometric study, various analyses are carried out to define the scientific structure using different units including keywords, authors, articles, and journals (Lu & Wolfram, 2012). In a network, these units are represented by the nodes, and the relationships between nodes are represented as edges. It is possible to create different bibliometric networks using the relationships between these units (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011). One of the bibliometric networks is a co-word network created based on the co-occurrence of keywords. This study aims to reveal the development of the healthcare leadership literature, which started to attract more attention with the COVID-19 Pandemic by analyzing the co-word networks. The findings have the potential to provide important clues for trends and future research directions in this field. Additionally, this is the first study to evaluate the conceptual development of healthcare leadership literature with a network approach.

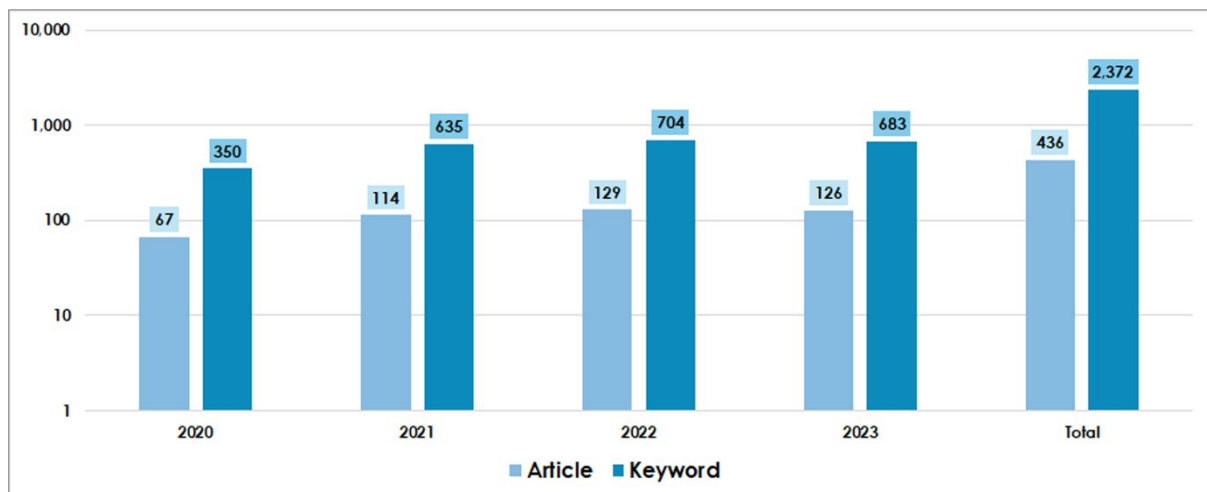
2. Methods

2.1 Analysis of Co-word Networks

In this study, centrality measures were preferred to analyse the co-word networks. These measures were used to interpret the importance of the topics in the network. Among the various centrality measures, this study used degree centrality, betweenness centrality and eigenvector centrality. Degree centrality is the number of direct ties that a node has with other nodes in the network (Ortiz, Hoyos, & López, 2004). Betweenness centrality is an indicator of how much one node lies in the shortest way that links another pair of nodes (Kim, Jeong, & Chung, 2021). If the node appears in many shortest paths, it has a high betweenness centrality (Perez & Germon, 2016). Eigenvector centrality captures the extent to which a node is connected to well-connected other nodes in the network (Basyouni & Parkinson, 2022). The eigenvector centrality suggests the idea that a node is more central as it is connected to important nodes (Bamakan, Nurgaliev, & Qu, 2019). Analysis of the co-word network entails generating a co-occurrence keyword matrix. To create a co-occurrence keyword matrix, two steps were followed: firstly, a keyword pool was created by extracting keywords from the healthcare leadership literature, and then keyword pairs that occur simultaneously in the same paper were identified. Thus, it was able to create a matrix based on the co-occurrence of keywords, and the value of cells in the matrix depended on how many times the two keywords appear together in the same article.

2.2 Retrieval of Articles

The authors searched for all articles written in English between 2020 and 2023 in Web of Science Core Collection and Scopus databases with the key phrases “healthcare leadership”, “healthcare leader”, “health care leadership” or “healthcare leader” as the query to search the following fields within a record: Title, Abstract, and Author Keywords. 134 articles in the Web of Science database and 585 articles in the Scopus database were reached. Duplicate articles (271) were first eliminated, then articles with one keyword (12) were excluded since one keyword is not appropriate for network analysis. Consequently, 1,360 unique keywords of 2,372 from 436 articles were entered into the analysis scope. The numbers of Keywords and Articles related to the period from 2020 to 2023 are presented in Figure 1.



Note: Logarithmic scale is used.

Figure 1: The number of articles and keyword (2020-2023)

As Figure 1 illustrates, there has been a significant surge in healthcare leadership-related articles published in 2021 compared to 2020, which attests to researchers' growing interest in this area with the COVID-19 Pandemic.

3. Findings

Figure 2 shows the leading 30 keywords with the highest frequency in healthcare leadership literature for each year and the overall study period. Over the last four years, *COVID-19/Pandemic* has been the most frequently (87 times) used keywords in the articles published. Along with *COVID-19/Pandemic* the major top-ranking keywords are *leadership*, *healthcare*, *healthcare leadership*, *qualitative research*, and *management*.

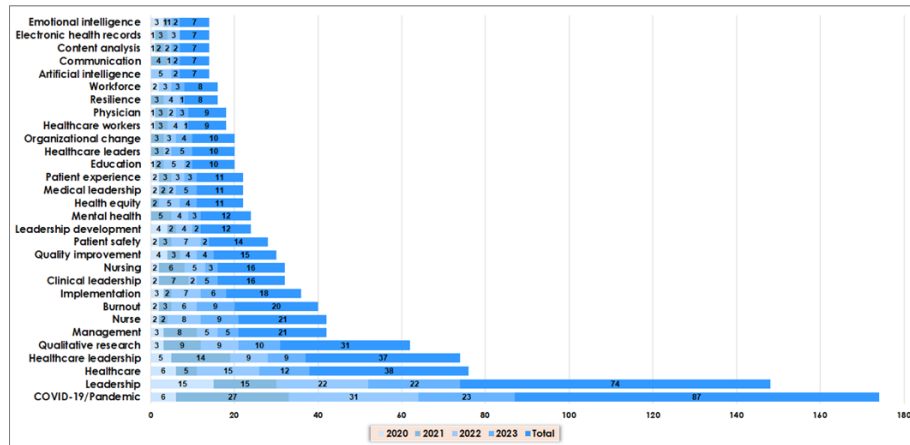


Figure 2: The leading 30 keywords with the highest frequency

Table 1 illustrates the descriptive statistic for whole network. Network density, number of edge and connected components were found respectively 0.012, 10,800 and 27.

Table 1: Descriptive statistic for whole network

Network Statistic	
Network density	0.012
Number of ties	10,800
Number of connected components	27

After finding the results of network measures for each period, the words with the 20 highest network measures scores were sorted and created a new keyword set with their union set. To examine the evolutionary change of the keywords in the created keyword set, graphs showing the scores of network measures (degree centrality, betweenness centrality, and eigenvector centrality) were created in each period.

Figure 3 illustrates the degree of centrality of the 44 keywords for each year. Degree centrality shows how often a word is used together with other words in networks. The higher the centrality of a keyword, the more it proves associated with more keywords in the network (Yu et al., 2022). High-degree centrality keywords have a relatively large number of neighbors, meaning that they appear in various contexts concerning the topic that a group of words represents (Yano, Blandford, Maruyama, & Nakamura, 2018). The degree centrality in Figure 3 shows how the use of these keywords has evolved. For example, *leadership*, *COVID-19/Pandemic*, *healthcare*, *qualitative research*, *burnout*, and *nurse* became core research topics in healthcare leadership fields between 2020-2023. Additionally, although some of the keywords such as *sensemaking*, *safety*, and *compassion* have relatively high degrees of centrality values for some years they disappeared at the end of the period.

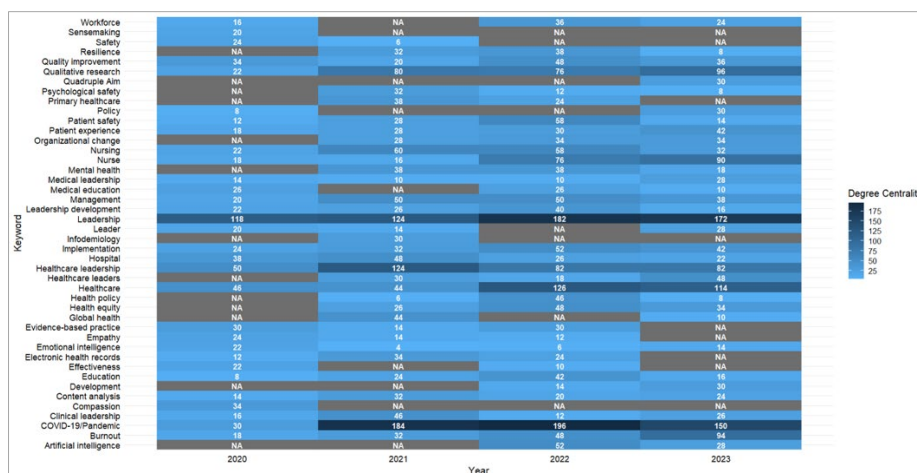
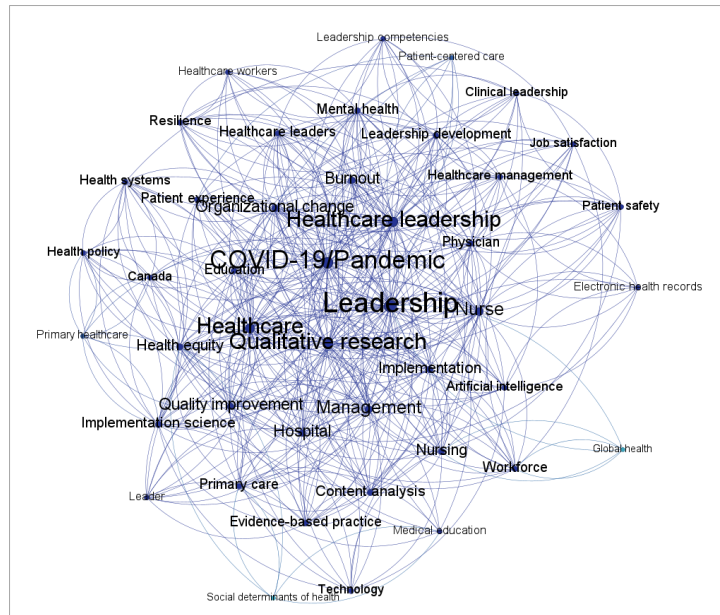


Figure 3: Degree centrality of 44 keywords

Figure 4 shows the network of the keywords with the highest degree centrality ranged between 50 and 514 retrieved from whole network for more clear visualization. The size of the node in the network was expressed proportionately to the degree centrality. In the figure, *leadership*, *COVID-19/Pandemic*, *healthcare leadership*, *healthcare*, *qualitative research*, *nurse*, *burnout*, *nursing*, *implementation*, and *management* are the first 10 keywords taking over notable positions in healthcare leadership literature for the overall study period.



Note: Degree Centrality is between 50 and 514.

Figure 4: The network of keywords with high degree centrality

Figure 5 illustrates the betweenness centrality of the 49 keywords for each year. Betweenness centrality reflects the bridging effect of keywords. The keywords with high betweenness centrality help to bridge disconnected clusters of keywords into an integrated network (Wanying, Jin, & Kun, 2018). Betweenness centrality takes up a value between 0 and 1. The higher the betweenness centrality value of the keyword, the stronger its bridge spanning role in a network. In Figure 5, keywords with relatively high betweenness centrality such as *leadership* and *COVID-19/Pandemic* played a role as bridges among research topics during 2020-2023. *Sustainability*, *safety*, *nurse leader*, *effectiveness* and *compassion* had bridge roles only in 2020. *Quality improvement*, *qualitative research*, *patient safety*, *patient experience*, *nursing*, *nurse*, *management*, *leadership development*, *leadership*, *implementation*, *hospital*, *healthcare leadership*, *healthcare*, *clinical leadership*, *COVID-19/Pandemic*, and *burnout* consistently had bridging effects for the overall study period.

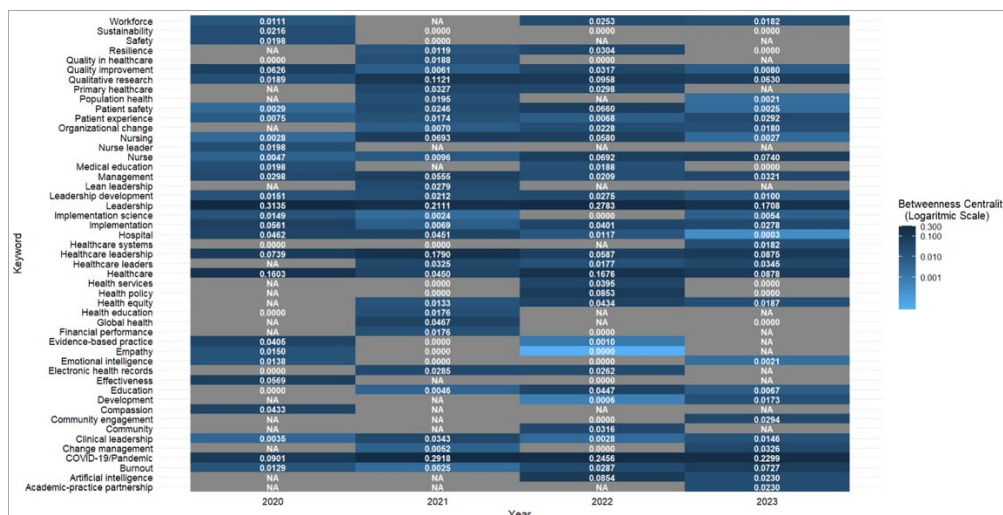
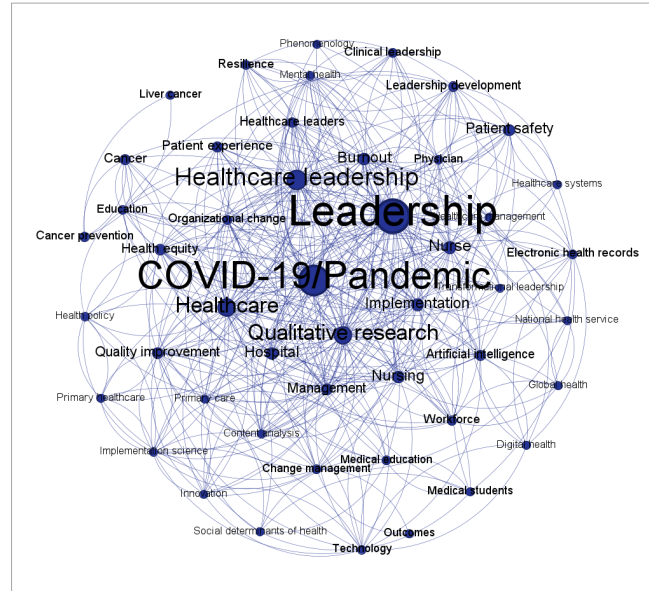


Figure 5: Betweenness centrality of 49 keywords

Figure 6 displays the network of the keywords with the highest betweenness centrality ranged between 0.007693 and 0.219827 retrieved from the whole network for more clear visualization. The size of the node in the network was expressed proportionately to the betweenness centrality. In the figure, *leadership*, *COVID-19/Pandemic*, *healthcare leadership*, *healthcare*, *qualitative research*, *nurse*, *implementation*, *hospital*, *nursing*, and *burnout* were the first 10 keywords having an important role in bridging disconnected topics in the healthcare leadership literature.



Note: Betweenness centrality is between 0.007693 and 0.219827.

Figure 6: The network of keywords with high betweenness centrality

Figure 7 illustrates the eigenvector centrality of the 52 keywords for each year. Eigenvector centrality gauges a keyword's influence within the network. High eigenvector centrality keywords are essential focal points for networks (Sreenivasan, Suresh, Nedungadi, & R, 2023). Figure 7 shows the keywords' influence within the healthcare leadership literature during 2020-2023. *Quality improvement*, *qualitative research*, *patient experience*, *nursing*, *nurse*, *management*, *leadership*, *implementation*, *hospital*, *healthcare workers*, *healthcare leadership*, *healthcare*, *emotional intelligence*, *education*, *content analysis*, *COVID-19/Pandemic*, *burnout*, and *behavior* consistently had an influence on the healthcare leadership literature at changing level. While the influence of some research topics in literature has decreased over the years, some of them have increased. For example, the influence of *qualitative research* and *nurse* in the healthcare leadership literature have increased significantly in 2023. While *COVID-19/Pandemic* had the most effective concept in 2021 and 2022, *leadership* was the most effective in 2020 and 2023.

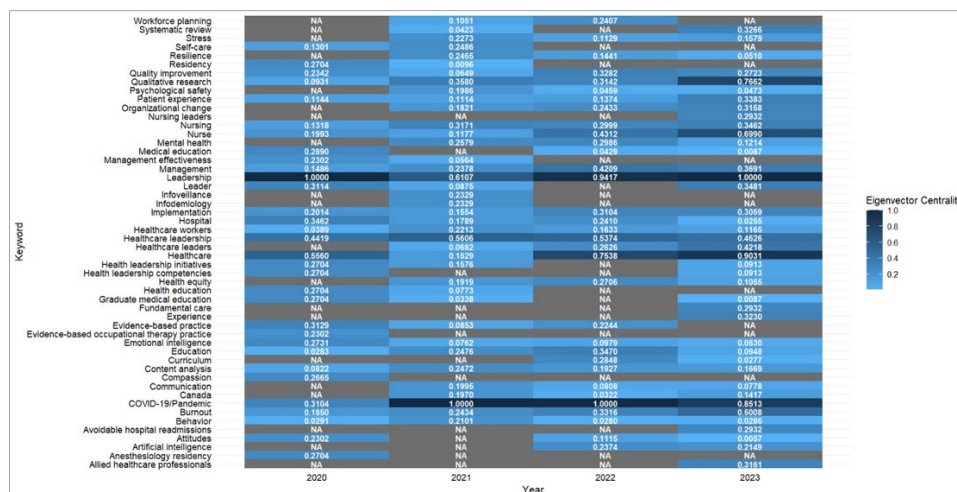
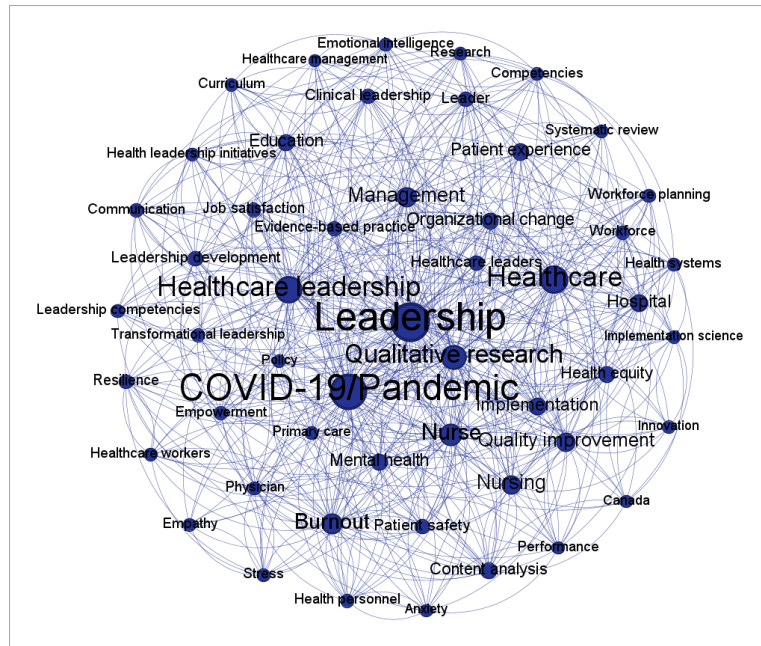


Figure 7: Eigenvector centrality of 52 keywords

Figure 8 displays the network of keywords with eigenvector centrality ranged between 0.143763 and 1 retrieved from the whole network for more clear visualization. The size of the node and label in the network was expressed proportionately to the eigenvector centrality. In the figure, *leadership*, *COVID-19/Pandemic*, *healthcare*, *healthcare leadership*, *qualitative research*, *nurse*, *burnout*, *management*, *nursing*, and *quality improvement* were the first 10 influential keywords in the healthcare leadership literature.



Note: The score of Eigenvector Centrality is between 0.143763 and 1.

Figure 8: The network of keywords with high eigenvector centrality

4. Discussion and Conclusion

By analyzing the keywords in healthcare leadership research over the last four years, it was possible to see both the general view of the cognitive structure of the healthcare leadership literature and conceptual change in the literature over the years. The most significant findings from this study are as follows. *Leadership*, *COVID-19/Pandemic*, *healthcare*, *healthcare leadership*, *qualitative research*, and *nurse* are the first six keywords that have the highest degree centrality, betweenness centrality, and eigenvector centrality. Thus, it is suggested that all these keywords are the backbone concept in the healthcare leadership literature. Although *communication*, *workforce planning*, *systematic review*, *health personnel*, *empowerment*, *emotional intelligence*, *research*, *transformational leadership*, *health leadership initiatives*, *healthcare workers*, *stress*, *curriculum*, *empathy*, *competencies*, *performance*, *policy*, *anxiety*, and *innovation* are the keywords that are not in the first 50 keywords list with the highest degree centrality, they are listed in the first 50 keywords with the highest eigenvector centrality. It means that even if they have a lower degree centrality, they are essential focal topics for healthcare leadership literature. These topics offer a productive area for new studies. *Cancer*, *cancer prevention*, *change management*, *liver cancer*, *medical students*, *outcomes*, *healthcare systems*, *digital health*, *innovation*, *national health service*, *transformational leadership*, *phenomenology*, and *health education* are the keywords that are not in the 50 keywords list with the highest degree centrality, even so they are listed in the first 50 keywords with the highest betweenness centrality. Although these are not salient concepts, they are important concepts because of having a bridge role between disconnected clusters of topics in healthcare leadership literature. These topics also reveal the interdisciplinary structure of the literature. This study is expected to enlarge existing knowledge of analyzing research trends by reviewing scientific subjects with two aspects, quantitative and relational changes.

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