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Analytical Approach to Society 5.0 Phenomenon Studies with Scientometric Analysis Method

(Araştırma Makalesi)

Bilimetrik Analiz Yöntemi ile Toplum 5.0 Olgusu Çalışmalarına Yönelik Analitik Yaklaşım

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Sergen GÜRSOY
Öğr. Gör., Alanya Alaaddin Keykubat Üniversitesi, Kariyer Merkez Ofisi
sergen.gursoy@alanya.edu.tr
Orcid No: 0000-0002-9032-2999

Ayten YAĞMUR
Dr. Öğr. Üyesi, Akdeniz Üniversitesi, İİBF, Çalışma Ekonomisi ve Endüstri İlişkileri
aytenyagmur@akdeniz.edu.tr
Orcid No: 0000-0003-2138-240X

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ABSTRACT

As a result of the intense penetration of globalization into societies, the necessity of integrating technology with society has emerged. In this context, an increase in the tendency of researchers towards the phenomenon of Society 5.0 has been observed. Since the subject is current and affects future social sustainability, it has become important to examine the literature from a holistic perspective. The study aims to examine the studies on the phenomenon of Society 5.0 in the literature from a systematic and holistic perspective and to ensure that the study is a source for future research. Using the Scopus database, qualitative interpretations are made within the scope of a total of 151 bibliographic quantitative data. The fact that Scientometrics studies and CiteSpace analysis have never been done in the literature on this phenomenon has increased the originality of the study. Analysis of countries, intellectual analysis, keywords; burst point and cluster analyzes has been performed. As a result of the findings, an increase in the research tendency, an increase in the production and collaboration networks of the countries, and an increase in the diversity of keywords (especially sustainable society) have been observed as the trend towards the subject increased. Moreover, it will be important for social sustainability to increase the study orientation for future studies in areas that are lacking (sociology, psychology, gerontology, etc. social sciences).

Anahtar kelimeler:
Toplum 5.0, Süper Akıllı Toplum, Bilimetrik Analiz, CiteSpace

ÖZET

Küreselleşmenin toplumlara yoğun bir şekilde nüfuz etmesi sonucunda teknolojinin toplumla bütünleştirilmesi gerekliliği ortaya çıkmıştır. Bu bağlamda araştırmacıların Toplum 5.0 olgusuna yönelik eğilimlerinde artış gözlemlenmiştir. Konunun güncel olması ve gelecekteki sosyal sürdürülebilirliği etkilemesi nedeniyle literatürün bütüncül bir bakış açısıyla

incelenmesi önemli hale gelmiştir. Çalışmanın amacı, literatürde Toplum 5.0 olgusu üzerine yapılan çalışmaları sistematik ve bütüncül bir bakış açısıyla incelemek ve çalışmanın ileride yapılacak araştırmalara kaynak olmasını sağlamaktır. Scopus veri tabanı kullanılarak toplam 151 bibliyografik nicel veri kapsamında nitel yorumlar yapılmaktadır. Bu olgu ile ilgili literatürde Scientometrics çalışmalarının ve CiteSpace analizinin hiç yapılmamış olması çalışmanın özgünlüğünü artırmıştır. Ülkelerin analizi, entelektüel analiz, anahtar kelimeler; patlama noktası ve küme analizleri yapılmıştır. Elde edilen bulgular sonucunda konuya yönelim arttıkça araştırma eğiliminde artış, ülkelerin üretim ve işbirliği ağlarında artış, anahtar kelime çeşitliliğinde (özellikle sürdürülebilir toplum) artış gözlemlenmiştir. Ayrıca, eksik olan alanlarda (sosyoloji, psikoloji, gerentoloji vb. sosyal bilimler) yapılacak çalışmalara yönelimin arttırılması sosyal sürdürülebilirlik açısından önemli olacaktır.

1. INTRODUCTION

Digitalization, which is the necessity of the new world order, and the infusion of the internet into the way of life of societies have been indicators of a new phase. The rapid development of information and communication technology (ICT) has brought great changes to society and industry. Digital transformation has created a new material and moral values and has become the pillar of industrial policy in many countries (Fukuyama, 2018: 47). For this reason, it is valuable in terms of social sustainability to read the concept well, to identify priority countries, to examine and adapt their policies in terms of developing the systematic sustainability of the world's societies of the future. It is important to determine many references, networks and keywords used with Society 5.0, to make inferences for the future, to examine the categories that deal with the concept, to identify interdisciplinary situations and to suggest applications for all these.

The research has been concluded using the scientometrics analysis method. Keywords, abstracts and titles have been searched from the Scopus database with the titles "Society 5.0" and "Super-smart Society". With the data obtained, systematic inferences were made from literature trends, countries and keywords. The quantitative data in the research has been evaluated from an interpretative perspective. The fact that the Scientometrics study or the CiteSpace Java application has not been used in the literature for the Society 5.0 phenomenon increases the originality of the study.

2. LITERATURE REVIEW FOR SOCIETY 5.0

The concept of Society 5.0, in the socio-economic structure in which globalization has intensified, is the implementation of the Japanese government policy that emerged in 2017. Under the name of "Future Investment Strategy", it is thought that the policy will be a solution to economic growth with the gains to be achieved in the medium-long term (Waldenberger, 2018). The concept of Society 5.0 is the national policy initiative that Japan aims to implement in 2015 (Keidanren, 2016). Then, Japan's Prime Minister Shinzo Abe, who participated in the IT fair CeBIT 2017 summit, introduced it under the name Society 5.0. He stated that technology-friendly their social life should be adopted and aimed that technology would help individuals in social life.

In Japan, especially recently, a decreasing workforce and increasing social security costs have emerged. The current workforce of more than 77 million people is expected to decrease to approximately 70%, 53 million people, by 2050. On the other hand, the cost of social security will rise from 120 trillion yen in fiscal 2015 to 150 trillion yen in the fiscal year 2025 due to

the aging of the population (Fukuyama, 2018, s. 47). Keidanren, Japan Business Federation is well aligned to proactively fulfill the United Nations Sustainable Development Goals to end poverty, protect the planet and ensure prosperity for all through the creation of Society 5.0 (Shiroishi et al., 2018, s. 91). The case aims to unite the physical life and the virtual world and to help individuals improve their quality of life by eliminating economic development and social problems.

It has been seen that humans and machines are integrated into working life, communicating and using artificial intelligence in a synchronized way, and production mechanisms and efficiency have improved through the Internet (Capgemini-Prognos, 2018). According to this strategy, the key to achieving medium and long-term growth is to integrate the rapidly occurring innovations of the 4th Industrial Revolution (eg Internet of Things-IoT, big data, artificial intelligence, robotics, sharing economy, etc.) into every industry and social life to meet various societal challenges. The solution is to realize Society 5.0 (Fukuyama, 2018, s. 48).

3. RESEARCH PHILOSOPHY AND METHOD

Our study is based on idealism, which constitutes the philosophy of qualitative research methods, and its extension, Post-Modern/Anti-Positivist understanding (Ritchie et al., 2013: 15). Accurate and actual vary depending on the context (Holloway and Wheeler: 2010). The average for the phenomenon of Society 5.0 is not correct, and the concept is constantly updated and expanded. Considering the mentioned approaches, the interpretative paradigm is used to interpret the perspectives and minds of social actors (countries, authors, documents, etc.) towards the phenomenon of Society 5.0. The perspectives and opinions of the documents in the literature have been interpreted (Günbayı, 2019; Deetz, 1996; Reeves and Hedberg, 2003: 32). According to TerreBlanche and Durrheim (1999), the research process has three main dimensions. These are ontology, epistemology, and methodology. Ultimately, the common point of these dimensions has based on the nominalist perspective, where truth and truth take place in the mind and perspective of the individual (Günbayı & Sorm, 2018; Collins, 2010; Burrell & Morgan, 1979). In this context, the data of the research is based on the opinions, perspectives, and ideas shared by the social network actors as a result of the situation they are in, that is, the interpretation of social networks (Guba and Lincoln, 2001; Collins, 2010). Similar studies in bibliometrics and scientometrics research, in which quantitative data reveal findings from an interpretative perspective, have been important for research analysis selection (Buter et al., 2004; Buter et al., 2006; Gläser, 2001). So much so that in the study of Zavaraqi and Fadaie (2012), these analysis methods were thought to be important in revealing findings with qualitative interpretation of quantitative data.

The study has the distinction of being the first research article in the international literature on the phenomenon of Society 5.0, made with the scientometrics method. In addition, for the first time, the CiteSpace application has been used to analyze the Society 5.0 phenomenon. In addition, the reason why it is different from other scientometrics research is that has been studied for the first time in the case of Society 5.0. Therefore, it is a work with high originality. However, there are certain limits. Scopus, one of the most important and effective search channels has been used in the study. But search channels like Web of Science (WOS) and Google Scholar will also affect coverage size. Expansion can be achieved by using these scopes in future studies.

3.1. Scientometrics

Scientometrics, V. V. Nalimov has been literated in 1960 by the term "scientometrics" and used to identify science studies that revealed growth, structure, relations network and productivity (Hood and Wilson, 2001, s. 291). It has intersecting networks of scientometrics, bibliometrics, informatics and information technologies. Refers to relationship networks related to the discovery of dynamic structures of data I<n the literature. Scientometrics and bibliometrics are difficult concepts to distinguish. But the focus of bibliometrics, despite much broad-scale recognition, has always been the scientific literature itself, whereas science and technology are more than just a literary output for scientists to measure and analyze; for example, the applications of researchers, socio-organizational structures, research and development management, the role of science and technology in the national economy, government policies for science and technology, etc. Statuses (Wilson, 2001). Nagpaul, et al (1999) categorized trends in scientific studies; made implications for science and technology policies, including the structure and dynamics of science, including internationally collaborative collaboration between regional aspects of science to the individual level, within the scope of the methodology used in science and science. Evaluation of the phenomenon of Society 5.0 within the scope of scientometrics in the research, the fact that both itself and the method of obtaining literature data have technological and scientific commonalities; It will assist in obtaining inferences and policy recommendations for the scientific literature and society.

3.2. Problem Definition

It is aimed to interpret the research trends, countries and keywords analysis of the documents in which the phenomenon of Society 5.0 takes place in the literature.Research problems have been created for this purpose;

• How do literary trends for the case of Society 5.0 follow the course?
• How are the productivity and relationship networks (such as collaboration networks, centrality and frequency) of countries regarding the phenomenon of Society 5.0?
• How do the references dealing with the phenomenon of Society 5.0 contribute to the field?
• For the keywords studied within the scope of Society 5.0; What are the implications of collaborations, burst points and cluster analysis? How do representative documents contribute to the field? What are the implications for future directions?

3.3. Database Selection

Research evaluation applications are becoming increasingly important today as the main providers of universally used bibliometric data. Since the reliability of these channels depends on the data source, the most appropriate database should be selected. Scopus is one of the two most important main bibliographic databases (Pranckutė, 2021, s. 1).

The database of the research was chosen as Scopus. This database was chosen because Scopus is quite comprehensive in the field of social sciences (Jabali et al., 2020, s. 4-5). For citation analysis, Scopus offers about 20% more coverage than Web of Science, while Google Scholar provides inconsistent accuracy results (Falagas et al., 2008, s. 338). Scopus is currently the world's largest research abstract and citation database, containing 24,600 journals from 5000 publishers (Elsevier, 2020). Scopus is the world's largest peer-reviewed scientific literature data source, with 75 million indexed items. In addition, Scopus updates the data daily and 32% of the total content indexed in Scopus belongs to the social sciences literature (Rashid, 2021, s. 3). The use of the Scopus database in our study is an important factor in terms of scope and compatibility with technology.

3.4. Query Statement

In order to obtain bibliographic data about the phenomenon of Society 5.0 and to make scientometric inferences, a search interface was run in the type of search query and search field. In the Search tab: "Article Title, Abstract and Keyword" query was made. search terms; TITLE-ABS-KEY (“Society 5.0”) OR (“Super-Smart Society”). The two phrases have been chosen because they are compatible and related to each other and because they are the most effective terms within the scope of the subject. There is no time limit on the search tab. The date of data collection from the system is 30.05.2021.

3.5. Research Data

165 studies for the term "Society 5.0" and 10 studies for the term "Super-Smart Society" have been obtained in the search on the database. In total, 175 studies have been examined in detail and two studies have been determined not to be subject-specific and excluded. No temporal restrictions were made (from 2017-2021 End of May), no language or geo-filtering has been applied. Data; conference paper (*N*=71), article (*N*=67), book chapter (*N*=17), conference review (*N*=5), review/review (*N*=5), book (*N*=3), editorial (*N*=3), grade (*N*=1) and short questionnaire (*N*=1).

3.6. Data Analysis Method

The bibliometric data of 173 studies have been obtained and the 5.7.R5 version of the CiteSpace application has been used to perform the scientometrics analysis method. The application was chosen because of its high quality in simplifying, transforming and analyzing our analysis process, innovative mapping of network of relationships, and being the first research application to be written in this field. This app combines many types of data as well as countries, keywords, references etc. In this context, it will help in mapping studies (Chen, 2006). In addition, it has been determined that the CiteSpace application has a lower error and miss rate that can take place in data reading, unlike other applications such as VOSviewer, BibExcel, UCINET (Dang et al., 2021). Therefore, this has been an important factor in the application selection. Analysis on Citespace is purely analytical and has based on text mining (clustering) and network analysis, as well as descriptive statistical tables and graphs.

Before starting to analyze the data, the quotation marks have been deleted with the Notepad++ program to make the data suitable for analysis. Then in the application "ris." format has been converted. The analysis has been continued with 172 studies that could not be converted to 1 study and 6456/6088 (94.0%) valid references. 95.0% is a very good success rate, considering all the irregularities of the cited references (Chen, 2014, s. 66). In our study, it has been seen that it provides a good conversion rate as it is very close to 95%. The last operation, which is the deletion of duplicate documents, has been carried out before being put into the analysis. On the application, 21 duplicate documents have been excluded from the scope of analysis, and finally, 151 documents have been included in the scope of analysis.

CiteSpace general application parameters for the analysis of 151 studies; periods covering all studies (2017-2021), year per slice (1), term source (all fields), node type (select one by the field at a time), selection criteria g-index scale factor (k = 25), Top N %10 was chosen as pruning (pathfinder).

3.7. Definitions of Statistical Methods

In the application software, node-link graphs, co-citation network analysis, detection of collaboration, centrality, citation burst points, cluster analysis, modularity, silhouette value etc. There are stages of analysis such as (Chen, 2004). Node sizes indicate the number and density of studies. The colors on the nodes represent different periods. The lines between nodes; It reflects collaboration and relationship, and the colors represent time.

Centrality is an important species in the field. Centrality represents the degree of importance. The center spacing of a node is similar to the constantly used toll booth, the center spacing of the most used toll booth will be high, and the center spacing of the less used toll booth will be low (Chen, 2016, s. 30). The fact that the center edge of the node is purple shows the importance, power and effectiveness of the centrality between them. The key node is the part with intermediate centrality ≥ 0.1. The bursting point is an important indicator for determining the trend of the research focus. Redness of circles and lines in the graph; it shows the time period of quote bursts and trend, trend has been detected.

Cluster analysis reveals themes determined through the application's algorithm. The modularity of the clustered partner networks and their average silhouette scores represent the algorithm features of the cluster analysis. Modularity has been applied in order not to focus on individual nodes and local details (so that the overall schema is not overlooked) and to divide the panoramic network into separate node groups within the visual analytic process for this. This kind of splitting can be done with quite a variety of clustering algorithms. The modularity of the network measures the extent to which it can be decomposed into multiple components or modules within the network. Modularity value (Q); It is convincing that it is between $0{,}30 < Q < 1.00$ (Chen, 2016, s. 32). A value close to 1 indicates that it is fairly well partitioned. The silhouette value (S) of the cluster measures the quality of the clustering. It ranges from $-1 < S < 1$, value of 1 represents perfect resolution.

4. RESULTS

4.1. Literature Trend

The year 2017 represents the starting point for studies on the Society 5.0 phenomenon. Between 2017-2021, it has been observed that the studies on this subject in the literature have grown significantly. From 2017 (N=8) to the end of 2020 (N=63), it has been observed that the number of studies on the subject increased approximately eight times.

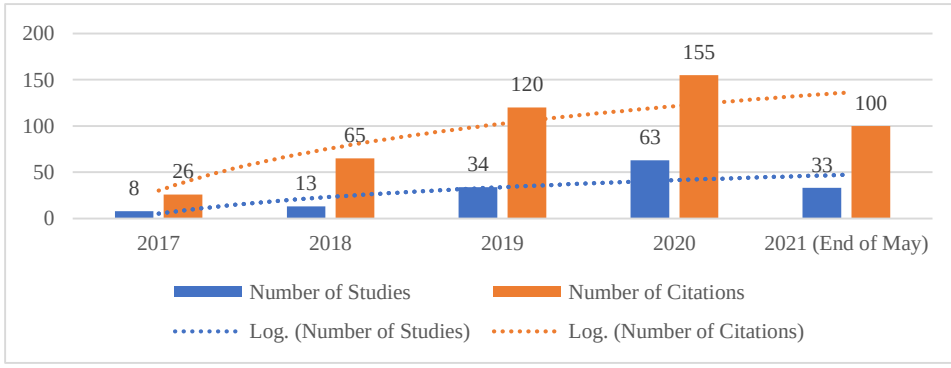

Figure 1. Study and Citation Counts and Trendlines

As can be seen in the figure, there is an acceleration in an increasing structure. As of May 2021 (*N*=33), it was seen that more than half of the studies published in 2020 have been published. If the momentum continues in this way, the end of 2021 will be the year in which the largest number of works will emerge. In addition, when the number of citations has been examined, it is seen that it follows a similar course. The number of citations in 2020 (155) is approximately six times more than the number of citations in 2017 (26). As of the end of May 2021, it has been determined that the acceleration of the number of citations (100) increased rapidly compared to the previous year. As a result, these two situations show us that the trends in the literature on this subject have increased rapidly and the subject has attracted attention over the years.

4.2. Productivity and Collaboration Analysis of Countries

The CiteSpace application revealed 61 nodes and 43 links to analyze and map the countries. There are publications on the subject of Society 5.0 in 61 different countries. However, with the emergence of 43 connections, it has been observed that there has limited collaboration between countries on this issue, that countries either establish connections with studies within themselves or collaboration is made between studies among major countries (figure 2). At this point, the increase in the collaboration of countries; It will help each country's conditions, contexts, and countries to produce unique outputs. With the increase in collaborations, the authors can make the phenomenon adaptable to their own country within the framework of certain references.

The top ten countries in terms of number of publications and degree of centrality have listed in Table 1. The country with the most publications was Japan (42), which revealed the phenomenon of Society 5.0. Indonesia (29) and the United States (12) came first among the countries that broadcast the most. The degree of centralization on the basis of countries has remained low due to the limited number of studies and the fact that it only covers a period of four years. The most important country in terms of centrality is the United States of America (0.06), followed by Poland (0.03), Japan (0.02) and Russia (0.02). It was seen that Japan came to the fore on the basis of publication and the USA and Japan on the basis of centrality.

Table 1. Top Ten Countries by Number of Publications and Centrality Value

Number of Publications	Countries	Years	Centrality	Countries	Years
42	Japan	2017	0.06	United States	2019
29	Indonesia	2017	0.03	Poland	2019
12	United States	2019	0.02	Japan	2017
7	Russian Federatıon	2019	0.02	Russian Federatıon	2019
7	Italy	2020	0.00	Indonesia	2017
5	Canada	2019	0.00	Italy	2020
5	Poland	2019	0.00	Canada	2019
4	South Africa	2020	0.00	South Africa	2020
4	Portugal	2020	0.00	Portugal	2020
3	Turkey	2020	0.00	Turkey	2020

It is normal for Japan to have such a high number of publications, since it is the country that reveals the source of the phenomenon (Keidanren, 2016). However, it may seem surprising that the number of publications in the country of Indonesia is so high, but it is not. Because Indonesia is one of the countries that applies the phenomenon of Industry 4.0 to all areas of social life (Natalia & Ellitan, 2019; Hamdanunsera, 2018). The penetration of Industry 4.0 into

every aspect of society has led to the phenomenon of Society 5.0. The five industries (textile, automotive, electronics, chemicals, food and beverages), which have been considered focal points against Industry 4.0 and Society 5.0, are very important in terms of competitiveness and have expected to enter the top ten countries in the world economy in 2030 (Ellitan, 2020; 7-8). In addition, according to the Google Trends data of 2021, the countries with the most searches for the word Society 5.0 are respectively (if we consider that the least popularity value is 0, the most popular value is 100); Japan (100), Indonesia (41), Malaysia (18), USA (2), Germany (1). Thus, the relationship between Indonesia and Society 5.0 can be understood. On the other hand, it is seen that the USA started the studies as late as two years but formed the intersection point as the country with the highest level of importance.

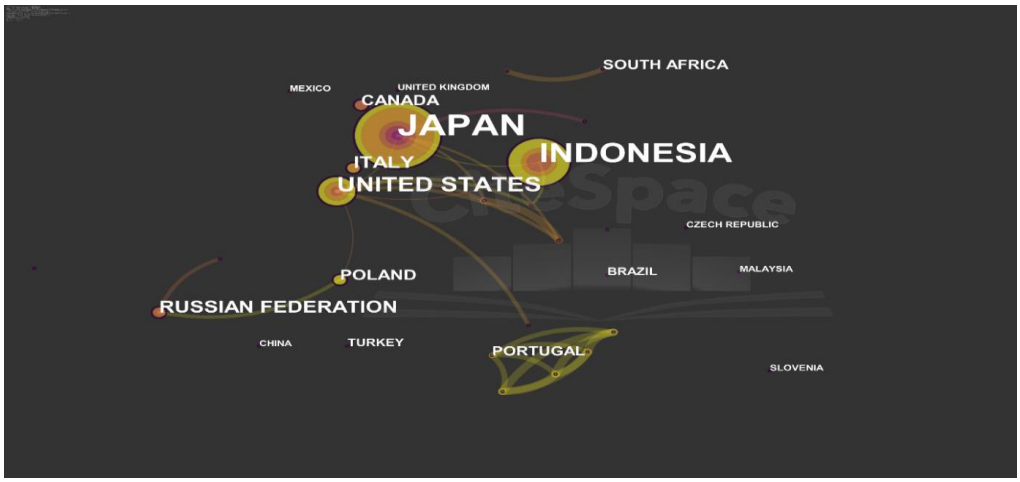

Figure 2. International Collaboration Network

It is seen through the nodes on the map that Japan has the oldest and newest works. Although naturally, that the studies in the USA are not as old as Japan, it is seen that the number of years is not to be underestimated. At this point, the USA is one of the countries with a high potential to continue its work in the future, as it carries out many and centralized studies in a short time.

In Figure 2, it is seen that the collaboration between the USA and Indonesia countries has followed a comprehensive course. It has been seen that the collaboration between the USA-Slovakia, Japan-Indonesia, Russia-Poland is extensive. It has been observed that Portugal's collaboration network with other countries is effective. The other strongest collaborations were seen to be Russia-Poland, USA-Indonesia, Japan-Indonesia, USA-Slovakia. (All of them have 1.0 value) Since the number of countries is higher than the number of connections, it is normal for the value of inter-country connections to be so high. In the future, it will inevitably be seen that there will be decreases in the value of the connection with the increase in the number of collaborations.

4.3. Reference Analysis

Analysis of references has been used to identify the intellectual structure and collaborations of the literature. Rather than the cited authors, reference analysis has been used because of the innovative nature of the case and the comprehension of the content of the studies. While determining the final decision regarding this situation, necessary information has been obtained by the founder of the CiteSpace application and an expert academician.

Considering the reference analysis of the studies studied for the case, Top *N* has been included in the analysis as 100% (all references), unlike other parameters. Unlike other analysis titles, when Top N% has been included in the analysis at a normal rate, it could not reveal the desired effect, even if it was similar to the analysis obtained in total. Including all studies in the system will be more important and effective in making discoveries and comments on references. It is seen that 5651 nodes and 17088 connections have emerged. The result was quite comprehensive as all of the studies have been included in the analysis. Figure 3 shows the relationship networks map. Table 2 shows the number of nodes and connections that change from year to year, Table 3 shows the references with a centrality level of 0.01 and above that are jointly cited in order of Centrality.

Table 2. Number of Nodes and Connections from Year to Year

Years	Nodes	Links
2017	116	348
2018	547	1641
2019	964	2892
2020	2382	7146
2021	1687	5061

When the table has examined, it is seen that the nodes increase rapidly from year to year. Parallel to this situation, it has been observed that the connections increased rapidly. In May 2021, it was seen that there were much higher nodes and connections than the result of the previous year when we divide it by average months. Therefore, when we come to 2021, it has been seen that there are quite good node and connection numbers according to the current studies, and if the increase rate continues in this way, it is predicted that the phenomenon will reach the highest number of references and connections by the end of 2021. This means a rapid expansion of the subject's scope.

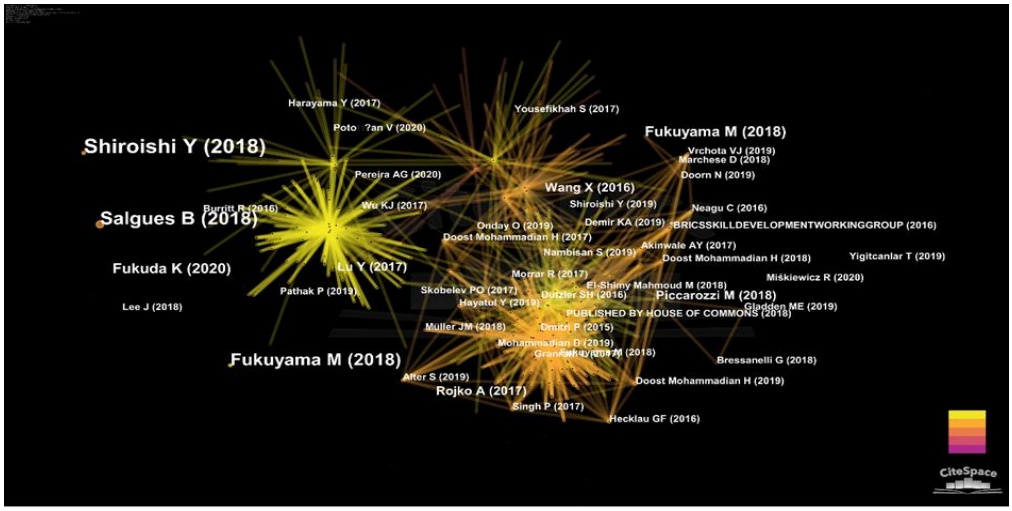

Figure 3. Citation Network in Society 5.0 Studies

When the network map has examined, it is seen that the number of references made to authors such as Y.Shiroishi, M. Fukuyama, B. Salgues, K. Fukuda is ahead of the others. These authors are the main reference sources for the Society 5.0 phenomenon. The level of centralization has been considered to be important in the reference analysis in Table 3. Since it determines the

studies with the highest level of importance, the importance of the studies that are taken as a common reference will be determined. However, the level of centralization remains low, as the case is still new and there is not much literature accumulation.

Table 3. Commonly Cited References by Centrality Ranking

Centrality	Author	Year	Source
0.02	Y. Shiroishi vd.	2018	Society 5.0 for Human Security and Well-Being
0.02	M. Fukuyama	2018	Society 5.0: Aiming for a New Human-Centered Society
0.02	R. Miśkiewicz	2020	Practical Application of the Industry 4.0 Concept in a Steel Company @ Sustainability
0.01	B. Salgues	2018	Society 5.0: Industry of the Future, Technologies, Methods and Tools
0.01	S. Alter	2019	Making Sense of Smartness in the Context of Smart Devices and Smart Systems
0.01	A. Rojko	2017	Industry 4.0 Concept
0.01	AY. Akinwale	2017	The Impact of Technological Innovation on SMEs' Profitability in Nigeria Int J Research Innovation and Commercialization

The cited article with the highest centrality and frequency is that of Y. Shiroishi et al.. In the study, there are objectives and targets for the phenomenon of Society 5.0 that emerged in Japan (Shiroishi et al., 2018). M. Fukuyama, on the other hand, in his study (2018; 47); He stated that information and communication technology will bring the global digital transformation and new values for the society and the sector will emerge. R. Miśkiewicz and Wolniak (2020) made inferences about the digitalization process in Industry 4.0-based company organizations. Salgues in his study (2018); He stated that the phenomenon of Society 5.0 emerged with the rapid development of technologies spreading globally, and he criticized the dramatic social changes that came with it. As can be seen, the cited references are important basic reference sources for the Society 5.0 studies. Because it provides general and basic information about the phenomenon and forms the basis for the studies to be included in the literature. It has been observed that the studies generally make general statements, policies and promotions in the technological and economic field for the phenomenon of Society 5.0. Currently, it is usual for general statements to be quoted in new works. As the subject becomes more specific and the fields become more specific, general information can evolve with different concepts.

4.4. Analysis of Keywords and Future Research Guidelines

When the common keyword analyzes in the studies has examined; It was seen that 195 nodes and 633 connections emerged. Of the 195 clusters, 70 (highest) were in 2020 and 52 in May 2021. It has been seen that there is an increasing scope as the years go by, the subject is quite up-to-date and 2021 has the potential to host the most studies on this subject. In Table 4., the year-based relationship network map of the keywords has revealed. In Table 4, the 10 common keywords with the highest number and the highest level of centralization have shared.

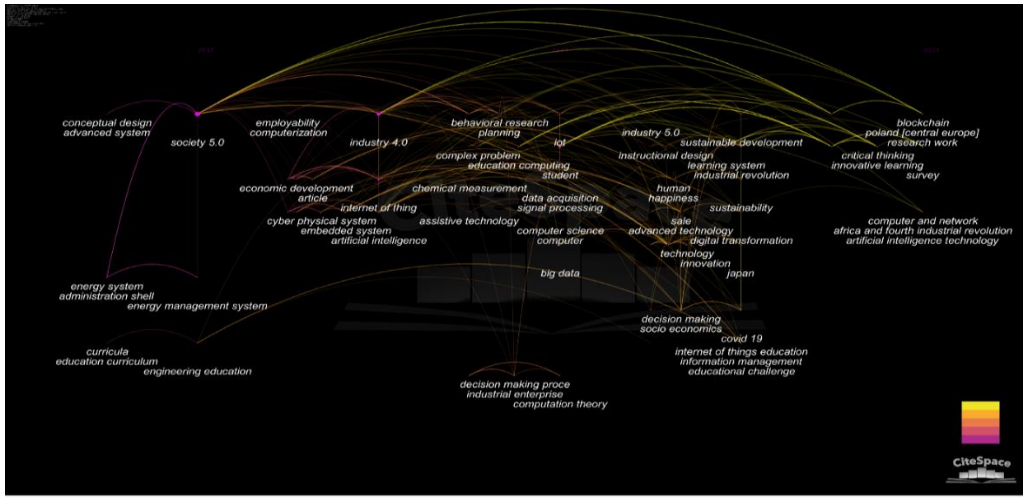

Figure 4. Keyword Network Map by Years

The years are given at the top of the figure. Before the Society 5.0 keyword; The keyword Society 5.0, which references keywords such as energy systems, energy management and conceptual design progression systems, constitutes the starting point of the case. Society 5.0 naturally has the most citations and the most centrality. The other most centralized keyword is Industry 4.0. As time progressed, the network of relations with this keyword increased and new keywords have been added to the literature.

Industry 4.0; computerization and employability, economic developments, cyber-physical systems, artificial intelligence were among the keywords with a high network in 2017-2018. Keywords for 2018-2019; Keywords such as complex problem solving, studentship, informatics education, assistive technology contain keywords for individuals to gain qualifications. 2019-2020 keywords; sustainability, learning systems, human happiness, technological innovation, sales technology. In the years 2020-2021, keywords such as digital transformation, sustainability, critical thinking, innovative learning, artificial intelligence technology, and blockchain have been predominantly used. As you can see, keywords are terms that differ from year to year and have intertwined and related to each other. It has been observed that the keywords are mostly shaped in the fields of economy, business and engineering.

Table 4. Keywords with the Most Number and the Highest Level of Centralization

Frequency	**Keywords**	**Centrality**	**Keywords**
57	Society 5.0	0.74	Society 5.0
29	Industry 4.0	0.40	Industry 4.0
12	Student	0.38	Student
12	Sustainable Development	0.30	Internet Of Thing
12	Internet Of Thing	0.15	Artificial Intelligence
12	Artificial Intelligence	0.10	Embedded System
8	Embedded System	0.09	Industrial Revolution
7	Industrial Revolution	0.09	Industrial Enterprise
7	Education Computing	0.08	Sustainability
6	Learning System	0.07	Engineering Education

It is usual for the words Society 5.0 and Industry 4.0 to be in the first place. Those who work on the phenomenon of Society 5.0 mostly mentioned the phenomenon of Industry 4.0. Because the facts integrate each other. In addition, the word student, the internet of things, artificial intelligence, industrial revolution, industrial entrepreneurship, sustainability, learning systems, and the fact that it contains common keywords with subjects related to many departments such as engineering education shows that the phenomenon of Society 5.0 is a mutli-disciplinary field. However, the scope of the multi-disciplinary field is still controversial due to the fact that the case is new.

Table 5 presents a list of the 20 most powerful citation bursts. Power gives the level of centrality and connectivity in the relationship between keywords. It is an indicator of the active use of keywords. While the blue area indicates a moderate citation status, the red area indicates how long the trend of relevant keywords, the boom state, lasted. The list is based on historical order.

Table 5. Top 20 Keywords with the Strongest Citation Bursts

Keywords	**Year**	**Strength**	**Begin**	**End**	**2017 - 2021**
Energy Management System	2017	1.24	**2017**	2017	
Economic Development	2017	1.2	**2018**	2018	
Internet Of Thing	2017	1.02	**2018**	2019	
Cyber Physical System	2017	0.92	**2018**	2018	
Competition	2017	0.86	**2018**	2019	
Computation Theory	2017	1.59	**2019**	2019	
Decision Making Proce	2017	1.06	**2019**	2019	
Data Acquisition	2017	1.06	**2019**	2019	
Signal Processing	2017	1.06	**2019**	2019	
Industrial Enterprise	2017	1.06	**2019**	2019	
Computer	2017	1.06	**2019**	2019	
Higher Education	2017	1.06	**2019**	2019	
Computer Science	2017	1.06	**2019**	2019	
Planning	2017	1.06	**2019**	2019	
IoT	2017	0.73	**2019**	2019	
Sustainable Development	2017	1.89	**2020**	2021	
Japan	2017	1.64	**2020**	2021	
Innovation	2017	1.09	**2020**	2021	
Technology	2017	0.81	**2020**	2021	
Embedded System	2017	0.77	**2020**	2021	

The words with the strongest citation bursts; They have listed as "sustainable development", "japan", "computation theory", "energy management system", "economic development". These words are mostly related to economic developments and show a tendency towards sustainable business and economy.

Together with the citation bursts, it is seen whether there is a change between the topics that were spoken in trend between 2017-2018 and the topics that were mostly spoken in recent years. On the basis of the common keyword of the case, it has been observed that the only trend word was “energy management system” in 2017. In the following process, it has been determined that the keywords “economic development”, “internet of thing”, “cyber physical system”, “competition” became a trend in 2018. When the common key developments have

been examined in 2019, it was seen that the tendencies of data collection, internet of things, signal processing, industrial organizations, computer and information technologies were higher. Sustainable development in 2020-21 Terms such as innovation, technology, etc. The reason why terms such as Society 5.0, Industry 4.0 and Industrial Revolution are not included in the citation bursts is because they are not an instantaneous phenomenon but are always trend terms that concern the general lines of the subject. These words are the keywords that have been studied more than in the previous periods. Especially the last two words are important keywords that have increased rapidly in frequency and centrality, although they have entered the trend list in 2020 and are still new terms. Keywords refer to previous terms. Industry 4.0 based cyber physical system uses embedded system to communicate and connect via IoT (trend keyword of 2018). Thus, the connection between physical and digital systems has established and personalized (Peraković et al., 2020; 205). Therefore, it is usual for cyber-physical systems to be the trend in 2018 and then to develop embedded systems. With the implementation of these systems in the future, new terms can be created in the same field and these new terms can cooperate with different fields.

When the common keyword trends have examined in general in the case of Society 5.0; economy (sustainability), engineering and technology fields were seen to be the focus of attention. The phenomenon of Society 5.0 is an issue that concerns all areas of society. Ultimately, not only the economic aspect of the Society 5.0 phenomenon, but also the social aspect dominate with the smart society understanding.

Cluster analysis has been carried out in order to examine and interpret the keywords in detail today and to predict the future keywords in the light of the suggestions of the obtained documents. For this purpose, a common keyword cluster map is drawn in Figure 5.

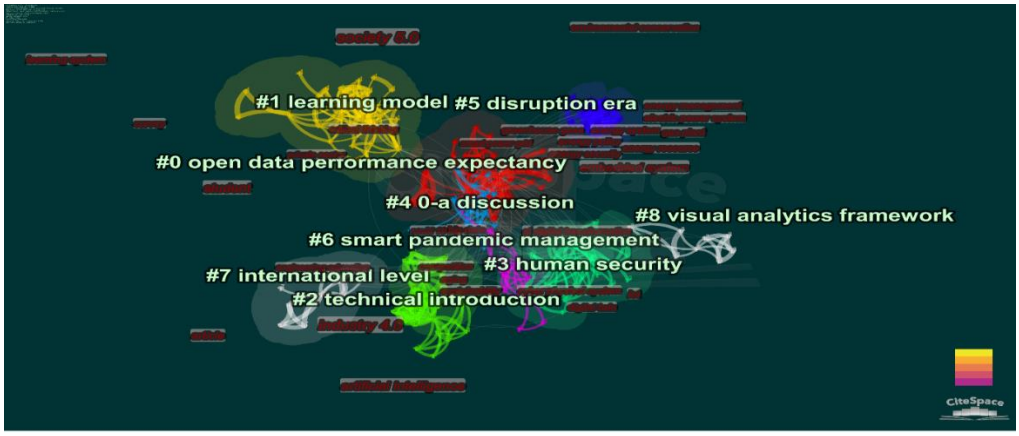

Figure 5. General Common Keyword Cluster Map

Modularity (Q) value: 0.6606 and Silhouette (S) value: 0.9019 are quite good figures. According to the modularity value, it has been seen that each cluster is properly separated. According to the silhouette value, it is obvious that the clusters have resolved quite well. LLR (Local Linear Regression) algorithm has been used to label the clusters. 9 sets of keywords emerged. The largest of the clusters is #0; It contains 40 keywords and an average S value of 0.842, #1; It has 31 keywords and pretty good S values of 0.978. Table 6. shows the first 5 of the clusters in order of size. However, 9 clusters have been also included in the analysis.

Table. 6. Major Keyword Clusters

ID	Size	Mean Silhouette	Mean Year	Terms (Local Linear Regression)
0	40	0.842	2019	open data performance expectancy (25.02); sustainable infrastructure evolution (23.49); sustainable development report (21.98); sustainable development goal (20.47)
1	31	0.978	2020	learning model (19.72); google classroom (19.72); competency assessment (19.72); 21stcentury student (19.72)
2	25	0.935	2018	technical introduction (20.56); care training robot (20.56); joint load material (20.56); basic consideration (20.56); east asia (16.37)

The first four terms of the values obtained with the LLR are at close levels. The labels in each cluster have been selected from the keywords in the articles with the log-likelihood ratio (LLR) weighting algorithm, which is a measure that calculates the weighting coefficient of the keywords in the cluster. Silhouette values given in the table are quite good and it is seen that the keyword sets have resolved appropriately. Keywords in the clusters, if they are in the document titles, have automatically changed to yellow background.

In the #0 cluster with 40 keywords; The year 2019 has considered as the average year. The terms aim to establish infrastructure systems for data performance, as well as to realize sustainable infrastructure evolution and sustainable development. In the #1 cluster with an average year of 2020, it was seen that the most studied subjects were learning techniques, learning stages, the concept of studentship and competency assessment. In cluster #2, whose average year is 2018; It is seen that the tendency to robotic technologies is high. #3 and #4 indicate similar average years and include super-smart societies, security structures of societies and future work, social perspectives, cyber-physical systems and self-control systems. In other clusters, it has been observed that technology, economy, engineering, health care and medical fields have been emphasized.

Table 7. Representative Documentation of Major Keyword Sets

Cluster #	Citing Papers	Coverage %
#0 open data performance expectancy; sustainable infrastructure evolution; sustainable development report	Matsuda, K (2019) Technologies of production with society 5.0. 6th International Conference on Behavioral, Economic and Socio-Cultural Computing, BESC 2019.	7
	Da, Costa (2021) Society 5.0 as a contribution to the sustainable development report. International Conference on Tourism, Technology and Systems, ICOTTS.	5
	Świątek, L (2019) From industry 4.0 to nature 4.0 – sustainable infrastructure evolution by design. AHFE International Conference on Human Factors, Sustainable Urban Planning and Infrastructure.	5
	Sołtysik-Piorunkiewicz, A (2021) How society 5.0 and industry 4.0 ideas shape the open data performance expectancy. Sustainability (Switzerland).	5

#1 Learning model; google classroom; competency assessment	Ilma, AZ (2021) Assessment for learning model in competency assessment of 21st century student assisted by google classroom. 2020 National Physics Seminar, SNF.	9
	Zahara, M (2021) Teachers' perceptions of 3D technology-integrated student worksheet on magnetic field material: a preliminary research on augmented reality in stem learning. Young Scholar Symposium on Science Education and Environment 2020, YSSSEE.	6
	Liliasari, S (2021) Innovative chemistry education: an alternative course models in the disruption era. 1st Mathematics and Science Education International Seminar, MASEIS 2019.	6
	Umamah, N (2020) Teacher perspective: innovative, adaptive, and responsive instructional design aimed at life skills. 2nd International Conference on Environmental Geography and Geography Education, ICEGE 2019.	5
	Sajidan, -- (2021) A framework of science based entrepreneurship through innovative learning model toward indonesia in society 5.0. 2nd International Conference on Science Education and Technology, ICOSETH 2020	5
#2 technical introduction; care training robot; joint load material	Takase, J (2018) Care training robot joint load material of basic consideration technical introduction. Transactions of Japanese Society for Medical and Biological Engineering.	9
	Takakuwa, S (2018) “industry 4.0” in europe and east asia. 29th International DAAAM Symposium on Intelligent Manufacturing and Automation, DAAAM 2018.	7
	Fathi, S (2020) The role of urban morphology design on enhancing physical activity and public health. International Journal of Environmental Research and Public Health.	6
	Hall, A (2019) Detectors and light-sources for optical spectrometry: from a 3d-printed light-source to a self-powered sensor fabricated on a flexible polymeric substrate, and from there on to an iot-enabled smart system. 1st IEEE International Conference on Flexible and Printable Sensors and Systems, FLEPS 2019.	5
	Nieuważny, J (2020) How religion and morality correlate in age of society 5.0: statistical analysis of emotional and moral associations with buddhist religious terms appearing on japanese blogs. Cognitive Systems Research.	5

In the table above, documents with a coverage ratio of less than 5% were not included in the chart but have been included in the analysis. It has been tried to gain a broad perspective by examining the representative documents. K. Matsuda's article in cluster #0 corresponds to 7% of the keywords belonging to the cluster and the study carries the most relevant keyword document associated with the cluster. According to this study of Matsuda et al. (2019); With

Society 5.0, a new idea of production technologies emerged. The advertising and proliferation of the 5G network will bring a revolutionary technological advance in production management by accommodating new technical networks. Other studies within the same cluster have focused on sustainable development. In this cluster, it has been observed that economic factors and studies on the creation of infrastructure in working life are predominant.

The work of A. Z. Ilma et al. in cluster #1 covers 9% of the keywords belonging to the cluster. In this study (2020), interview has been conducted which showed that assessment for learning is useful in redesigning more online learning strategies to improve students' abilities in the 21st century. Other studies in the same cluster have been also studied in the fields of qualification training for competency assessment.

In cluster #2, J. Takase et al. corresponds to 9% of the keyword coverage in the cluster. In this study (2018), special attention was paid to concepts such as sharing information, new values, low birth rate, aging and local population decline; It has been stated that reductions against poverty and wealth gap will be realized with robotic technology. In other documents of the same cluster, intelligence generation and automation systems, public health, IoT smart technologies, certain statistical analyzes were made.

In the #3 cluster, the study of Y. Shiroishi et al. (2018) corresponds to 6%. In the study, based on Keidanren's United Nations Sustainable Development Goals, the policies to reduce the poverty of the Society 5.0 phenomenon, increase the welfare of the society and protect the world have mentioned. Other documents of the same cluster have also aimed at services for the society. Finally, it has been seen that one of the main purposes of the Society 5.0 phenomenon is the service to the smart society and individuals. However, it is debatable whether this cluster is at a sufficient level for the subjects studied in social sciences.

The only work covered in cluster #4 is A.V. Mavrodieva and R. Shaw (6%). The study (2020) aims to ensure sustainable development by focusing on disaster risk and climate change policies in the case of Society 5.0. Study subjects of other articles in the same cluster; focused on security challenges in smart societies, the use of medical artificial intelligence, and the importance of innovation and values in the transition with the phenomenon of Society 5.0.

The subjects studied in the representative documents in the #5 cluster with a silhouette value of 0.971, whose average year is 2017: medical artificial intelligence, smart pandemic management and 4d mathematical modeling systems. The average year of the #6 cluster was 2020, and the Silhouette value was 0.862; It has been observed that research have carried out in more ecosystem and working conditions-oriented areas such as flexible decision-making systems, smart pandemic management, innovative ecosystem transformation, and sustainable working conditions. In the #7 cluster, whose average year was 2018, the Silhouette value was 0.961; It has been seen that there are many studies on education policies, open data performance expectations, and best practices for the Internet of Things. In #8 clusters, the average year is 2019 and the Silhouette value is 0.980. It has been determined that computer-based studies such as visual analytical framework, cyber-physical systems, conditional monitoring, open data performance expectations are at the forefront.

As a result of the cluster analysis, it is seen that the work is at a multidimensional stage and as its social importance increases, there may be an increase in studies in different fields. At this point, the important thing will be to specialize in the subjects studied and to start and continue working on issues that are seen as incomplete and that concern the society.

5. CONCLUSION

The literature trends of one hundred fifty-one articles in accordance with the CiteSpace application scientometric analysis from the Scopus database, analysis of countries and references, and detailed analyzes of keywords (collaboration, burst points, centrality levels, cluster analysis, document analysis) were made within the framework of the interpretive paradigm. The content of the aforementioned analyses has been discovered and interpreted. In particular, this paradigm has been important in the interpretation of the relations established after the discoveries and cluster analyses in the analysis.

There are various restrictions. In the future, in addition to Scopus scope, a wide range of research can be carried out in the Web of Science and Google Scholar databases with different search options. While this phenomenon cumulatively increases its scope in the literature over time, the inclusion of other databases in the analysis will also help in the emergence of more comprehensive findings.

By using the qualitative research paradigm, which constitutes the method of the research, the quantitative equivalent of the data in the literature regarding the phenomenon of Society 5.0 is interpreted. First, it is thought that the studies on the case have increased and may accelerate with its integration with the society. Within the scope of countries, it is seen that the countries with central and numerical importance are predominantly developed countries and these countries attach importance to the issue in terms of social sustainability. In addition, it is seen that there has been a rapid increase in the number of authors conducting research within the scope of the subject, especially in relation networks recently. Ultimately, the increase in the tendency towards the phenomenon of Society 5.0 within the scope of the literature has brought with it an increase in the number and variety of keywords. It confirms the reason why the keyword with a high breaking point is sustainable development and countries attach such importance to it.

When the trends in the literature have examined, the Society 5.0 field is currently developing and has expected to continue its development in the future. The fact that the phenomenon of Society 5.0 has included in the fields of multi-disciplinary expands its scope. In the analysis of the countries' collaboration, it has been seen that Japan, Indonesia, and the USA on the basis of quantity and countries such as the USA, Japan, Poland and Russia on the basis of centrality constitute an important scope in the literature. When collaboration has examined, it is seen that the country that cooperates the most is the USA. In the reference analysis, it was seen that the works of authors such as Y. Shiroishi et al., M. Fukuyama, R. Miśkiewicz, B. Salgues were at the forefront. It has been observed that the documents, which are high in number and centrality level of the cited studies, were taken as reference for the purpose of promoting the Society 5.0 phenomenon in general terms, and to indicate its technological and economic structures. As the phenomenon becomes specialized in different fields, it has predicted that these general expressions will evolve in those fields.

Keyword cluster analysis provides guidelines for the future. It is foreseen that the studies will be in the trends of innovation education, data literacy, complex problem solving, critical thinking, taking artificial intelligence technology to advanced levels and pandemic management (especially coping with the coronavirus epidemics) in 2021 and beyond. Because when the keywords have considered over the years, it has been seen that the previous period forms the basis for the next period because it has a complementary structure. According to the report shared by the World Economic Forum in 2020, it has been seen that there are findings similar to the prediction. Technologies that are likely to be adopted in companies include

concepts such as data analysis, internet of things, cyber security, artificial intelligence, cloud computing, robotic studies, virtual reality. To this end, it has envisaged that companies' demands for workers should be based on qualifications such as critical thinking and complex problem solving, self-management and technology use.

It has been observed that the keywords included in the phenomenon of Society 5.0 have changed dimensions over time and shifted to multi-disciplinary fields. Keywords in cluster analysis; It has been observed that studies on health, engineering, mathematics, technology and economy have been predominant. When all these clusters have evaluated in general, it is seen that the other 7 clusters have a similar structure despite two clusters (#3 and partially #4). In the studies in which the keywords common to the Society 5.0 keywords have included, it has been observed that social perspectives are lacking and instead sustainable development, infrastructure stages and technological developments (internet of things, computer information systems etc.) come to the fore. Due to the limited number of studies in areas such as sociology, psychology, social policy, and gerontology, and the fact that the Society 5.0 phenomenon does not have a structure that directly concerns the society (Keidanren, 2018; 17), it has recommended that studies be developed in a multi-faceted manner. The findings of our research have determined that there are gaps that should be discussed especially in terms of research in the mentioned areas. Therefore, the tendency of researchers to these areas will be important.

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