

CHAPTER

Digital Transformation and Productivity in Higher Education

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Introduction

In today's globally competitive environment, industries must put change and transformation on their agenda to keep up with innovation and continue their activities. Especially in the 21st century, known as the digital age, businesses need to perform their transformation activities quickly. This transformation, which has been going on for years, started as the first industrial revolution in the 1700s and continues today as the fourth industrial revolution. Industry 4.0, first heard at the Hannover Fair in Germany in 2011, has led to a digitalization process that the world has followed closely (Gabacli & Uzunoğlu, 2017; Kagermann et al., 2013). This digitalization concept, which emerged in the 3rd industrial revolution, has left its place in digital transformation with Industry 4.0 (Sukhova, 2016).

Before moving on to what digital transformation is, it would be appropriate to explain the concepts of digital and transformation. Digital is expressed as the state of being numerical and consisting of 0-1. That is, analog signals are replaced by digital signals (Tilson et al., 2010). This expression evokes technology. Transformation means change and innovation, and in the process, it means digital structuring in general. However, digital transformation expresses an approach beyond the combination of these two concepts and is beyond technology (Henriette et al., 2015). Because it can be said that digital transformation is not only based on the use of technology, but also on a vision and strategy. This concept, which is not an instant process, requires long-term planning (Seres et al., 2018). In this context, there are different definitions of digital transformation in the literature. Some of them are as follows.

It is the holistic transformation carried out by organizations in human, business processes, and technology elements to provide more effective-efficient service and to ensure beneficiary satisfaction (TUBITAK-BILGEM, 2020).

Digitization means using digital technologies and data to generate revenue, improve businesses, change/transform business processes and create digital business environments (Schallmo & Williams, 2018).

With the use of technology, unlike the use of existing services in the digital environment; refers to a holistic transformation process formed by the individual, business processes, and technological elements (Karaman & Aydin, 2020).

It covers both the digitization of the process with a focus on efficiency and digital innovations that focus on improving existing physical products with digital capabilities (Berghaus & Back, 2016).

This concept, which has a very heavy financial burden, is accepted as one of the biggest trends in the industry and public sector and affects many areas. Sectors such as health, transportation, industry, agriculture, finance, retail, and education are some of them (Sandkuhl & Lehman, 2017). In this process, where the transition from industrialization to complete digitalization takes place, the perspectives of educational institutions and their adaptation to this transformation are very important. With digital transformation in educational institutions, it is expected to provide opportunities to students by using both traditional classroom-based methods and modern technologies and increase efficiency by facilitating learning, especially in higher education (Jain, 2019).

Digital Transformation in Higher Education

When students graduate, the knowledge gained in the first years of the university is now outdated (WEF, 2016). In this rapid change, the structure of universities should be re-examined, and they should be transformed into structures that keep up with the age and even manage the age (Aybek, 2017). These institutions, which are one of the important elements of social change and transformation, are very important in terms of using and developing technology, adapting people to these technologies, and creating an information society. It is a known fact that the use of new technologies in the digitalization of higher education is not yet at the desired level. This situation pushes universities into a transformation (Akteke et al., 2008). In addition, higher education institutions must put digital transformation on their agenda to survive and continue their development, as in other sectors (Colone, 2019).

Increasing competitiveness and changing student expectations and changing teacher roles seem to be among the underlying causes of digital transformation in higher education (Scott, 2022). In addition, universities are trying to use and even add new information technologies that will save their teaching activities from time and space limitations. In this context, higher education institutions had to keep up with digital transformation and make changes in management, infrastructure, business processes, and professional development (Margaryan, 2011; Taslibeyaz & Tasci, 2021). This situation has increased the activities for the use of digital resources in the learning process (Seufret & Meier, 2016).

The digital transformation observed in higher education, which first started with the establishment of corporate web pages and then with basic processes such as student affairs, student information systems and library services, and educational processes began to digitize, especially with computer-aided applications. In addition, the intense use of distance education applications, and then the integration of digital technologies and e-learning into face-to-face education processes accelerated digital transformation activities in higher education (Bates, 2015; Navitas Ventures, 2017). With these digital transformation activities, opportunities such as following the lessons easily, providing online collaborative learning opportunities, providing improved communication between student-instructor-staff, realizing a positive learning process with multimedia-supported learning opportunities, and getting instant feedback on online platforms (Bilyalova et al., 2019; Kaur, 2019; Lynch, 2020; Nsocialtr, 2020; Pham, 2021).

These activities provide institutions with advantages such as flexibility and adaptability (James, 2021), improving the student experience, optimizing resources (Spear, 2019), and increasing efficiency (McKinsey & Company, 2012) within the scope of digital transformation. The reflections of productivity, which is one of the advantages it provides, in higher education institutions; human resource efficiency as a result of doing more work

with less staff (Betchoo, 2016), the efficiency of education-teaching processes with higher education staff with digital skills (Faria & Nóvoa, 2017), and sustainability efficiency with smart campus applications (Musa et al., 2021) can be listed as. In this study, which emphasizes the importance of efficiency, which is one of the reflections of digital transformation in higher education, it is aimed to examine the trend in the literature toward the concept of digital transformation and efficiency in higher education. In this context, answers to the following research questions were sought.

- R.Q.1. What is the distribution of studies on digital transformation and efficiency in higher education by years?
- R.Q.2. What is the distribution of studies on digital transformation and efficiency in higher education by language?
- R.Q.3. What is the distribution of studies on digital transformation and efficiency in higher education by publication type?
- R.Q.4. What is the distribution of studies on digital transformation and efficiency in higher education by country?
- R.Q.5. What is the distribution of the most used keywords in studies on digital transformation and efficiency in higher education?
- R.Q.6. What is the Three-Field Plots Analysis of studies on digital transformation and efficiency in higher education?
- R.Q.7. What is the Thematic Map Analysis of studies on digital transformation and efficiency in higher education?
- R.Q.8. What is the Factorial Analysis of studies on digital transformation and productivity in higher education?

Methodology

Research Design

Within the scope of the study, document analysis, one of the qualitative research methods, was used. Document review, it refers to the analysis of written materials containing information about the researched subject (Yildirim & Simsek, 2008). To reach related studies in the literature, Web of Science (Wos) and Scopus databases were searched with related keywords, and bibliometric and text-mining analyses were used to examine the studies reached. Bibliometric analysis is based on the extraction of a general framework and analysis according to certain characteristics (Marti-Parreno et al., 2016; Yavuz et al., 2021). Text mining, on the other hand, is used to obtain meaningful information by extracting the main trends from the text in big data (Aydemir et al., 2021; Feldman & Sanger, 2007). VOSviewer and RStudio programs were used to perform the analyses.

Sampling

Derivatives of the words “digital transformation, higher education, university, efficiency, and productivity” have been brought together to reach studies on digital transformation and productivity in higher education. The number of studies and selection processes obtained in the scanning conducted in both databases are given in Figure 1.

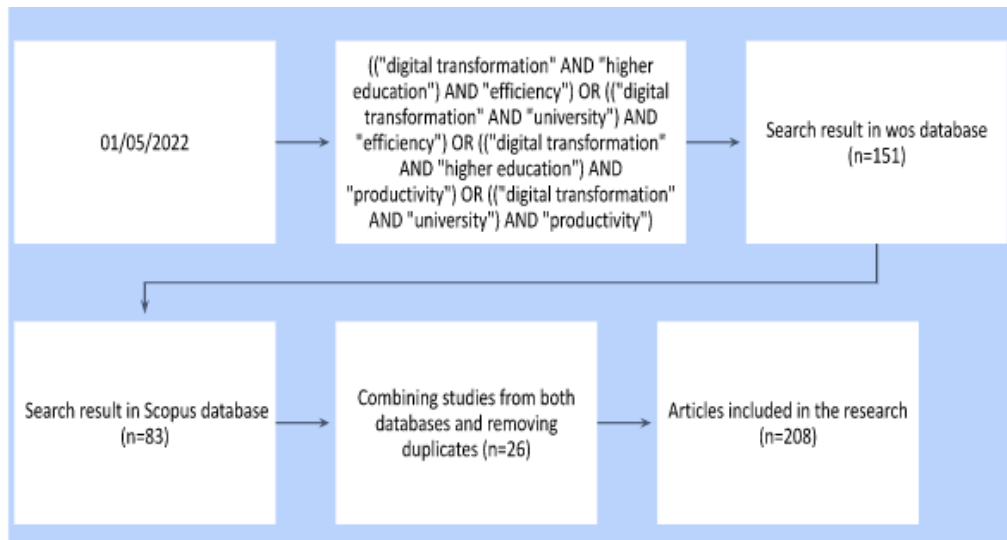


Figure 1. Selection: PRISMA Flow Diagram (Liberati et al., 2009)

Search results with keywords in Wos and Scopus databases were exported and imported into the RStudio program to be combined. As a result of the combination, it was determined that 26 studies were repeated, and these repetitive studies were removed. Later, with 208 studies obtained, analyzes were carried out in both VOSviewer and RStudio programs.

Data Analysis and Research Procedures

The VOSviewer program is a functional and useful tool for visualizing data and bibliometric analyzes are performed (Goksu et al., 2020). Bibliometric and text-mining analyzes are also performed with the RStudio program. Various analyzes were performed using both programs. These analyzes are the distribution of studies by years, distribution of studies by languages, distribution of studies by publication type, distribution of studies by country, the most used keywords, three-field plots, conceptual structure map, and thematic map.

Findings

In this section, the trends of the studies in the literature within the scope of the concept of digital transformation and efficiency in higher education are presented and the general scope of the studies is presented. The findings obtained in this context are given below in parallel with the research questions. First, general information about the studies examined as a result of the analysis carried out is given in Table 1.

Table 1. General information on the studies reviewed

Description	Results
Timespan	2012:2022
Sources (Journals, Books, etc)	153
Documents	208
Average years from publication	1.91
Average citations per documents	3.851
References	8346
Keywords Plus (ID)	532
Author's Keywords (DE)	765
Authors	705

Authors of single-authored documents	22
Authors of multi-authored documents	683
Single-authored documents	27
Documents per Author	0.295
Authors per Document	3.39
Co-Authors per Documents	3.54
Collaboration Index	3.77

R.Q.1. Distribution of studies by years

Within the scope of the first research question, the distribution of the studies in the literature by years was examined. The results obtained in this context are given in Figure 2.

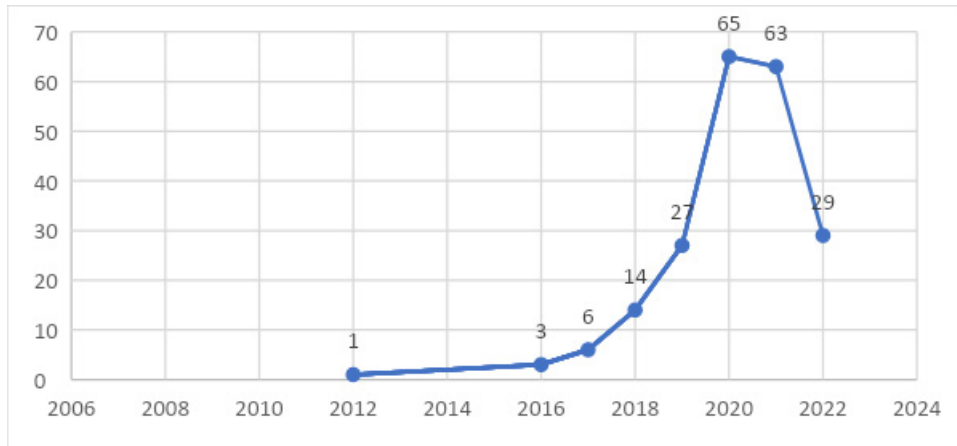


Figure 2. Distribution of studies by years

When Figure 2 is examined, it is seen that the studies were carried out between the years 2012-2022. In addition, it is seen that most of the studies were published in 2020 (n=65) and there was a decrease in the number of articles after 2020. It is seen that in 2021 (n=63) studies were carried out close to 2020 and 29 studies were published in 2022. It can be said that the low number of studies for this year is since the year has not yet ended. While there is an increasing trend in the number of studies between 2012-2020, it shows a decreasing trend between 2020-2022.

R.Q.2. Distribution of studies by languages

Within the scope of the second research question, the distribution of the publications according to the language in which they were published was examined. As a result of the examination, it was revealed that the studies were written in six different languages and the results of the analysis are given in Figure 3.

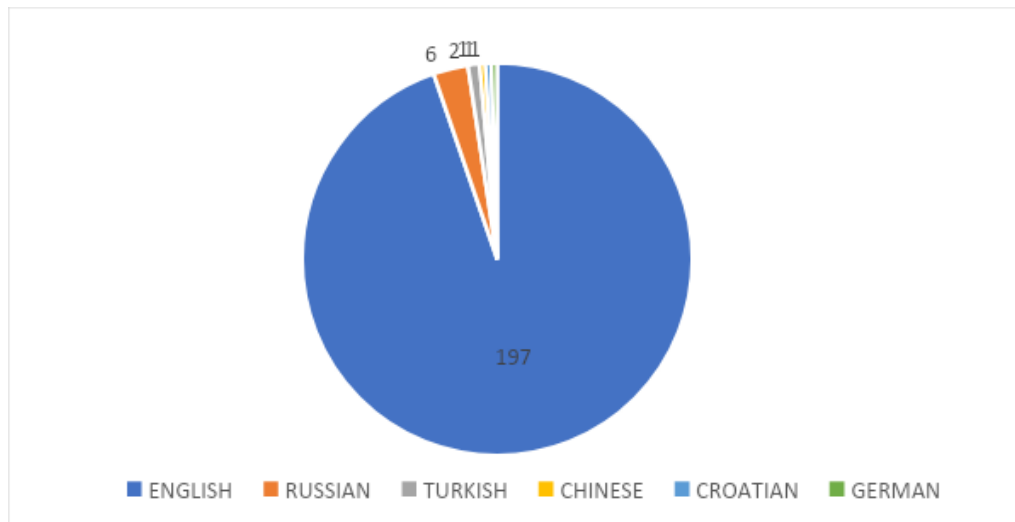


Figure 3. Distribution of studies by languages

When Figure 3 is examined, it is seen that most of the 208 studies were written in English ($n=197$). Russian ($n=6$), Turkish ($n=2$), Chinese, Croatian and German ($n=1$) are listed as other broadcast languages. It can be said that the lack of diversity with six different languages is due to the fact that the publications are mostly written in English.

R.Q.3. Distribution of studies by publication type

Within the scope of the third research question, an examination was carried out according to the type of publications. In the analysis made in this context, it is seen that the publications are generally published as articles. Detailed results regarding this are given in Figure 4.

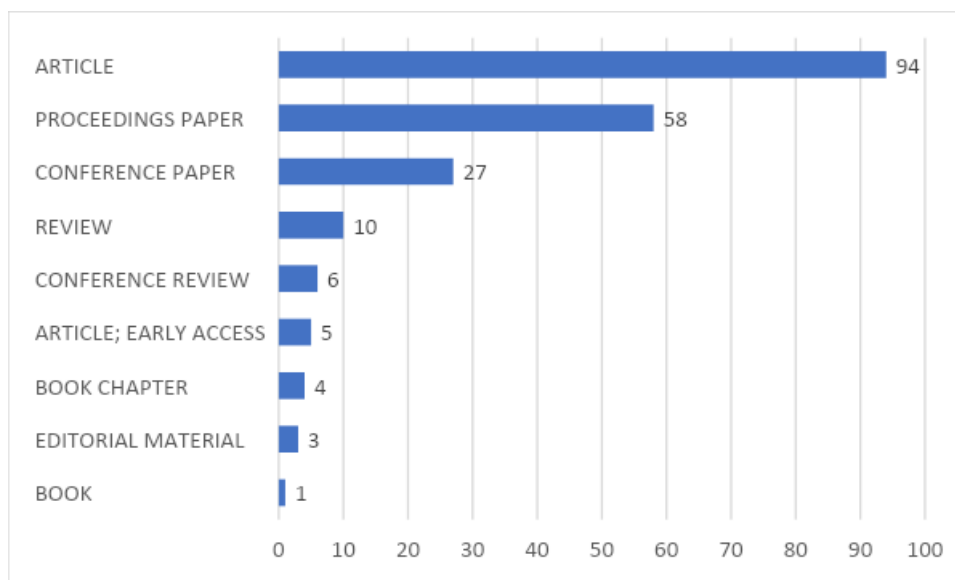


Figure 4. Distribution of studies by publication type

When Figure 4 is examined, the studies were published at least as Book ($n=1$), Editorial Material ($n=3$), Book Chapter ($n=4$), and Article-Early Access ($n=5$). It was mostly published as Article ($n=94$), Proceeding Paper ($n=58$), Conference Paper ($n=27$), Review ($n=10$) and Conference Review ($n=6$). It is seen that there is a tendency to write more articles on this subject.

R.Q.4. Distribution of studies by country

Within the scope of the fourth research question of the study, the distribution of the articles according to the countries in which they were published was examined. In this context, the distribution of publications by country is given in Figure 5.

Country Scientific Production

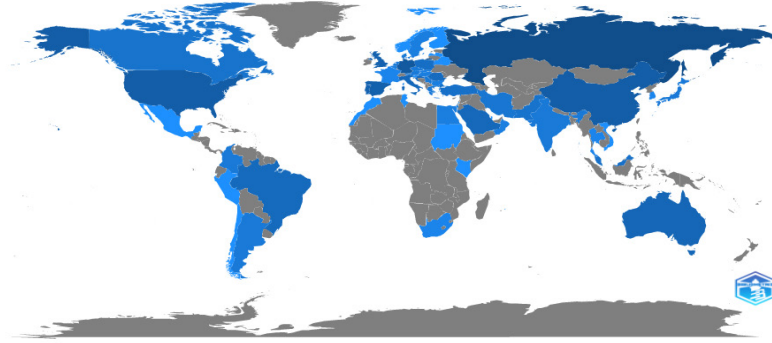


Figure 5. Distribution of studies by country

When Figure 5 is examined, it is seen that the studies carried out are spread over a wide area. This shows that the issue is given importance by many countries. Detailed information on which countries prefer the publications is given in Table 2.

Table 2. Distribution of publications by country

Country	Articles	Country	Articles
Russia	37	Brazil	4
China	13	Hungary	4
Germany	9	Italy	4
Spain	7	Romania	4
USA	7	Saudi Arabia	4
Croatia	6	Turkey	4
Poland	6	Czech Republic	3
Portugal	5	Serbia	3
United Kingdom	5	Singapore	3
Australia	4	Other	76
		TOTAL	208

It was revealed because of the analysis that a total of 208 studies were conducted in 44 different countries and most publications were made in Russia. Russia was followed by China (n=13), Germany (n=9), Spain – USA (n=7) and Croatia-Poland (n=6), respectively. The information on the most cited countries in relation to the countries of publication is given in Table 3.

Table 3. The number of citations of the publications and the number of citations per publication by country

Country	Total Citations	Average Citations	Country	Total Citations	Average Citations
Singapore	127	42,333	Netherlands	9	9
Spain	101	14,429	Hungary	6	1,5
China	69	5,308	Malaysia	5	2,5
Russia	45	1,216	Mauritius	5	5
Italy	36	9	Colombia	4	2
India	35	17,5	Oman	4	4
Saudi Arabia	35	8,75	Serbia	4	1,333
Germany	30	3,333	Argentina	3	3
Brazil	29	7,25	Slovakia	3	3
Usa	22	3,143	Croatia	2	0,333
Australia	21	5,25	Czech Republic	2	0,667
Peru	19	19	Egypt	2	2
Canada	18	9	Korea	2	1
Poland	17	2,833	Austria	1	0,5
Türkiye	17	4,25	Latvia	1	1
Romania	14	3,5	Morocco	1	1
United Kingdom	12	2,4	Pakistan	1	0,5
Vietnam	12	12	Qatar	1	1
Portugal	11	2,2	Slovenia	1	1
			TOTAL	727	

In Table 3, the number of citations by country is given. Here, the most cited countries are Singapore (n=127), Spain (n=101), China (n=69), Russia (n=45), Italy (n=36) and India (n=35) respectively. The least cited countries are listed as Austria, Latvia, Morocco, Pakistan, Qatar, and Slovenia with one citation. When the number of publications and citation numbers are compared, although Russia is the country with the highest number of publications, it lags behind many countries in the average number of citations (n=1.2). Singapore, which received the most citations, took the first place with the number of citations per publication (n=42.3) and the total number of citations (n=127), although the number of publications was low (n=3). Considering in terms of efficiency, it is seen that it receives many citations with a small number of publications.

R.Q.5. Most used keywords in studies

Within the scope of the fifth research question of the study, the distribution of the most preferred keywords by the authors in the articles was examined. In this context, the distribution of the most used keywords is given in Figure 6.

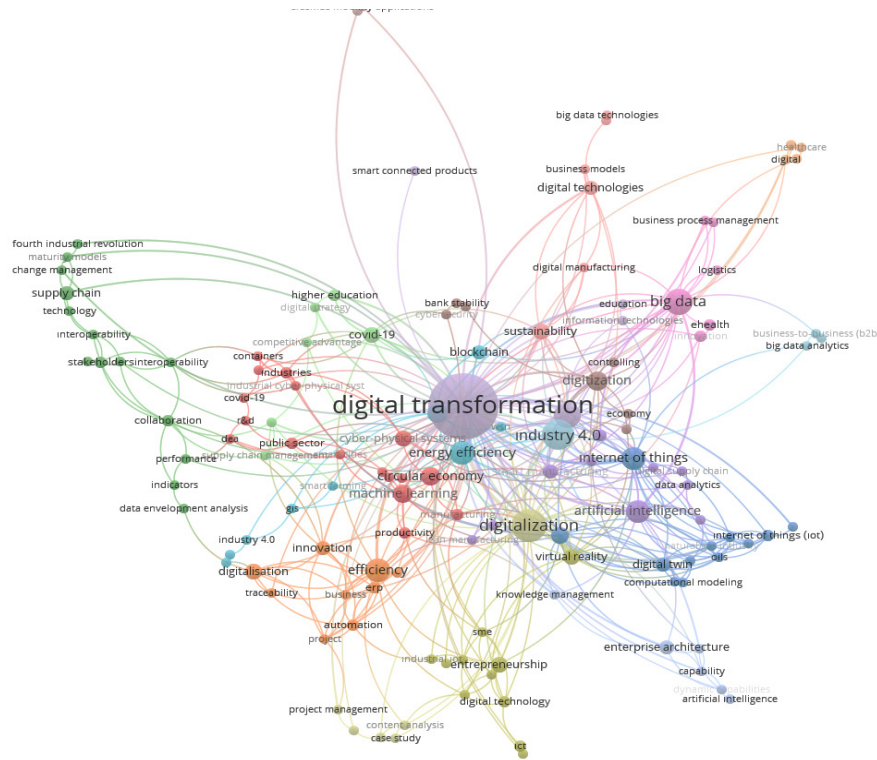


Figure 6. Most used keywords in studies

When Figure 6 is examined, the most used keywords are listed as digital transformation (Occurrences=59), digital economy (Oc=14), industry 4.0 (Oc=13), digitalization (Oc=11), artificial intelligence (Oc=10), higher education (Oc=10) and internet of things (Oc=10). Some of the least used keywords are virtual technology, university staff, university learning, the effectiveness of scientific research, and technical education. Efficiency keywords were used as Efficiency (Oc=3) and productivity (Oc=3). It has been observed that these keywords are not preferred enough by the authors. This situation can be explained by the low number of publications or the fact that they are not widespread.

R.Q.6. Three-Field Plots

Within the scope of the sixth research question of the study, the analysis of a three-field plot based on the Sankey diagram was carried out. Three-field plot analysis is used to explain the relationship between three different pieces of information (Koo, 2021). In this context, three-field plots were used to visualize the relationship between journal, author, and country variables in the study.

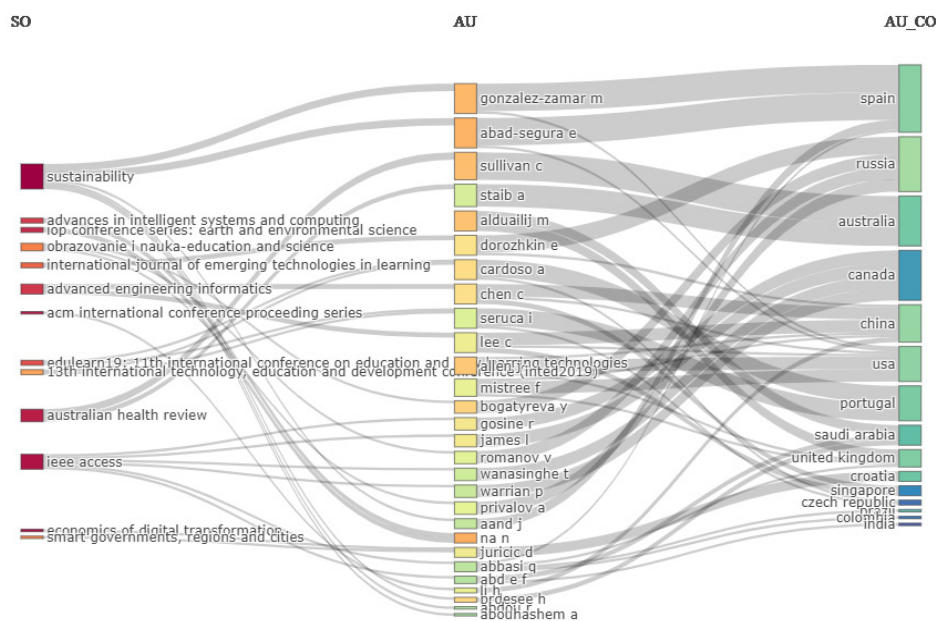


Figure 7. Three-Field Plots analysis in studies

The relationship between the journal (left), author (middle), and country (right) variables is shown in Figure 7. For colored rectangular nodes, the height is proportional to the number of posts in that element. The width of the lines between these nodes is proportional to the number of connections. As the thickness of the lines increases, the strength of the connection increases (Riehmman et al., 2005).

In the figure, 13 journals are listed within the scope of the first variable, the journal. In this list, it is seen the most publications were published in the journal Sustainability (n=11). These 11 studies were carried out by six different authors. Among these authors, Gonzalez-Zamar, M. and Abad-Segura, E. carried out two studies, while other authors published one study each. In terms of the second variable, the author, 27 authors are listed. Authors who have the highest connection power are listed as Gonzalez-Zamar, M. (OC = 12), Abad-Segura, E. (OC = 12), Sullivan, C. (OC = 11) and Stareb, A. (OC = 9). In terms of the countries with the third variable, the countries with the highest linking power were found to be Spain (Oc=27), Russia (Oc=22), Canada (Oc=20) with four authors, and Australia (Oc=20) with two authors.

R.Q.7. Conceptual Structure Map

Conceptual structure mapping was carried out within the scope of the seventh research question of the study. It is used to map the relationship between one word and others to create a conceptual structure map that includes a visualization of the contextual structure of each word, often featured in research articles on higher education and productivity. It is also used to define the conceptual structure of the subject and to define the main themes and trends in an area (Della Corte et al., 2019). The analysis result obtained in this direction is given in Figure 8.

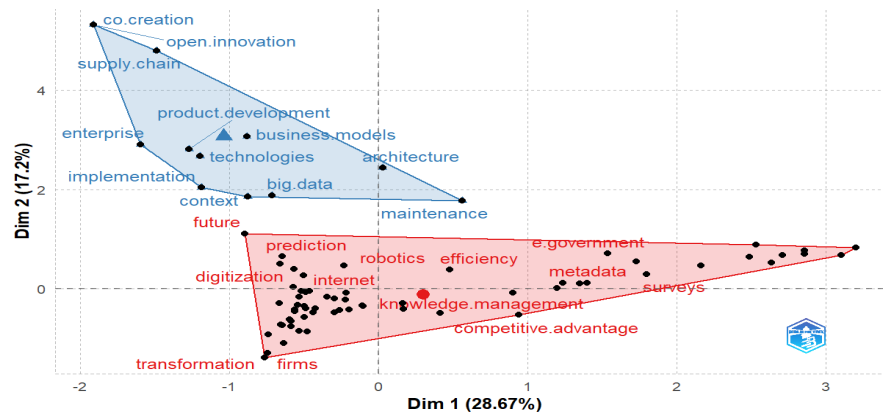


Figure 8. Conceptual structure map of keywords

When Figure 8 is examined, it is seen that two clusters, blue and red, are formed. Each dot in the cluster represents keywords. In addition, since the words are similar in terms of distribution, they are positioned close to each other on the map. There are 11 keywords in total in the “Blue Cluster” on the map. Some of these are listed as co creation, open innovation, supply chain, enterprise, product development, architecture, implementation, big data, and maintenance. This cluster includes technologies, business models and context studies used within the scope of digital transformation in higher education. There are 64 keywords in total in the “Red Cluster”. The prominent ones among these keywords are listed as digitization, transformation, internet, robotics, efficiency, prediction, and metadata. This cluster includes technologies used within the scope of digital transformation in higher education, data collection tools, e-government applications, knowledge management and efficiency. When both clusters are compared, it can be said that Red Cluster is more related to digital transformation in higher education.

R.Q.8. Thematic Map

Thematic map analysis was carried out within the scope of the eighth research question of the study. Thematic map is used to show research topics, basic keywords and the relationships between them (Akter et al., 2021). In addition, it is a type of analysis that visualizes four different theme typologies based on two dimensions, Density and Centrality (Farooq, 2022). The result of this analysis used within the scope of the study is given in Figure 9.

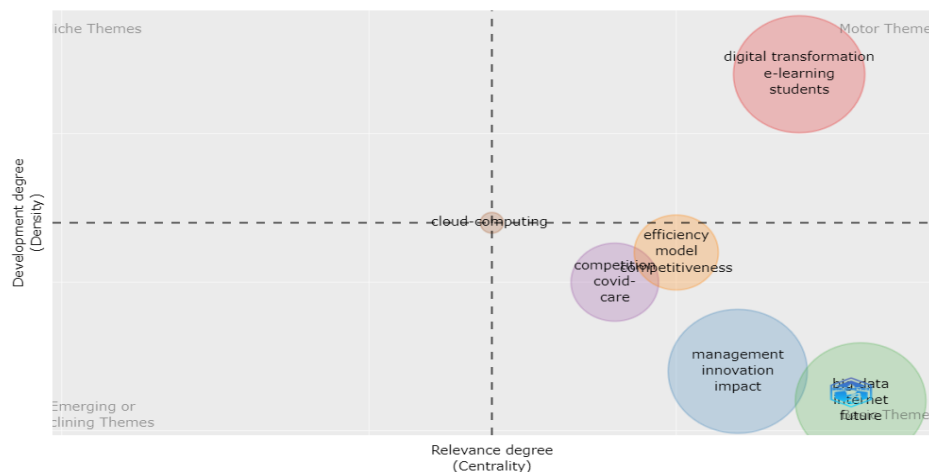


Figure 9. Thematic Map

A theme map based on density (x-axis) and centrality (y-axis) is given in Figure 8. While Centrality measures the importance of the chosen theme, Density measures the development of the chosen theme. As seen in Figure 8, thematic mapping is divided into four parts. The upper right part represents high density and high centrality. The themes in this section are developed and important engine themes. The themes in the lower right part of the map are the main themes and represent high density and low centrality. The themes in this section are developed and important engine themes. The themes in the lower right part of the map are the main themes and represent high density and low centrality. Adequate research has been done on these themes. The upper left portion represents low density but high centrality. These themes are highly advanced and isolated themes. Finally, the bottom left consists of themes with low intensity and low centrality (Wang et al., 2022). In line with the explanations, keywords with high density and high centrality are listed in the upper right part as digital transformation, e-learning, and student. These keywords in a cluster appear as both the most used and the most important keywords in digital transformation in higher education. In the lower right part, some keywords with high density and low centrality; efficiency, model, competition, care, impact, big data, and internet. These keywords have high density and low centrality. However, it can be said that these keywords, which are divided into four clusters, decrease in centrality from orange to green. Finally, the key word that touches all the themes at the center of the coordinate system has been cloud computing.

Conclusion

In this study, it is aimed to examine the trend in the literature towards the concept of digital transformation and efficiency in higher education. In this context, as a result of the literature review, related studies were reached and bibliometric and text-mining analyzes were carried out through VOSviewer and RStudio programs.

As a result of the analyzes carried out, 208 studies were reached. It was seen that the studies were carried out in 2020 with the most 65 publications. 197 of these 208 studies were published in English as a language. Again, it was seen that 94 of these studies were published as articles.

Published studies were found to be mostly from Russia and China, while Singapore and Spain were found to be most cited. The two countries with the highest number of citations per publication were Singapore and Peru. The most used keywords in publications are digital transformation, digital economy, industry 4.0, digitalization, artificial intelligence, higher education and internet of things. In the Three-Field Plots analysis, it was seen that the journal in which the most studies were published was Sustainability, the authors with the most published studies were Gonzalez-Zamar, M. and Abad-Segura, E., and lastly, the countries with the highest connectivity were Spain and Russia. As a result of conceptual structure mapping, it was seen that words close to each other were grouped as two clusters. As a result of thematic mapping, it was seen that the keywords were stacked in the upper right and lower right parts. The fact that the keywords are not stacked on the left shows that the subject is new and there are no isolated concepts. As a result, it has been seen that the study is still new in the examination conducted within the scope of “digital transformation and efficiency in higher education”. Despite the emergence of publications in the last 11 years, it has been observed that the studies were mainly carried out in 2020. This shows that the subject is very new. This shows that there is a need for new studies on the related subject.

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