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An Investigation of Digital Transformation Activities of Higher Education in Türkiye

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This study aimed to examine the digital transformation activities of universities. The document analysis method was used in the study, one of the qualitative research methods. In this context, the websites of 207 universities were examined using the "Digital transformation activities form of universities" developed by the researchers. The data were analyzed by content analysis method. As a result of the analysis, six broad themes, also called dimensions in the current study, emerged, such as research, education, culture, process, technology, and community service regarding digital transformation activities of higher education institutions. Infrastructure studies, educational activities for research and supply and the use of smart systems to provide various cooperation opportunities are discussed within the scope of the research dimension. There are online scientific studies, online education programs, digital resources, and open access opportunities in the education dimension. As for the culture dimension, online manager activities for corporate culture, training of trainers, culture-arts and scientific activities took place. With the transfer of business processes to the digital environment, corporate promotion and communication activities were included in the process dimension. In the technology dimension, smart systems, smart campus applications and innovative technologies took place. Finally, the scope of community service compromised related units, university-industry cooperation activities and social activities. As a result, universities carry out activities to support processes such as education, research, management, and cooperation and to realize them in digital environments. For this purpose, it can be said that they perform effective and efficient processes by using various intelligent systems.

Introduction

In the 21st century, which is called the digital age, change has gained significant momentum, and the size of the change has increased daily with current technologies. Every area of society needs to adapt to this change and transform themselves (Uzun & Gök, 2020). In

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the field of industry, which is seen as the pioneer of transformation, various industrial revolutions have occurred in this context, including the invention of steam-powered machines (1st Industrial Revolution), mass production with electrical energy (2nd Industrial Revolution), use of robotic automation systems (3rd Industrial Revolution) and big data, internet of things, 3-D printing, cloud technologies, technologies such as augmented reality and cyber, and the use of systems where intelligent robots communicate with each other (4th Industrial Revolution) (Sağbaş & Gülseren, 2019).

The new industrial revolutions that emerged with the development of technology and mentioned above have brought new concepts. These concepts, which are often confused and used interchangeably, are shown in Figure 1.

Figure 1. Concepts that emerged as a result of industrial revolutions

In Figure 1, we can clearly see the concept of digitization. This concept, also known as the conversion of analogue signals to digital (Tilson et al., 2010), became widespread with electricity use during the 2nd Industrial Revolution. Another concept is digitalization. This concept emerged with robots and related technologies in the 3rd Industrial Revolution. This period can be defined as the use of digital technologies in sectors beyond digitization. The Gartner dictionary (2020) defines the same period as using digital technologies to change a business model and provide new revenue-generating opportunities. Finally, we can see the concept of digital transformation in Figure 1. The concept in question is Industry 4.0, which coincides with the 4th Industrial Revolution. The concept goes beyond digitization and digitalization, causing changes in organizations related to products and services, even affecting the entire organizational structure, which harbors a radical change in corporate culture (Mora & Sánchez, 2020; Salas, 2018).

Digital Transformation

Digital transformation is typically characterized by the concepts of digital and digitalization. However, digital transformation goes beyond these two concepts because digital transformation is more than these concepts that evoke technology (Henriette et al., 2015). In other words, rather than being just about technology and being synonymous with innovation, it includes strategies as well as "When?" and "How?," and also is a phenomenon that provides answers to questions (Colone, 2019). Digital transformation, defined in different ways in the literature, is best known as the use of various disruptive technologies to facilitate the work of individuals, improve processes, increase efficiency in business and transactions, and create new business models (Fitzgerald, 2013; Rodrigues, 2017; Taşlıbeyaz & Taşçı, 2021).

With Industry 4.0, institutions in education also get their share from the digital transformation that affects all areas of society, such as health, transportation, industry, agriculture, finance, and retail. At the forefront of these institutions are higher education institutions, which are pioneers in terms of innovations and the implementation of innovations. In particular, higher education institutions with digital transformation potential (Sandkuhl & Lehmann, 2017) feel the impact of digital transformation in terms of standing up and continuing their development as in other sectors (Colone, 2019).

The digital transformation activities in higher education, which started with the rapid spread of the internet, began primarily with the preparation of institutional websites, followed by student affairs and library services, subsequently followed by computer-assisted educational applications (Akgün Özbek, 2019). With the advancing technology, the educational environments of higher education institutions have transformed, and virtual learning opportunities have been provided to students (Harkins, 2008). Additionally, digital technologies offer many opportunities for lifelong learning, personalized learning, and open access (Dewar, 2017; Fisk, 2017). These technologies have created more social, flexible, immersive, and online learning environments, all of which emphasize visual content.

Furthermore, higher education institutions have become technology transfer entities in line with the needs of the technological society, in addition to their education and research activities. In this mission, universities must develop their entrepreneurship culture, establish technology companies, and apply for patents (Kuznetsov & Engovatova, 2016). Developing qualified human resources and imparting high-standard skills are among the other expectations (Bonekamp & Sure, 2015). With digital transformation, higher education institutions have assumed a role in producing knowledge and advanced technology products (Kuznetsov & Engovatova, 2016). As a result of the situations above, universities have undergone radical transformations in their teaching activities, social responsibilities, used technologies, and institutional structures (Efimoz et al., 2012).

Digital transformation, called ‘Industry 4.0’ in Germany, ‘Society 5.0’ in Japan, and ‘4th Revolution’ in the USA, was reflected in our country as ‘Digital Türkiye’. In this context, the Digital Transformation office was established for the first time in Türkiye and along with this, the “Digital Transformation Project in Higher Education” was initiated by the Council of Higher Education (CHE) (YÖK, 2019a). This project, completely carried out by CHE, was initially implemented in eight universities (Ağrı İbrahim Çeçen, Bayburt, Iğdır, Munzur, Muş Alparslan, Siirt, Şırnak, Bingöl). Under Anadolu University’s (AU) leadership, a course called “Learning and Teaching in Higher Education in the Digital Age” was given to 3,112 instructors in eight pilot universities in the first place through distance education. In addition, 36,000 first-year students at these universities were given the “Digital Literacy” course via the e-campus platform, and the exams were held online on this platform (AU, 2019). In the second phase of the project, eight more universities (Ardahan, Artvin Çoruh, Batman, Bitlis Eren, Gümüşhane, Hakkari, Kilis 7 Aralık and Osmaniye Korkut Ata) were included in the project. The project is aimed to be implemented in all universities across Türkiye (YÖK, 2019b).

When the studies on the digital transformation activities of higher education institutions in the literature are examined, it is seen that there are a limited number of studies. The first of these studies was carried out at the University of Geneva, which was conducted in the realm of education, research, and service missions within the scope of digital transformation in order to make the institution’s processes more efficient. In the study, a digital strategic plan was prepared in order to increase, develop, and encourage university activities on digital

technologies, to offer digital opportunities in teaching, research and IT services, and finally to develop strategic collaborations with important external stakeholders through digital communication. The study generated a strategic plan consisting of six dimensions: (1) digital skills for all, (2) digital support and services, (3) digital society, (4) digital research, (5) digital innovation and open ecosystem, and (6) agile and participatory management (Geneva, 2018). A study by Balyer and Öz (2018) study aimed to determine academicians' views on digital transformation in education regarding program and management processes. Interviews were held with 20 lecturers, and it was revealed that in the digital transformation process, administrators should first create an institutional vision for an effective educational environment, and activities should be carried out accordingly. In addition, it was concluded that stakeholders should be supported within the scope of technologically appropriate content and infrastructure included in the transformation process. In addition, it was stated that it is important for education administrators and program experts to be ready for this transformation and to have the qualifications to manage this transformation. Another study, which focused on the technology dimension in digital transformation, aimed to compare the use of ICT for education and administrative processes by higher education institutions in five Latin American countries (Argentina, Brazil, Chile, Mexico, and Peru). The study was carried out in a total of nine public and private universities from five countries. Semi-structured interviews were conducted using an interview form consisting of 29 open-ended questions. Institutions were analyzed at five levels and three dimensions. In the research, it was seen that large universities are ahead of other small universities in terms of digital transformation. In addition, it was suggested in the study that corporate and national digital strategic plans should be put on the agenda, and digital transformation roadmaps of society and universities should be drawn. They also stated in the study that a well-planned digital strategy could overcome the structural and bureaucratic obstacles that may occur, and that more efficiency should be obtained from the process by giving importance to digital transformation in education (Martínez-Pérez & Rodríguez-Abitia, 2021). Finally, the study carried out by Kuzu (2020) aimed to determine the status of digital transformation in the strategic plans of universities. For this purpose, the strategic plans of 18 Turkish universities in the top 1000 in the world ranking were examined by content analysis method. As a result of the examination, digital transformation components were gathered under four themes, 14 categories, and 35 codes, namely Education (learning technologies, communication with students, in-service training, library, accreditation), Research (Innovation, Entrepreneurship, Research technologies), Community Service (Relationship with external stakeholders and society, Sustainable campus, Relationship with the sector), Management/Governance (Technological infrastructure, Automation-software, Management Information System). Within the scope of the study, it was concluded that universities could not transform digital transformation into an integrated transformation model and strategic vision beyond technological infrastructure renewal.

Digital transformation in higher education is critical for universities to establish themselves internationally and prepare their students for the future (Richter et al., 2019). Studies on digital transformation in higher education focus on the education, management, and social contribution components and emphasize the need for institutions to improve their technological infrastructure (Santos et al., 2019). However, while some research has been conducted on digital transformation, particularly in Türkiye, the number of studies is limited (Taşçı & Taşlıbeyaz, 2021).

However, due to the pandemic that started suddenly and spread rapidly, universities had to do business and provide training online, as in many sectors, to prevent learning losses. This has made it mandatory for universities to carry out their activities online within the scope of digital

transformation (Yavuz et al., 2020). This unexpected situation caused many higher education institutions unprepared for online education activities (Kayalı, 2022). In this context, it is essential to determine the digital transformation activities carried out by universities in this process to shed light on the studies to be done. Thus, it is considered that the studies will guide other institutions. The present study aimed to examine the digital transformation activities of universities in Türkiye, in attempts to identify activities that could indicate digital transformation in higher education, such as smart systems, smart campus applications, digital workflows, and online events that universities possess. For this purpose, answers to the following research questions were sought.

- How are the dimensions of digital transformation in higher education?
- What are the activities of higher education institutions in Türkiye within the scope of digital transformation?

Method

Research Design

Document analysis, one of the qualitative research methods, was used in the study. This method can be defined as a systematic process in which results are obtained and evaluated by analysing electronic or printed documents (Bowen 2009). Accordingly, in this study, the digital transformation activities of the higher education institutions were examined by the document analysis method. A series of steps are used in document analysis. These steps are listed below in sequence (Forster, 1995):

Table 1. Steps of document analysis

1	Reaching the documents	University web addresses were accessed from CHE's webpage (https://www.yok.gov.tr/universiteler/universitelerimiz).
2	Checking the originality	Data were retrieved from the official webpages of the universities.
3	Understanding the documents	Applications, events, activities, tools, and training that could be used as examples of digital transformation were identified on the webpages of the relevant universities. Similar meanings were deduced in this direction using a standard form.
4	Analysing the data	The collected data were subjected to content analysis.
5	Using the data	For the analysis results to be usable, care was taken to prepare them in a way that would not harm a particular institution or person. In this regard, the names of the institutions were kept confidential.

Sampling

The sample of the study consisted of the websites of state and foundation universities in Türkiye. Of note, the websites of 207 universities, which could be accessed through the links provided on the website of CHE during the data collection process, constituted the sample of the study. Descriptive data of the 207 websites is presented in Figure 2.

	City of University	f	City of University	f
1	İstanbul	62	Balıkesir	2
2	Ankara	21	Erzurum	2
3	İzmir	9	Hatay	2
4	Antalya	5	Isparta	2
5	Konya	5	Kahramanmaraş	2
6	Gaziantep	4	Kocaeli	2
7	Kayseri	4	Kütahya	2
8	Mersin	4	Malatya	2
9	Eskişehir	3	Nevşehir	2
10	Bursa	3	Sakarya	2
11	Trabzon	3	Samsun	2
12	Adana	2	Sivas	2
13	Afyonkarahisar	2	Other	32
			Total:	207

Figure 2. Provinces of the universities examined in the study

Data Collection Tool

Within the scope of the study, a data collection tool titled "The Form for Determining the Digital Transformation Activities of Universities" was developed by the researchers to examine the university websites. A draft form was created by examining the websites of 10 universities. Two field experts evaluated the resulting draft form. Necessary arrangements were made in line with expert opinion, and the data collection tool was given its final shape. As a result of the analysis and expert opinion, a standard framework was created for digital transformation studies on the webpages of all universities. A Microsoft Excel form consisting of a two-dimensional table was prepared, with the first dimension including the names of the universities and their corresponding website addresses and the second dimension including the activities of the universities. The university activity section included the titles of smart systems, smart campus applications, personalized education activities, research and collaboration programs, and promotional and communication activities of each university.

Data analysis

In the research, studies conducted on the digital transformation activities published on universities' websites were examined using content analysis. By using this method, it was aimed to classify similar data and activities under certain categories and themes (Yıldırım & Şimşek 2016). In this direction, the universities' websites were examined using content analysis in order to determine the digital transformation activities of higher education institutions. Content analysis was carried out in three stages (McMillan & Schumacher, 2010). In the first stage, the data was separated into codes in a meaningful way. In the second stage, codes with standard features were grouped and categorized. In the final stage, the categorised data were organized, and themes were created. The stages of content analysis are presented in Figure 3.

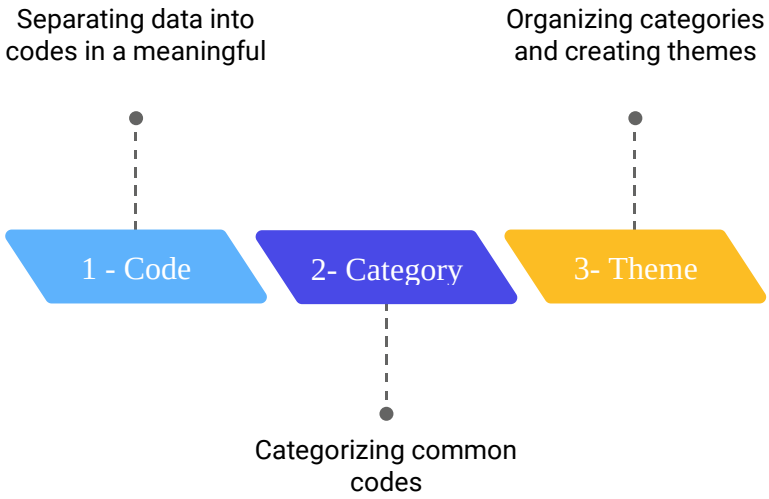

Figure 3. Stages of content analysis implemented in the study (McMillan & Schumacher, 2010)

Data analysis was carried out in line with the three stages above. First, the first two researchers equally shared all the websites and examined them separately. Each researcher entered the data of the sites examined into the Excel form. In the second stage, after both researchers completed the data entry for all sites, an online meeting was held to detect different or inconsistent data entries. All the data entered by both researchers at the meeting were reviewed and evaluated. As a result of the evaluation, the disagreements that emerged between the researchers were re-examined and resolved. In cases where the disagreements could not be resolved, the inconsistency was eliminated via expert opinion. After eliminating all the inconsistencies, both forms were combined and the reporting process was started.

Validity and Reliability

In qualitative studies, the concept of validity is defined as the ability to present the researched subject impartially and as it is (Kirk & Miller, 1998). To ensure the credibility of the study, language and field expert opinion was sought in developing the data collection tool parts of the study to ensure the reliability of the study (Brinberg & McGraft, 1985). Consistency between data was checked, and consensus among coders was achieved (Best & Khan, 2003). Again, in this context, expert field opinion was taken when needed to achieve consensus (Brinberg & McGraft, 1985). In order to realize the transferability of the research. Within the scope of the present study, the methods for validity and sample determination processes and the reasons for selection were explained in detail in line with the literature (McMillan & Schumacher, 2010). Moreover, the application processes of the study such as the development of data collection tools, data collection processes, and data analysis processes are explained in detail (Yıldırım & Şimşek, 2006) (See Figure 2 and Figure 3).

In scientific studies, the concept of reliability is expressed as the reproducibility of the results obtained within the scope of the study (Merriam, 1998). In order to ensure the consistency of the study, the research methods were explained in detail as mentioned above and the study was opened for review by seeking expert opinion when needed. In addition, in the method part of the study, a title in which validity and reliability measures are explained is included (Best & Khan, 2003). For the verifiability of the research, all transcripts and researcher notes were kept and all these documents were examined by different experts and researchers.

Findings

This study, it is aimed to examine the digital transformation activities of higher education institutions. In this direction, the data obtained by examining the universities' websites were subjected to content analysis. The findings obtained from the analysis are given below in parallel with the research questions.

As a result of the evaluation made on the websites of higher education institutions, the activities of these institutions within the scope of digital transformation were gathered under six themes. These themes are shown in Figure 4.

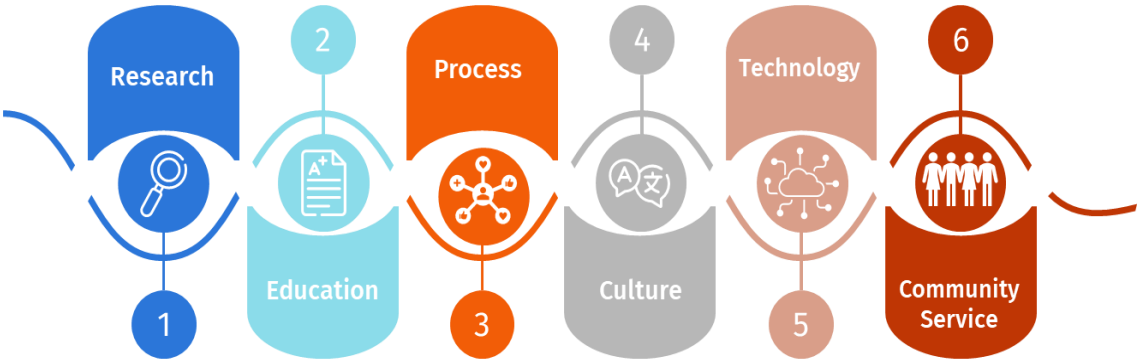

Figure 4. Themes obtained within the scope of the study

When Figure 4 is examined, research, education, culture, process, technology, and community service themes were formed within the scope of digital transformation activities of higher education institutions. The categories and codes obtained under the research theme are shown in Table 2.

Table 2. *Categories and Codes of the Research Theme*

Theme	Category	Code	f
Research	Infrastructure	Virtual Lab.	9
	Intelligent Systems/Technologies	Project Application System	29
		Scientific Research Projects (SRP) Information Monitoring System	11
		Project Repository	10
		Laboratory Information Management System	9
		Grant Programs Application Portal	7
		Laboratory Search System	7
		Online Laboratory Sharing System	7
		External Projects Information System	6
		Inter-University Collaboration Research Portal	6
		Patent Application System	6
	Educational Activities	R&D Technology Innovation Activities	7
		Research Seminars	6

According to Table 2, 12 codes were obtained under the research theme. By using these codes, categories of infrastructure, intelligent systems/technology and training activities were created. Virtual Lab. (n=9) under the infrastructure category; Project Application System (n=29), SRP Information Monitoring System (n=11) and Project Repository (n=10) under the intelligent systems/technology category; Under the category of training activities, the items on R&D Technology Innovation Activities (n=7) were the most frequently encountered items on the websites. The categories and codes obtained under the education theme are shown in Table 3.

Table 3. *Codes and Categories of the Education Theme*

Theme	Category	Code	f
Education	Online Scientific Activities	Online courses (English, academic, personal development)	27
	Online Program	E-certificate	148
		Diploma supplement	51
		Distance Master Program	35
	Digital Broadcast	E-library	192
		Online databases	110
		E-broadcast	55
		E-journal	23
		E-book	22
	Open Access	Open science	117
		Open access	24
		Open course materials	11
		Course materials portal	10
	Digital Learning Approaches	Flipped Classroom, Mooc learning models	8

When Table 3 is examined, it was seen that 15 codes were obtained under the education theme. Using these codes, five categories were created: online scientific activities, online programming, digital publication, open access and digital learning approaches. Online courses (n=27) took place within the scope of online scientific activities. Among the online programs of higher education institutions, e-certificate programs (n=148), diploma supplement (n=51) and distance master programs (n=35) are included. In the digital publications category, e-libraries (n=192) and online databases (n=110) made available to users took the first two places. Open science (n=117) and open access (n=24) policies were included under the open access category. The categories and codes obtained under the culture theme are shown in Table 4.

Table 4. *Code and Categories of Culture Theme*

Theme	Category	Code	f
Culture	Administrative Activities	Online senate meetings	9
		In-house information meetings	5
	Digital Trainings	Webinars/in-service training for stakeholders	15
		'Distance Teaching' training for teachers	7
		Digital literacy training	6
	Online Culture-Art Activities	E-exhibition	15
		Online concerts, festival	14
		Online training and speeches	13
		Online interview	13
		Online events	9
		Online graduation	9
		Disability awareness seminars	5
	Scientific Activities	Online career days	102
		Online scientific activities	59
		Online symposium	38
		Online congress	25
		Online conference	19
		Online workshop	12
		Online seminar	10
	Legal Background	Personal Data Protection Authority (PDPA)	5
	Support Activities	Coronavirus psychological support	18
		E- counselling	14

According to Table 4, 26 codes were obtained under the culture theme. Six categories were created using these codes. Higher education institutions held online senate meetings (n=9) and

in-house information meetings (n=5) within the scope of administrative activities. Within the scope of digital training, webinars/in-service training (n=15) were held mainly for stakeholders. In the category of online culture and arts activities, e-exhibitions (n=15), online concerts, festivals (n=14), online training and speeches (n=13) and online interviews (n=13) were organized. In the category of scientific activities, there were online career days (n=102), other online scientific activities (n=59), online symposiums (n=38) and online conferences (n=19). Higher education institutions have included PDPA regulations (n=5) under legal infrastructure for digitalization activities. Finally, coronavirus psychological support (n=18) and e-counselling (n=14) were provided within the scope of support activities. The categories and codes obtained under the process theme are shown in Table 5.

Table 5. *Code and Categories of the Process Theme*

Theme	Category	Code	f
Process	Units	Application and Research Centers	31
		Offices	15
		Coordinatorships	12
		Other (Informatics, Sociocity, etc.)	8
	Corporate Communications	Communication area (consulting, academic, administration, student clubs)	11
		Corporate Communications Portal	8
	Promotional	Promotion/ e-catalogue	85
		Promotion film	58
		Virtual tour	32
		E-campus	32
		E-newsletter	11
		E-orientation	8
		3D campus model	7
		Online promotion days	6

Table 5 shows three categories, and 14 codes are obtained under the process theme. Application and Research Centers (n=31), Offices (n=15) and Coordinatorships (n=12) were included under the units category. Within the scope of the research and application centers, there are 23 different research and application centers, such as computer research and application centers, industrial designs research and application centers, technology research and application centers and artificial intelligence research and application centers. There are also six different offices: the Technology Transfer Office (TTO) and the digital transformation office. Among the coordinatorships, there are six different coordinatorships, such as information technologies coordinator, education planning coordinator and exchange programs coordinator. Communication area (n=11) and corporate communication portal (n=8) applications were carried out under the corporate communication category. Higher education institutions have benefited from applications such as e-catalogue (n=85), promotional film (n=58), virtual tour (n=32) and e-campus (n=32) for promotional activities. The categories and codes obtained under the technology theme are shown in Table 6.

Table 6. *Codes and Categories of Technology Theme*

Theme	Category	Code	f
Technology	Smart Systems	Electronic Document Management System (EDMS)	150
		Student Information System	122
		Graduate information system	75
		Application registration systems	74
		Smart campus systems	57
		University Information Management Systems	51
		Academic Data Management System	22
		Feedback Evaluation Systems (satisfaction, survey, self-assessment, etc.)	18
		Personnel and Visitor Entry System	18
		Instructional Management Systems (online exam, syllabus, congress management, etc.)	17
		Quality management system	16
		Tender, Procurement and Market Research Systems	15
		Online Store and Payment Systems	15
		E-dining hall	14
		Appointment Systems (hospital, career counselling, thesis, online promotion, etc.)	6
	Website	Different language support	95
		Social media	94
		Mobil Application	51
		Disabled friendly website	12
	Campus	Wireless Internet Connection	59
		Sustainable university	13
		Green Campus	12
		Energy field (electricity, heating, and cooling)	10
		Barrier-free library	8
		Accessible ATM	7
		Green energy	6
		Electric vehicle charging station	6
		Data Analytics Driven Sustainable Campus	6
		Occupancy area (parking lot, cafeteria, rooms)	5
		Environmental area (irrigation and labelling)	5
	Innovative Technologies	Blockchain	5
		Cyber security	5
	Technology Support	Licensed Software	29
		Cloud	25

When Table 6 is examined, it is seen that a total of 37 codes were obtained under the technology theme. These codes created Smart Systems, Website, Campus, Innovative Applications and Technology Support categories. EDMS (n=150), Student Information System (122), Alumni Information System (n=75) and Application Registration Systems (n=74) came to the fore under the smart systems category. In addition, smart campus systems (n=57) included applications such as smart ventilation, smart dustbin, attendance list, smart door, classroom information, space management, disabled orientation and information, event tracking, milk analysis and community information systems. Within the scope of University Information Management Systems (n=51), applications such as administrator portal, personal affairs web automation, norm staff system, information processing support portal, institute automation system, strategic management information system, personnel information management system and additional course automation took place. There are different language supports (n=95), social media (n=94) and mobile applications (n=51) on the websites of higher education institutions. Wireless internet connection (n=59) and sustainable university (n=13) applications were included under the campus category. Higher education institutions have started to use innovative applications such as blockchain (n=5) and cyber security (n=5). Finally, higher

education institutions provided support such as licensed software (n=29) and cloud storage (n=25) under the category of technological support. The categories and codes obtained under the Community Service theme are shown in Table 7.

Table 7. *Codes and Categories of Community Service Theme*

Theme	Category	Code	f
Community Service	Industry Cooperation	University-industry cooperation	35
		Talent Gate Career Platform	24
		R&D Consulting	13
		University-Industry R&D Congress	4
	Unit	Continuing Education Center (CEC)	85
		TTO	65
		Technopolis	24
		Incubation Center	15
	Social Activities	Online course/Training	68
		TV-Radio Broadcast	15
		Society and Science Website	13
		Online Practice Exam	3

According to Table 7, three categories and 12 codes are obtained under the theme of community service. University-industry cooperation (n=35) activities were included under the industry cooperation category. Accordingly, CEC (n=85), TTO (n=65) and Technopolises (n=24) units were established. Within the scope of social activities, online courses (n=68) and TV-Radio broadcasts (n=15) were the most preferred activities.

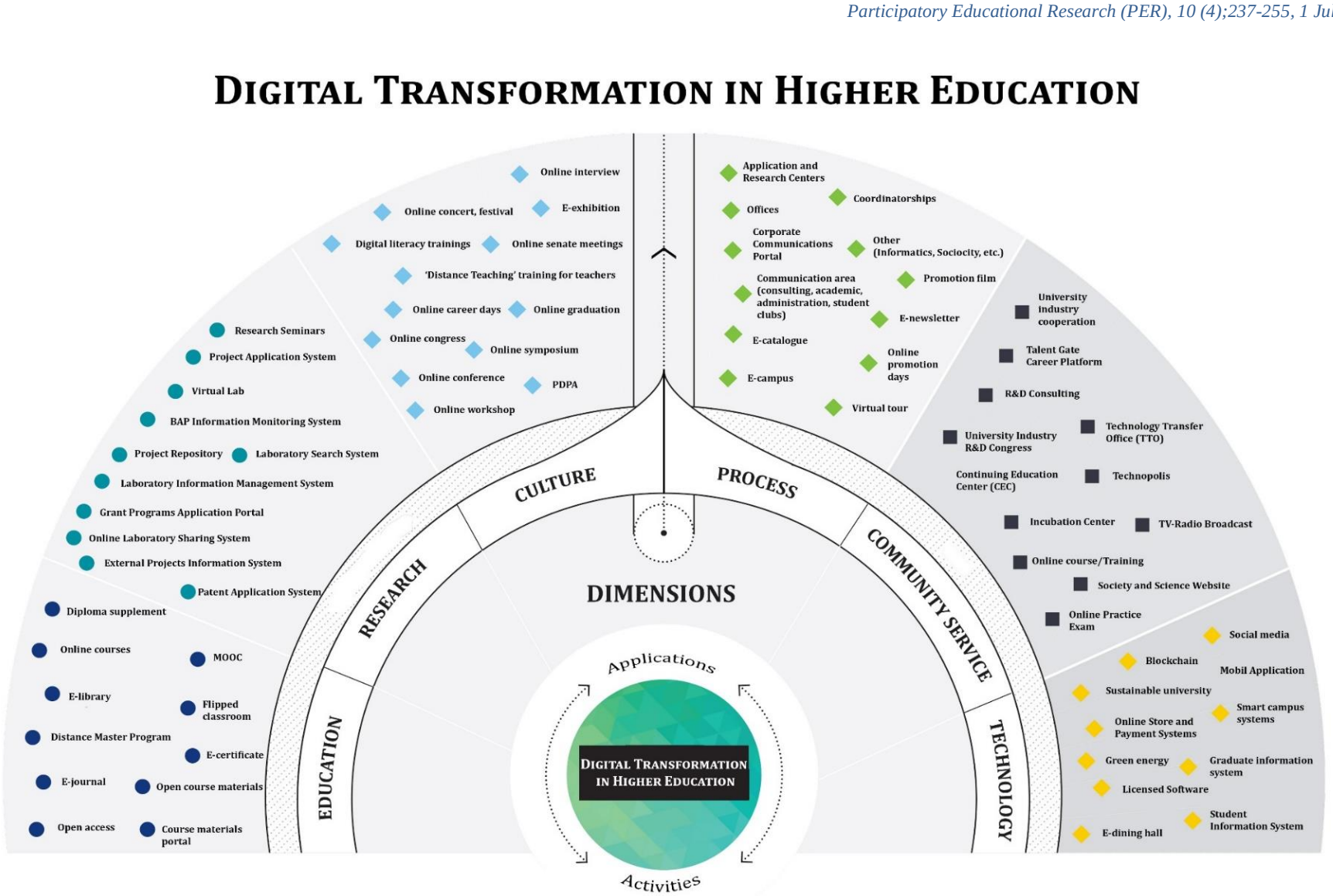

Figure 5. Summary of Findings

Discussion and Conclusion

The present study aimed to examine digital transformation activities of higher education institutions in Türkiye. In this context, the data obtained from the examination of university websites were subjected to content analysis. The analysis results and the correlation of these results with the literature are explicated below.

After examining the webpages of higher education institutions within the scope of the study, digital transformation activities of these institutions were grouped under six dimensions, namely Research, Education, Culture, Process, Technology, and Community Service. These dimensions coincide with these mission areas of universities, which include education, research, and contribution to society (Erdem, 2006). In addition, it was seen that the dimensions of education (Kuzu, 2020; Parker, 2020; Yavuz, 2022) and research (Đurek et al., 2018; Jisc, 2019) have been suggested in different studies in the literature. For example, Higgs and Rowland (2005) and Sirisukha (2020) stated that the process dimension should be addressed for an effective digital transformation. Likewise, Balyer and Öz (2018) suggested that sufficient technological infrastructure should be provided to realize digital transformation. In a similar way to our study, Egloffstein and Ifenthaler (2021) and Parker (2020) observed technology as a dimension of digital transformation.

The ***research*** dimension obtained in the present study involved the infrastructure, smart systems/technology, and the educational activities carried out by universities. In this direction, the establishment of virtual laboratories, various project systems, and the organization of training in scientific projects stand out as digital transformation practices carried out under this heading. In the literature, Safiullin et al. (2019) stated that various digital services should be provided to academicians to promote the number of publications. This result may have emerged as a result of universities' activities towards this requirement. On the other hand, the European University Association (2015) suggested similar activities that will provide the necessary technical infrastructure and support for research activities as an indicator of digital transformation. In addition, the necessity of providing inter-institutional working opportunities with various collaboration portals and sharing systems coincides with the studies on this subject in the literature (DigCompOrg, 2015). When the literature is examined, it can be seen that Đurek et al. (2018) and Jisc (2019) have also proposed a similar research dimension.

The ***education*** dimension obtained in this study consisted of activities under the titles of universities' digital learning approaches, digital publications, online programs, open access, and online scientific activities. In this direction, it was seen that universities adopt learning models such as flipped classroom and that various online courses and distance graduate programs were implemented. In addition, material support was provided within the scope of digital broadcasting services and open access policies. Safiullin et al. (2019) stated that universities students' MOOC should provide students an environment to attend the courses. DigCompOrg (2015), on the other hand, emphasized the necessity of preparing, storing, and using digital content using ICT in educational activities. The existence of such situations can be considered one of the reasons for the obtained result. Adopting computer-assisted innovative learning approaches (FCMM, 2010) and providing ubiquitous learning and open curriculum opportunities within the scope of open courses (Chen & Kidd, 2011) are the results that we encounter in the literature and are in parallel with the findings of the study.

Another dimension obtained within the scope of the study is the ***cultural*** dimension. This dimension includes administrative, digital training, online culture-art, scientific, legal

infrastructure, and support activities. In the literature, it has been stated that for the successful realization of digital transformation, digital culture should be assimilated on an institutional basis (Vliet, 2018). In this direction, it is recommended to adopt a collaborative, data-based decision, customer-oriented, and innovative approach (World Economic Forum, 2021). Accordingly, it can be asserted that providing digital skills training to employees, conducting in-house meetings online, and conducting various scientific, cultural, and artistic activities online will contribute to developing this digital culture. These contributions can be considered reasons for the digital activities demonstrated by universities in the field of culture. In a similar way to the studies conducted by Gill and VanBoskirk (2016), Tmforum (2017), and Kane et al. (2015), our study also proposes culture as a dimension.

The fourth component obtained in the study was the ***process*** dimension. This dimension included existing units, corporate communication, and promotional activities. It was seen that higher education institutions established various research centers, offices, and coordinatorships within the scope of digitalization studies. In addition, the creation of various portals for the realization of communication between stakeholders was also evaluated under this heading. Finally, the digital promotion activities of the university (such as virtual tour, e-bulletin, and online promotion days) were included. The aim of transferring university business processes to a digital environment for efficient and fast service to stakeholders (Rodrigues, 2017) can be expressed as one of the main reasons for the emergence of this result. Seres et al. (2018) obtained results such as modelling agile, fast and highly adaptable collaborative processes, executing business processes with full automation, and analysing the decision-making processes of stakeholders. In addition, the authors also suggested the use of data analytics as the basis of decision-making processes in line with the IT infrastructure that supports all the business processes, goals and strategies of an institution. These recommendations support the findings obtained in this dimension.

Another dimension obtained within the scope of the study was ***technology***. Activities such as smart systems, website, campus, innovative technologies and technology support fell under this component, as well as various systems offered by universities (EDMS, Alumni Information System, Application Registration System, Academic Data Management System) to provide an effective and efficient service to stakeholders and different processes related to websites that provide corporate visibility to disabled people (various language support, and social media, such as a website suitable for use). In addition, technologically supported solutions (wireless internet connection, green campus, barrier-free library, electric charging stations, etc.) also emerged in this dimension, all of which facilitate the execution of business processes within the campus. When these indicators were examined, it was observed that universities made huge investments in the technology dimension, which could be a result of higher education institutions' emphasis on digital transformation technology. In the literature, Đurek et al. (2018) evaluated sub-dimensions such as software-hardware resources, support services, and security within the scope of infrastructure. Safiullin et al. (2019) suggested the high usability of higher education institutions' websites, the development of mobile applications, and the use and follow-up of innovative technologies (internet of things, big data, cloud technologies, etc.) are similar to the results of the study.

Finally, another dimension that emerged within the study's scope was the community service dimension. Establishment of industry cooperation within the scope of community service, which is one of the reasons for the existence of universities, the establishment of various units that play an active role in industry-university cooperation, and the realization of social activities such as various online training and courses for the community are prominent exemplary

practices. In this direction, activities such as using the talent door career platform, establishing various units (such as CEC, TTO, Technopolis, and incubation centers), TV-Radio broadcasts, online courses, and the establishment of socio-science websites have emerged as activities carried out by universities. In the literature, activities such as providing training on the use of ICT (Ae-MOYS, 2011; Finne, 2011) and conducting studies on university-industry cooperation in research (DigCompOrg, 2015; Microsoft, 2018) are discussed in this context.

As a result, within the scope of the study, six dimensions were obtained in the realm of digital transformation activities carried out by higher education institutions. Institutions carry out activities to support processes such as education, research, administration, and cooperation or to perform them in digital environments. For this purpose, it can be asserted that they carry out effective and efficient processes by using various intelligent systems.

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