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Digitized Higher Education: Digital Transformation in Education from a Bibliometric Perspective

Dijitalleşen Yükseköğretim: Bibliyometrik Perspektiften Eğitimde Dijital Dönüşüm

Abstract

Higher education institutions should give high priority to keeping up to date by studying how the business environment reflects the technological and social developments brought about by digitalization. This will enable future generations to take advantage of technological inventions for research and teaching. The implementation of the digital transformation approaches brought by Industry 4.0 in higher education has led to the creation of a technologically-supported education area in higher learning. In the educational dimension of this digital transformation, there is a need to organize complex relationships between existing structures and technologically supported structures. The aim of this article is to examine the literature of digital transformation in education and to identify the current state of affairs. In this context, filtering was carried out using the keywords "digital transformation" and "education" in the Web of Science database. A bibliometric data analysis was carried out through VOSviewer by downloading the data set obtained as a result of the filtering. The analysis found that the pandemic had an impact on the increase in the number of publications in literature, and the most common type of text was the article. In addition, the most broadcasting country is Russia, and the most commonly used keywords in terms of conceptual unity are digital transformation, higher education, education, digitization and COVID-19.

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Özet

Yükseköğretim kurumları, iş ortamının dijitalleşmesinin getirdiği teknolojik ve toplumsal gelişmeleri nasıl yansıttığını inceleyerek güncel kalmaya yüksek öncelik vermelidir. Bu sayede gelecek nesillerin araştırma ve öğretimi için teknolojik buluşlardan faydalanmalarını sağlayacaktır. Endüstri 4.0'ın beraberinde getirdiği dijital dönüşüm yaklaşımlarının yükseköğretim alanına uygulanması yükseköğretimde teknolojik olarak desteklenen bir eğitim alanının oluşmasına sebep olmuştur. Bu dijital dönüşümün eğitim boyutunda ise mevcut yapılarla teknolojik olarak desteklenen yapılar arasındaki karmaşık ilişkilerin organize edilmesi gerekliliği ortaya konulmuştur. Bu makalenin amacı, eğitimde dijital dönüşüm literatürünün incelenmesi ve mevcut durumun saptanmasıdır. Bu kapsamda Web of Science veritabanı üzerinden "digital transformation" ve "education" anahtar kelimeleri kullanılarak filtreleme yapılmıştır. Yapılan filtreleme sonucunda elde edilen veri seti indirilerek VOSviewer aracılığıyla bibliyometrik veri analizi yapılmıştır. Yapılan analiz neticesinde pandeminin literatürdeki yayın sayısının artışında etkisi olduğu ve en yaygın dokümanın türünün makale olduğu bulgulanmıştır. Buna ek olarak, en çok yayın yapan ülkenin Rusya olduğu ve kavram birlikteliği açısından en sık kullanılan anahtar kelimelerin dijital dönüşüm, yükseköğretim, eğitim, dijitalleşme ve COVID-19 olduğu görülmüştür.

Introduction

Digitization has forced many old habits and existing structures to transform. This transformation was carried out in the direction of rethinking the basic elements of business processes, changing systems, creating new concepts by staying true to the old, and ensuring the sustainability of existing structures with new technologies. It is seen that technology and digitalization have an impact on certain areas such as information systems, online learning, artificial intelligence technologies, information management, communication, cyber security, digital

currency markets, and mobile technology. The phrases "digital inequalities," "digital communication," "social media," and "digital education," on the other hand, have become commonplace in everyday parlance as a result of digitalization (Carroll & Conboy, 2020; Venkatesh, 2020).

The use of social media, telephones, tablets, and the Internet has been embedded in every facet of how today's youth live and learn. The OECD (Organization for Economic Co-operation and Development) reported in 2019 that there is a digital divide among today's children between those who have access to digital technology and those who can and cannot advance their technological literacy (Organisation for Economic Co-operation and Development (OECD), 2019). Although the digital divide will eventually close, this issue will be resolved in the medium term by altering the continuing activity structures across all sectors. In this regard, universities, which are the final educational settings where students learn how to function in the corporate world, are making an effort to contribute to the conversation. In the second decade of the 21st century, higher education institutions now prioritize digital transformation in every field.

1. Transformation of the University

Industrial Revolution 4.0's effects on technology have made it necessary for higher education institutions to redesign their operational procedures in every discipline through digital transformation. In fact, the term "digital transformation" refers to a considerable change in company operations, business models, and organizational structures as a result of how society has evolved in response to technological innovation and potential. Higher education institutions must undergo a complete evolution if they are to remain important to this shift over time and avoid disappearing from the scene. Furthermore, establishing oneself in a competitive climate on the global market requires rethinking entire business models and successfully utilizing all the opportunities and potentials provided by the wealth of digital technology. As part of a cycle of renewal for their sustainability, higher education institutions are altering their current structures and practices.

Higher education institutions actually use the term "digital transformation" to express an array of micro and nano-level effects, including having knowledge of technological developments for research and teaching purposes, following technological and social developments concurrently with digitalization, and exploratory (Kergel & Heidkamp, 2018). Lina et al. explained that digital transformation processes in higher education institutions developed primarily in the education dimension, and then in the infrastructure and curriculum dimensions (Benavides, Arias, Serna, Bedoya, & Burgos, 2020). Teachers depend more and more on AI to create curricula and handle every other aspect of teaching. However, by gathering and evaluating data on student performance, AI also assists educators in making well-informed judgments on curriculum enhancements and teaching strategies. Because diverse learning and teaching styles don't always mesh well, teachers who can customize the curriculum for each class are able to provide their students with a significant edge.

On the other hand, to modify educational systems using digital transformation, researchers must create new tools and techniques. It is challenging for an artificial intelligence teaching assistant to adjust to these variables and guarantee that students are taught using the most efficient techniques in accordance with their learning preferences. But, as a result of numerous strategies for keeping up with the times, education underwent new and sudden changes (Govindarajan & Srivastava, 2020). In order to determine what has to be done to include digital transformation in educational programs, universities should have new, interdisciplinary curricula must be known, which is essential for teaching students how to use the strategies and instruments of digital transformation. Higher education institutions use e-learning as a tool to enhance their digital strategies even if it is only one sort of digitalization and one of numerous elements of digital transformation (Arnold, Prey, & Wortmann, 2015). Utilizing all of the opportunities offered by technology is essential since online models serve a superior learning-teaching purpose. Therefore, artificial intelligence-driven technologies play a significant role in the operation of online learning environments. Several learning management systems are used to deliver online education, including Moodle, Blackboard,

Microsoft Teams, Adobe Connect, Canvas, Google Classroom, Zoom, and TeamLink (Moodle, 2020; Setzekorn, 2020). Students have been found to be more active and productive in online learning environments than in conventional classroom settings (Means, Toyama, Murphy, & Baki, 2013). However, neither students nor teachers thought this represented a meaningful advancement. Because it is difficult to carry out online education using various learning techniques and to adapt to new technologies outside the school environment. By experimenting with novel, sustainable methods, universities may put their systems online (Norris & Lefrere, 2011). For this purpose, while video conferencing tools promote learning and the acquisition of new knowledge in the educational setting, they also offer real-time communication during meetings, which facilitates the development of new business networks in the professional work sector. Therefore, it is evident that meetings aid in the creation, upkeep, and growth of knowledge communities both inside and outside of the business (Kodama, 2020). In addition, the requirement for physical presence has been replaced by video conferencing tools. As a result, it is also a fact that universities' efforts to actively use multimedia contribute to both supporting and expanding educational opportunities for adults and improving education in remote areas.

One sector that has experienced a considerable digital transformation is higher education on a global scale. Technological elements, which have an important place in our lives and are becoming increasingly widespread, have made further progress with the pandemic (Bautista and Lissen, 2020; Mhlanga and Moloi, 2020). In this process, digitalization has accelerated in education (Mhlanga and Moloi, 2020). The utilization of multimedia technology on a worldwide scale has let people establish an educational environment without needing to be physically there, transcending time and geographical boundaries. In this way individuals can select the courses that best suit their requirements and learning styles based on their interests, regardless of where they live, go to school, or work.The viability of university education has also been impacted by the pandemic-related global campus closures, national quarantine regulations, and social segregation requirements. But thanks to the academics' attempts to adopt new online teaching methods and adapt the current curricula to the online learning format, solutions have been developed.

The digitization of higher education aims to enable educators and students to adopt digital technologies and use digital platforms (Constantiou, Márton, & Tuunainen, 2017). The coordination of digital learning tools, digital learning support systems and digital learning methodologies enables university students to have a successful online experience (Sousa, Carmo, Gonçalves, Cruz, & Martins, 2019). As a result of increasing digitalization, the university education system enables more efficient decisions to be made, the identification of interdisciplinary trends, the assessment of problem areas and the more systematic allocation of resources (Avella, Kebritchi, Nunn, & Kanai, 2016).

Only, the effects of the unique COVID-19 on the usage of digital technologies in education must be assessed while taking into account individual differences in access to opportunities and resources. Because, while the epidemic persisted, neither developing nor underdeveloped countries could be offered equal educational possibilities (UNESCO, 2020b; 2020c). When the abrupt transition of students to distance learning and student engagement are taken into account within the categories of access to computer devices, regular internet connection, and capability to use digital tools, it has become evident that this situation has a cost for all students. Teachers stated in Houlden and Veletsianos' (2020) study that during the COVID-19 crisis, kids did not have easy access to laptops or Wi-Fi. In his study, Ziyu (2020) stressed that the shift to online education at all levels in the education sector during the COVID-19 period to ensure the continuation of education had made the disparity in education even worse. Digital transformation; In addition to problems such as access to resources, lack of devices, and limited connection, it has also brought up the issue of online security and revealed the necessity of more nuanced and sustainable education programs that support the development of media literacy.

2. Transformation of the Student

The digital age has predicted that educational institutions will use cutting-edge artificial intelligence-based technologies to run their online programs. However, it was not envisaged that the COVID-19 effect would result in a fundamental shift in the higher education industry worldwide that would be driven by technology. Due to this situation, the well-known equation for education has been altered, rearranged, and reviewed. It was especially hard for students to adapt to this sudden change in their educational setting.

Changes and transformations have varying effects on every industry. However, the requirement that students be prepared for the new business model structure that emerged as a result of remote working arrangements carried with it another issue (Krishnamurthy, 2020). The unfettered access to all information made available by digital transformation across various digital platforms raises the question of what level of knowledge students will have in the corporate sector. As a result of the digital transformation, it is crucial for universities to accomplish their objective of educating students for the industry and equipping them to thrive there. It has become necessary for pupils to be prepared individuals who can master and use artificial intelligence algorithms and have the capacity to evaluate in the digital environment. Due to their learning power-based acquisitions, students will also be able to participate in their professional lives as experts, planners, and problem solvers (Letheren, Bennetta, & Whittaker, 2020; Krishnamurthy, 2020, Toprak 2020). Students will exhibit high productivity in remote working environments, similar to their performance in distant education, making it simpler for future business models to adjust to teleworking restrictions (Dingel & Neiman, 2020). As a result of the digital transformation, it is crucial for universities to accomplish their objective of educating students for the industry and equipping them to thrive there. University faculty members should prepare their students for future digital structures by developing the viewpoint of adapting and utilizing new digital systems, which goes beyond the idea of employing technology simply for online learning (Francis, 2019).

In contrast to traditional education, curriculum changes at universities have been implemented to address the problem of maintaining education without experiencing physical contact. By upgrading the curriculum to take into account technological changes, university education can be improved. The goal of the digital curriculum is to give students the experience they need to be competitive in the job market today. This offers a flexible solution to the labor market's requirements. Universities employ digital technology tools to deliver high-quality instruction and give students freedom in their learning as part of their efforts to enhance teaching strategies and modify curricula. These resources support and encourage students' learning.

3. Transformation in Academia and Industry

Digital applications are preferred because of their simplicity of use, capacity for business cooperation, and potential to foster greater innovation in both individuals and businesses. The goal of Society 5.0 is to create "an ultra-smart society" by uniting both academia and business and integrating the real and virtual worlds. Therefore, concepts like collaborative education, cooperative education, integrated learning, sandwich learning, internships, experience-based learning, and work-integrated learning are prioritized in the university model needed by Industry 4.0 or Society 5.0 (Cabinet Office, 2020; M. Toprak, 2018).

Also, students have access to technology solutions that enable both education and career preparation with the help of artificial intelligence. These resources give students the chance to get individualized advice on how to build their professional careers. The pandemic has forced students at all educational levels to adopt digital technology. In particular, advances in IoT are encouraging the networking of products across different products and industries, significantly expanding individual product functionality. This networking organically combines core technologies and individual business processes across wide-ranging industries with a variety of big data sent and received in real-time from people and things across a variety of professional domains. Therefore, once clearly defined boundaries between products and industries are blurring, increasing the potential for new boundaries to form. In IoT, networking and the Internet of Things support the

convergence of people, data, technologies, and processes, creating new business models with synergies between different products and industries. These services or integrated systems blur established boundaries between products and industries, increasing the potential for new boundaries to form.

This change has been made possible by the rising popularity of technology's cloud-based infrastructure (Kodama, 2020). The artificial intelligence-based application Lipko (2016) used for university students in her study is a great example of this. From commercial operations to healthcare, from contacts with religion and the government to education, this cloud-based infrastructure is regarded as the continuum of technology use (Barnes, 2020; Griffin & Denholm, 2020). It has therefore become crucial for students to develop themselves through online learning and to be able to utilize these electronic environments in their future professional lives.

However, the requirement that students be prepared for the new business model structure that emerged as a result of remote working arrangements carried with it another issue (Krishnamurthy, 2020). The unfettered access to all information made available by digital transformation across various digital platforms raises the question of what level of knowledge students will have in the corporate sector. It has become necessary for pupils to be prepared individuals who can master and use artificial intelligence algorithms and have the capacity to evaluate in the digital environment. Students will exhibit high productivity in remote working environments, similar to their performance in distant education, making it simpler for future business models to adjust to teleworking restrictions (Dingel & Neiman, 2020). As a result of the digital transformation, it is crucial for universities to accomplish their objective of educating students for the industry and equipping them to thrive there. University faculty members should prepare their students for future digital structures by developing the viewpoint of adapting and utilizing new digital systems, which goes beyond the idea of employing technology simply for online learning (Francis, 2019). Additionally, the strategic application of digital technologies offers choices for improving the speed, efficiency, and effectiveness of operations. On the other hand, problems like inadequate information technology infrastructures, inadequate business processes, high implementation risks, costs associated with transformation, resistance to change and transformation among educators and management, and disregard for the need for change are all thought to be barriers to digital transformation.

4. Transformation Models

A wide range of topics, including student article analysis, data mining in education, chatbots, smart agents, education for children with special needs, child-robot interaction, artificial intelligence-based evaluation systems, exploratory education, personalized education or dialogue education systems, and automatic test creation systems, are currently the focus of artificial intelligence research in the field of education. In addition, Holmes et al. (2019) state that it offers administrative support about the potential impact of artificial intelligence on curriculum, staff scheduling, test administration, cyber security, facilities management, and security in educational institutions. Expert systems, intelligent instructional systems, and SCHOLAR are some of the most widely used artificial intelligence programs.

Expert systems are computer programs that use a variety of artificial intelligence techniques to perform tasks often done by individuals who constitute subject experts in a particular area. Expert systems are one of the applications of artificial intelligence. The application of expert systems in education includes distance learning. With the answers gained through tailored structures and issues generated especially for the learner, distant education offers structures that broaden the knowledge base and boost decision-making processes. The most well-known illustration of an expert system in this area is MYCIN, which was created by Prof. Feigenbaum of Stanford University and his colleagues for use in the medical field's detection and treatment of bacterial infections (Doğaç, 2015).

Smart Tutoring Systems are one of the most popular artificial intelligence applications in education. According to Alkhatlan and Kalita (2018), these systems offer tailored learning

environments that are appropriate for each student and are carried out in stages. They are computer-based instructional systems that draw conclusions about students' subject knowledge.

SCHOLAR is the first illustration of an Intelligent Tutoring System, which is regarded as the second generation of computer-aided training. SCHOLAR has assisted in the construction of dialogue-based instructional systems, which are concerned with the experiences of the learner in using the system interface. Several alternative processing sequences are really followed within the rule-based learning logic. In dialogue-based tutorial systems, the process involves evaluating student responses using tried-and-true experimental methods and determining the expected result in light of the available data. In order to dispel any possible misunderstandings students may have about the subject and to enable them to construct a model on the selected topic, it is a system that provides data on what students entered, clicked, waited, moved around the screen, etc.

These days, users would rather interact with artificial intelligence robots like ChatGPT and Chatbot, which can respond to user input in natural language. The Chatbot and ChatGPT understand the requirements and objectives of the user by analyzing their input and producing responses. These robots can offer exercises, examples, and explanations that are suitable for the user's level and requirements in a learning environment. However, due to data restrictions, Chatbot and ChatGPT have trouble comprehending ambiguous or sophisticated input. A thorough analysis of the benefits and drawbacks of utilizing AI in education should be done prior to integrating AI robots like Chatbot and ChatGPT into instructional programs.

5. Benefits and Drawbacks of Transformation

When digital transformation and artificial intelligence are implemented in higher education, faculty members and students are given a proper opportunity to utilize the most effective teaching, learning, and research options. The particular needs of students can be satisfied and learning in higher education can be personalized with the use of artificial intelligence (Chatterjee & Bhattacharjee, 2020, Tavares,2022). Innovative thinking, multidimensional thinking, algorithm, and coding competencies are the key concepts in the digital university. Graduates will be equipped to apply technologies for R&D projects including database analysis, project execution, process design and management, and product-based patents, brands, and licensing as a result of these. By analyzing big data, designing digital media tools, and creating content that supports the growth of local or regional industrial sectors, quality be guaranteed. Diversity inside the institution has increased as a result of artificial intelligence being used in student admissions in higher education. Universities have the option to select their own applicants thanks to the use of video-based artificial intelligence in student applications. Artificial intelligence programs offer great observations and conclusions quickly and at a low cost, which is one of its most notable advantages (Zeide, 2019).

Many scholars contend that when applied properly in higher education, artificial intelligence may benefit universities, despite competing viewpoints (Cellan-Jones 2014; Tavares,2022). In the upcoming years, universities can include artificial intelligence due to these advantages.

Higher education investments in digital transformation are a solution to the current issue of supporting artificial intelligence applications through digital transformations. The spread of artificial intelligence and the utilization of digital instruments have been facilitated by the most recent situation. However, anxieties about artificial intelligence range widely. The first of them is the forecast that machine learning may one day outpace human intelligence (Spector and Ma, 2019). So, existing artificial intelligence will produce smarter generations of AI since it can recursively enhance itself (Spector and Ma, 2019). Second, it emphasizes how unpredictable artificial intelligence will become as a result of the growth of digital innovation (Fang, Su, and Xiao, 2018). There is a lot of discussion on how artificial intelligence is advancing in higher education, how it will impact future teaching and learning, and how universities will decide how to go in this area. Another issue is academics' worry about the eventual technological singularity of artificial intelligence. In today's culture, there are valid concerns that humans using digital technologies to conduct virtual lives with technology might lead to this situation (Spector and Ma, 2019).

In higher education, the addition of international students to the already huge student body has made it more challenging to pay the costs that are increasing. Also, AI learning algorithms that were developed using data from college students in one region could not produce the same results when applied to students in another region of the nation. This could be a result of the data being of lower quality or the sample not being representative of the target audience. Research has shown that using artificial intelligence to address this issue in higher education is a viable option (Popenici and Kerr, 2017). In particular, technological innovations that are widely accepted by field experts reveal that the role of faculty members in higher education should be reconsidered (Popenici and Sharon Kerr, 2017).

As a result, numerous studies have found that many university managers prefer to reduce the academic staff in order to cut costs (Popenici and Kerr, 2017; Taşç, 2018). At this point, it becomes necessary to develop policies to reduce public financing of higher education. The jobs most likely to be replaced by computers are repetitive and routine jobs. Since this typically happens in education with teaching assistants who answer numerous questions about grading, due dates, and related topics, these employees are most at risk of being replaced in universities. The Georgia Institute of Technology, one of the few colleges and universities that employs it, states that for a number of years, its instructors have used virtual teaching assistants and that both staff and students have been pleased with the program (McKenzie, 2018). Thus, the challenges of artificial intelligence can be taken into account, including the biases in AI models, the lack of personalization, the possibility of inaccuracy, and teachers' fear of losing their employment. Specifically, mistakes in AI recommendations or feedback can impact learning outcomes. It is imperative to overcome these obstacles if AI in education is to enhance results and assist pupils.

6. Measurement and Evaluation in Transformation

A new system of measuring and assessment is required in light of the issues encountered during the digitization of higher education. In the age of artificial intelligence, data mining technology plays a major role in the development of educational assessment by enabling learning analysis based on the outcomes of data analysis to carry out targeted teaching activities. When it comes to individual learners, the integration of multiple predictors can infer the development trend of a single predictor. This can be realized in multi-dimensional information integration, which takes into account the learning motivation, attitude, emotion, and cognitive processes of the learners. After, using the research findings have been established the learning model to predict the direction of learning in the future. Alternatively, a mathematical model for maximizing instruction's content and sequencing is created by examining the relationships between variables (Wang, 2020). The relationship between learners' various learning behavior patterns and their learning outcomes is clarified by gathering and evaluating data on learners' changes in learning behavior in the classroom. In order to comprehend and enhance learning and learning settings, learning analysis, according to Siemens et al. (2011), is the process of measuring, gathering, analyzing, and reporting data sets of students and learning environments. Learning analysis, as defined by On the other hand, Johnson et al. (2016), is the study and interpretation of real-time data on student performance, learning engagement, and learning process.

The relationship between students' various learning behavior patterns and their academic performance is clarified by gathering and evaluating data on how learners' conduct varies during classroom instruction. We can determine how satisfied learners are with their individual learning experiences by collecting and analyzing data from learner satisfaction questionnaires in nowadays. The identification of learners' future learning development trends is accomplished by acquiring and evaluating basic information data, such as student registration and registration sources. Real-time learning experience enhancements and learning ideas can be given to students through the collection and analysis of academic performance data. For certain students, support can be given through online courses by creating online teaching methodologies.

Measuring and evaluating Artificial Intelligence (AI) technologies in diverse areas, such as information retrieval, speech, language processing, and computer vision have usually focused on

measures of performance accuracy and the robustness of performance. Today, a range of software tools for AI Measurements have been developed by NIST with the aim of characterizing, categorizing, and standardizing terminology related to the characteristics of artificial intelligence (AI) systems. NIST's Performance Factor Analysis (PFA) software is utilized to calculate measurement uncertainty measurements. Among the metrics that are measured are classification accuracy, precision and recall (PR), area under the ROC curve (AUC), probability of missed detection at constant false alarm rate, time-based false alarm (TFA), logarithmic loss, mean squared error, and includes metrics like F-measures. Artificial intelligence systems that do not contain basic information from the past or present and are state-of-the-art, such software and metrics help in monitoring and evaluating progress over time and validating their data. These efforts will provide the foundation for creating AI systems that have these characteristics and for creating metrics and measurement techniques to determine the extent to which they do.

7. Improvement Potential of the Transformation

Artificial intelligence is referred to as a tool to improve education in a more individualized, adaptive, inclusive, and engaging way by analyzing real-time data (UNESCO, 2017). In order to facilitate artificial intelligence's integration with various disciplines, universities will need to adjust to the new opportunities it has provided (Davies, Dodgson, and Gann, 2017). Due to these advances, policies that consider artificial intelligence in higher education administration must be developed. This requirement suggests that institutions of higher learning should be in line with the best practices that evolve when artificial intelligence is used effectively, from the process of assisting faculty members' professional growth to student instruction (Cellan-Jones, 2014). The introduction, adoption, and use of new technologies in higher education policies, particularly in all areas where education and training activities are conducted, has advanced quickly in recent years

Also, the potential advantages of applying AI-based technology to problems in business, education, health, and communication should be assessed. The ethnic and cultural diversity of the human population will dramatically increase in the future. Communication is made challenging by the variations in the native languages that these individuals from these many origins and cultures speak. Artificial intelligence methods employed in language translation remove this lack of communication (Meador, 2019). Once more, apps like Skype, WhatsApp, Viber, and others have helped make it possible for people from all walks of life to interact without using a phone, in addition to university students. Thanks to artificial intelligence (AI) agents like Alexa and Google Nest on smartphones, critical thinking can now be described as the ability to scan and analyze big data quickly and make decisions with the ability to consider all options. Previously, critical thinking was only defined as organizing facts and ideas in one's mind. This made it possible to find relationships that are hard for people to tell apart. Business project managers demonstrated that the deployment of AI-powered assistants improves the efficiency of human-computer collaboration by balancing the team's strengths and shortcomings (Metz, 2019; Rayome, 2018). Industry 4.0-related improvements to education are not being adopted at the same rate as the new business models it has brought forth. According to Bughin (2017), university curricula could not be revised at the same time. Thus, graduates of today's generation must develop the ability to cope with sudden changes in the workplace. Universities should also prioritize their interactions with industry. Faculty members are provided direction on this subject. The need for a shared understanding of terminology should be satisfied, and in-depth research should be done on the digital revolution of education.

Traditional, pre-digital methods are still used to deliver education today. More work is required to offer educators and researchers suitable digital learning models. In this setting, it's crucial to increase collaboration between academic institutions and corporate sectors, identify the needs, and adapt the programs as necessary. By addressing the digital educational demands of faculty members, it would also be possible to develop new programs.

Although faculty members prefer to use traditional classroom methods, it is possible to argue that online education is much more transparent, open, and simpler than conventional tactics in terms of ensuring institutional control. It is indisputable that professors must alter to keep up with these

digital advances in higher education. Therefore, during the next years, university instructors' responsibilities will probably change (Pence, 2019). By giving students and faculty members in higher education new roles, artificial intelligence given by digital transformation can offer solutions to the issues in higher education. Since universities are providers of entrepreneurial and creative human capital and research, they support the development of their students' entrepreneurship, creativity, and leadership skills with digital education tools. Additionally, the strategic application of digital technologies offers choices for improving the speed, efficiency, and effectiveness of operations. On the other hand, problems like inadequate information technology infrastructures, inadequate business processes, high implementation risks, costs associated with transformation, resistance to change and transformation among educators and management, and disregard for the need for change are all thought to be barriers to digital transformation.

8. Method

It is important for the general framework to be established that the purpose of the study and the research question are well defined. This is possible by systematically examining the work in the literature. The conditions in which the accumulation of knowledge in the literature is formed, which critics are taken, and which are related to other concepts. Priority is given to prestigious journals and the most widely read books in the field. This helps to identify the key works with the most reference in literature and to find the research question (Tayşir, 2019). Bibliometric analysis is also used for a variety of reasons, including to identify articles and journal performances, trends in research, the intellectual structure of the field, and relationships between authors (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021). The current literature is summarized by analysing the social and structural relationships between various components such as author, country, subject, institution. In this study, the method of bibliometric analysis was used to identify the broadcasting trend in the field of digital transformation in education and to summarize the current situation.

8.1. Data Collection

To conduct the analysis, data was extracted from Web of Science and Scopus databases according to the determined criteria. The "Topic" field containing Keywords Plus, which contains the title, summary, author, keywords and words that are often found in the headings of the references of an article, but are not included in the title of the article itself, was filtered by writing "digital transformation" and "education". This filtered on 25 August 2023 showed 1,357 results. All studies displayed were included in the analysis. The data containing studies between 2009 and 2023 was downloaded as a "table delimited file" from Web of Science. In the Scopus database, the search field was selected as article title, abstract and keywords and filtered by typing "digital transformation" and "education". 2,502 studies between 1999 and 2023 were viewed and downloaded for analysis via VOSviewer.

In this phase, the analysis was carried out according to the steps shown in Figure 1

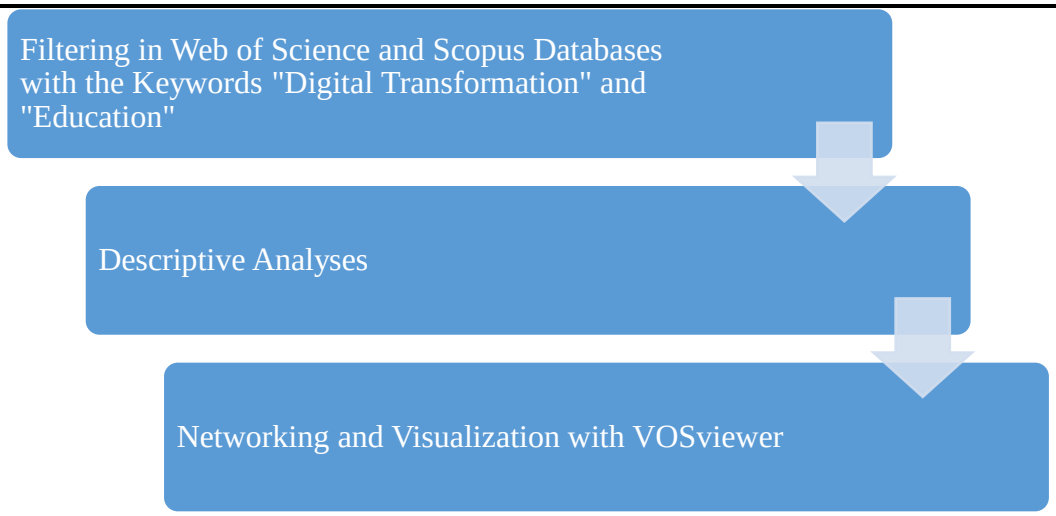

Figure 1. Analysis Steps

9. Results

While studies conducted in the field of digital transformation in education between 2012 and 2023 were discussed in the Web of Science database, studies between 1999 and 2023 were evaluated in Scopus. Accordingly, the findings were examined under the heads of trend analysis of publications, publishing type distribution of literatüre, number of documents by country, co-authorship of countries and conceptual unity analysis.

9.1. Trend Analysis of Publications

Trend analysis of both databases over the years is shown in Figure 2. This analysis took into account studies in the fields of title, summary, keyword "digital transformation" and "education".

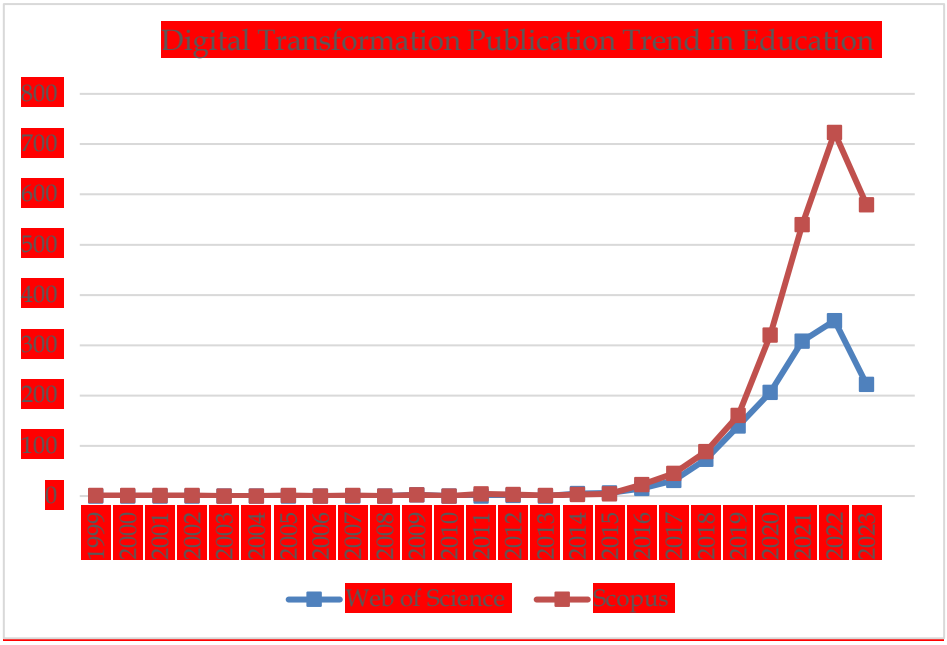

Figure 2. Digital Transformation Publication Trend in Education

Accordingly, it can be seen that the first study in the literature in Scopus was conducted in 1999, and in the Web of Science database in 2009. Although the beginning of publications in Scopus dates back to 1999, the significant number of publications was reached in 2016 with 23 publications. In parallel with Scopus, Web of Science also reached a significant number of publications in 2016 with 15 publications. While the number of annual studies in the field was less than 10 until 2016, there has been an increase in both databases compared to previous years since then, and the number of

publications has continued to increase every year. As of 2019, the annual number of broadcasts has exceeded 100. Since that date, the continued increase in broadcasts is believed to have been the impact of the COVID-19 pandemic, which has driven the education sector and digital transformation worldwide. The pandemic has led to increased work in this area on various issues, such as switching to distance learning, developing online technological solutions, and developing educational policies that support online platforms.

In addition, when the graph is examined, it is seen that the annual number of publications in Scopus as of 2022 is twice as high as Web of Science.

9.2. Publishing Type Distribution of Literature

The distribution of digital transformation literature in education is shown in Table 1.

Table 1. Publication Type Distribution of the Literature

	Web of Science		Scopus	
Type of Document	**Number**	**Percent (%)**	**Number**	**Percent (%)**
Article	865	63,77	1022	40,8
Proceeding Paper	399	29,38	939	37,5
Book Chapters	20	1,47	263	10,5
Others	73	5,38	278	11,2

In both databases, publications related to the field are predominantly in the form of articles, followed by papers and book chapters, respectively. Although there is no significant difference between them in terms of the number of articles, there is a significant difference in terms of proceeding paper and book chapter.

9.3. Number of Documents by Country

The number of publications by country was examined and the current status of Web of Science is shown in Figure 3. The country-based studies were examined, limited to the 25 most broadcasting countries.

Figure 3. Number of Publications by Countries (Web of Science)

The most broadcasting countries were Russia (207), Germany (156), Spain (135) USA (92) and Portugal (64). In the list of the top 25 countries, the countries with the least broadcasts were Croatia (23), France (23), Malaysia (23), South Africa (23) and Austria (21), respectively. Turkey ranks 14th with 35 publications.

The country distribution of the number of publications in Scopus is shown in Figure 4.

Figure 4. Number of Publications by Countries (Scopus)

Accordingly, the countries with the most publications in Scopus are Russia (448), Germany (239), USA (173), Spain (164) and United Kingdom (114), respectively. The countries with the least publications were Sweden (37), Colombia (237), Romania (38), Austria (38) and Switzerland (39), respectively. Turkey ranks 13th with 54 publications.

Although the results are mostly parallel when examined in terms of the top 5 countries, it is seen that Portugal, which is in the top 5 in Web of Science, is 8th in Scopus. In addition, it has been observed that Poland, Hungary, Croatia and France, which are among the top 25 countries in Web of Science, are not in the top 25 list of Scopus.

9.4. Co-Authorship of Countries

In international co-writing, which represents a network of countries, countries are shown in a diagram. The more important the country is, the greater the representation of the label and its surroundings. The size of each apartment represents the number of publications by the authors of that country. Every connection between countries indicates that there is a common authority between the countries shown. In order to create a map of the cross-country network of authorship, the analysis was carried out on the basis of 19 observation units linked to each other under the criterion that a country should publish at least 25 works and receive at least 50 references. As a result of the analysis, it was seen that there were 3 clusters, 162 links and 458 total link strength for Web of Science. The relevant network map is given in Figure 4.The relevant network map is shown in Figure 5.

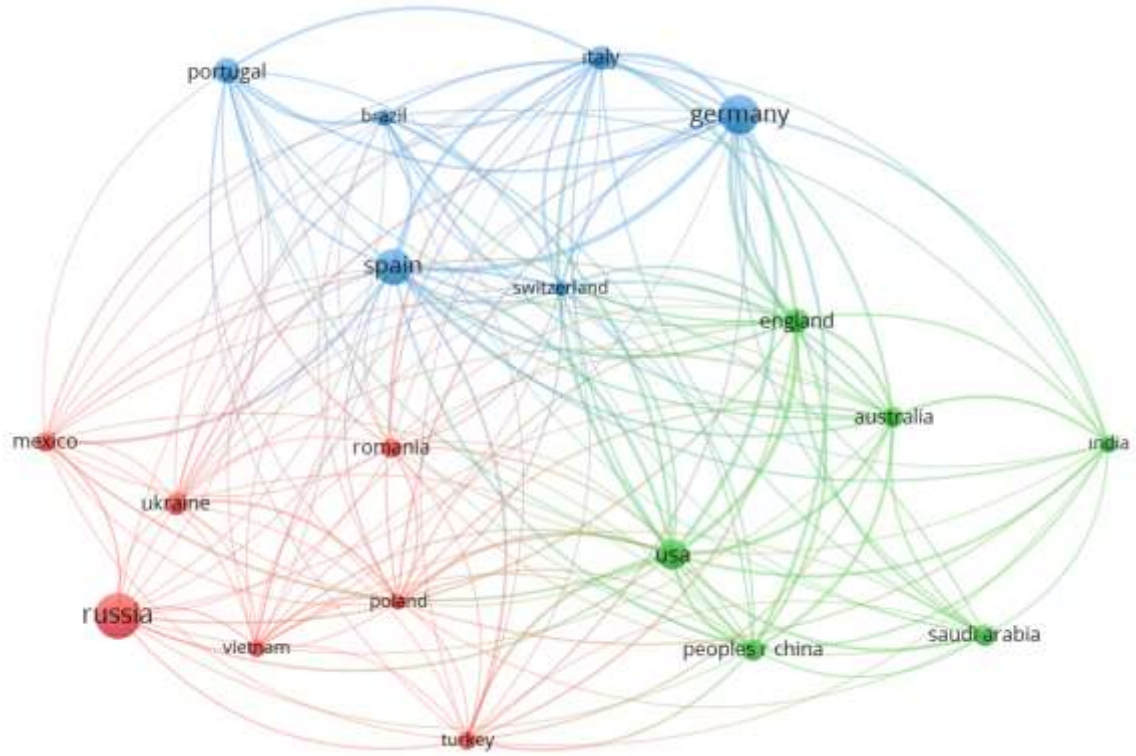

Figure 5. Co-Authorship of Countries

Of the 19 co-authorships of the countries, Russia, Germany, Spain and the USA are the countries with the most co-publishments, respectively. The findings in the analysis of co-authorship are parallel to the results in the number of publications on a country-based basis.

Co-Authorship of Countries network map could not be created for Scopus because there is no feature to create this network map within the features that the Scopus database allows for downloading.

9.5. Conceptual Unity Analysis

Conceptual synergy network analysis is based on the notions used in the title, summary and keywords of the study, which are classified as the concepts of central importance of the research being studied. There is a linear relationship between the frequency of observation of concepts in the given contexts and their connectivity. The purpose of the analysis is to help researchers gain an idea of the content of the study in order to define the overall structure of the literature (Rejeb, Rejeb, Simske, Treiblmaier, & Zailani, 2022). There are a total of 3863 keywords in the research in Web of Science. A minimum of 10 joint examinations were selected in order to a meaningful result. Of the 62 terms that provide this condition, the most commonly used are in Figure 6.

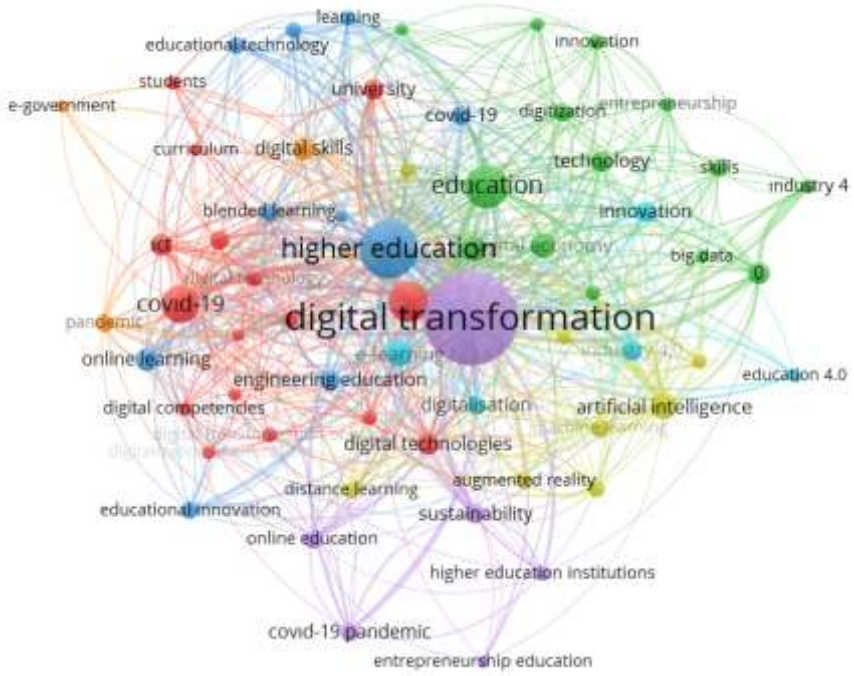

Figure 6. Concept Unity (Web of Science)

The five most commonly used keywords were digital transformation (507), higher education (199), education (107), digitalization (91) and COVID-19 (83).

When the same criteria were entered for Scopus, it was seen that there were initially 8833 words. After selecting the condition of appearing together at least 10 times in order to obtain meaningful results, 232 concepts remained. The most common concepts are shown in Figure 7.

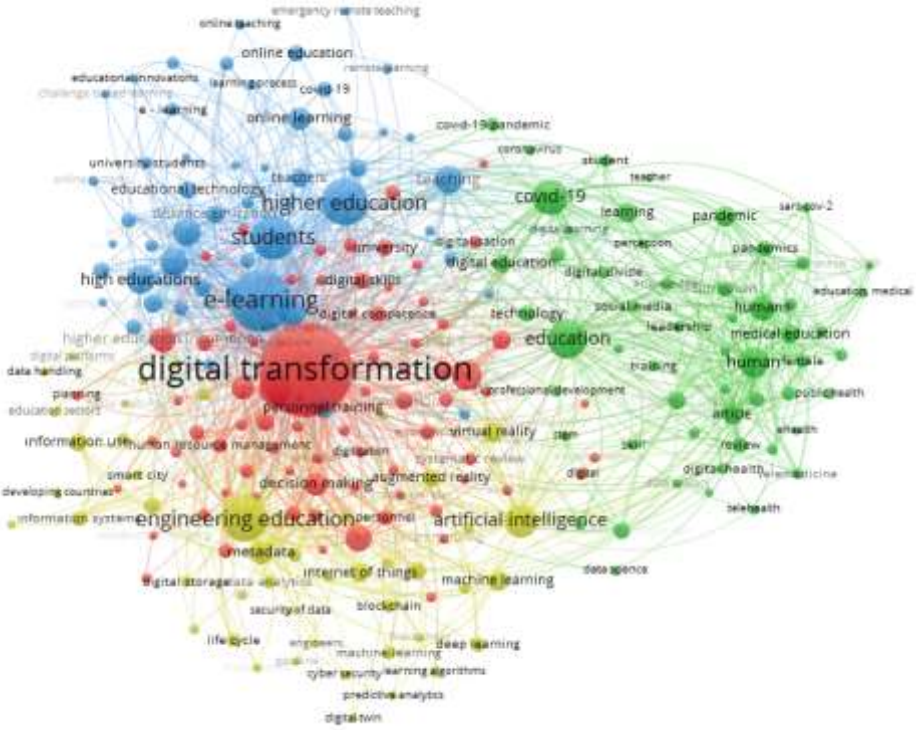

Figure 7. Concept Unity (Scopus)

According to the concept unity analysis, the 5 most frequently used keywords were digital transformation (1029), e-learning (444), higher education (264), engineering education (258) and students (233).

Conclusion

Teachers and students are expected to develop the necessary digital competence in order to deal with digital technology and select the finest educational resources. This digital deficit is the result of the concept of digital literacy not being developed enough.

These structures have different impacts on universities, depending on how much education is digitalized and how much of a value-creating role digital technology plays. Future programs should be created by universities to ensure that students in all grade levels are ready for this system that is transforming and changing.

Understanding how to handle digitalization in higher education institutions, carry out digital transformation successfully, and increase the effectiveness of digital transformation both now and in the future is crucial. Higher education institutions should take into account the necessity to finish the digital transformation process as quickly as possible for this reason.

It is necessary to conduct further research on how higher education institutions can understand digital transformation and respond to the needs of the 4.0 industrial revolution.

This study aims to examine the digital transformation literature in education and determine the current situation. For this purpose, filtering was done using keywords and criteria through Web of Science and Scopus databases. While the analysis covering publications made between 2009 and 2023 was made in the Web of Science database, the years 1999-2023 were examined for the Scopus database. As a result of this review, a bibliometric analysis of the literature was made and the current situation was revealed. Examination; Trend analysis of publications was made under the titles of publication type distribution of the literature, number of publications on a country basis, cross-country co-authorship and word association.

As a result of the review in Scopus, it was determined that the first publication in the literature was in 1999 and in Web of Science in 2009. However, when the publications in the two databases were examined, it was seen that there was no linear increase in the field over the years after the first publication. However, after the introduction of the concept of Industry 4.0, work on digital transformation in education has resumed. In addition, the actual increase in the area has been accompanied by the COVID-19 pandemic. Because of the pandemic, there has been an increase in publications aimed at developing new solutions in this area, with the need for remote education and the effective use of the remote learning environment. Similarly, Stella et al. (2023) emphasized that during the transition to distance education due to COVID-19, the lack of experience and low digital capacity of many schools caused gaps, inequalities and learning losses to increase. For this reason, it has been stated that studies in this field have increased in order to improve the digital capacities and preparations of schools, increase their digitalization levels, and achieve a successful digital transformation.

When the publication tendency of countries on Web of Science was examined, it was seen that they were Russia (207), Germany (156), Spain (135), USA (92) and Portugal (64), respectively. The countries with the most publications in Scopus were Russia (448), Germany (239), USA (173), Spain (164) and United Kingdom (114), respectively. There is a significant difference in the number of publications between the first and second countries in both databases. Russia is a leader in both databases. This shows that Russia carries out more research and publication activities in the field of digital transformation compared to other countries. It is also remarkable that Germany is the second country to introduce the concept of Industry 4.0, which is often referred to along with the notion of digital transformation. One of the main reasons for this is Germany's focus on digital transformation, primarily in the industrial sector. In addition, it is believed that if a bibliometric analysis is carried out in the context of the concept of Industry 4.0, the cause of this situation will be understood. The findings obtained in this study show the contributions of prominent countries in the field to the

literature. However, these findings alone are not sufficient to measure a country's digital transformation success. In order to comprehensively address a country, strategy plans and practices regarding digital transformation need to be evaluated together.

When looking at the digital transformation literature in education through Web of Science, there are a total of 1357 publications, 865 of which are articles, while there are 2502 publications, 1022 of which are articles, in Scopus. It is a fact that the number of broadcasts in this area is low and open to development, given the surge of technological developments every day. Considering the power of digital transformation to transform educational processes, its contribution to increasing the quality and accessibility of education should not be ignored. Digital transformation in education; It includes many areas such as student participation, teaching methods, and educational materials. For this reason, more publications in the field are important for developing effective strategies. It is thought that a collaboration between researchers, policy makers and educators will accelerate the developments in the field and contribute to more production.

In terms of co-authorship, the relationship between countries is often concentrated around Russia, Germany, Spain and the USA. Increased participation in international workshops requires networking among those working in this field.

When looking at the keyword frequency of studies in the literature based on concept unity, digital transformation, higher education, education, digitalization and COVID-19 were the prominent keywords in Web of Science. According to the concept association analysis in Scopus, the 5 most frequently used keywords were digital transformation, e-learning, higher education, engineering education and students. Through the analysis of conceptual cohesion, it is possible to look at keywords to gain insight into what topics the work in the literature focuses on. Accordingly, there are common keywords in both databases. These common keywords show that digital transformation in education and higher education studies come to the fore. On the other hand, it has been observed that the concepts of digitalization, education and COVID-19 in Web of Science differ from Scopus. Likewise, it has been observed that the concepts of e-learning, engineer education and students in Scopus differ from the other database. It is likely that these differences express the sub-topics on which the databases focus. Accordingly, it is possible to say that more emphasis is placed on the effects of COVID-19 on education in the publications in the Web of Science database, while Scopus focuses on more specific topics based on the concepts of "engineering education" and "e-learning".

In order to better understand and handle the digital transformation process in education, documents such as reports prepared by prominent countries within the scope of digital transformation, strategic plans and directives prepared by government institutions, and activity reports of educational institutions can be examined in future research. Thus, how digital transformation is implemented in the field of education will be evaluated comprehensively.

References

Alkhatlan, A. ve Kalita, J. (2018). Intelligent tutoring systems: A comprehensive historical survey with recent developments. arXiv preprint arXiv:1812.09628.

Arnold, P., Prey, G., & Wortmann, D. (2015). Digitalisierung von Hochschulbildung: E-Learning-Strategie (n) noch up to date? Zeitschrift für Hochschulentwicklung.

Arslan, K. (2020). Eğitimde yapay zekâ ve uygulamaları. Batı Anadolu Eğitim Bilimleri Dergisi, 11(1), 71-88.

Avella, J. T., Kebritchi, M., Nunn, S. G., & Kanai, T. (2016). Learning analytics methods, benefits, and challenges in higher education: A systematic literature review. Online Learning.

Barnes, S. J. (2020). Information management research and practice in the post-COVID-19 world. International Journal of Information Management.

Bautista, A. S., & Lissen, E. S. E-learning in 15 days. Challenges and renovations in Primary and Secondary Education of the Republic of Croatia during the COVID-19 crisis. How have we Introduced distance Learning? Revista Española de Educación Comparada, (36), 181-195.

Benavides, L. C., Arias, J. T., Serna, M. A., Bedoya, J. B., & Burgos, D. (2020). Digital transformation in higher education institutions: a systematic literature review. Sensors.

Carroll, N., & Conboy, K. (2020). Normalising the "new normal": Changing tech-driven work practices under pandemic time pressure. International Journal of Information Management.

Cabinet Office. (2020). Society 5.0. Retrieved from https://www8.cao.go.jp/cstp/english/society5_0/index. html#container

Cellan-Jones, R. (2014). Stephen Hawking warns artificial intelligence could end mankind. BBC News. http://www.bbc.com/news/technology-30290540

Constantiou, I. D., Márton, A., & Tuunainen, V. K. (2017). Four Models of Sharing Economy Platforms. MIS Quarterly Executive.

Chatterjee, S., & Bhattacharjee, K. K. (2020). Adoption of artificial intelligence in higher education: A quantitative analysis using structural equation modelling. Education and Information Technologies, 25, 3443-3463.

Davies, A., Dodgson, M., ve Gann, D. (2017). Innovation and flexibility in megaprojects: A new delivery model. (B. Flyvbjerg, Dü.) Oxford: The Oxford Handbook of Megaproject Management, Oxford University Press.

Dingel, J. I., & Neiman, B. (2020). How many jobs can be done at home? Journal of Public Economics.

Doğaç, A. (2015). MYCIN I - uzman sistemler. Elektik Mühendisliği. 7(7), 87-91

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research.

Fang, J., Su, H., & Xiao, Y. (2018). Will Artificial Intelligence Surpass Human Intelligence?. Available at SSRN 3173876.

Francis, T. (2019). What college presidents need to know about student success. Journal of Research on the College President.

Govindarajan, V., & Srivastava, A. (2020). What the shift to virtual learning could mean for the future of higher ed. Retrieved from Harvard Business Review: https://hbr.org/2020/03/what-the-shift-to-virtual-learning-could-mean-for-the-future-of-higher-ed

Griffin, D., & Denholm, J. (2020). This isn't the first global pandemic, and it won't be the last. Here's what we've learned from 4 others throughout history. Retrieved from The Conversation: https://theconversation.com/this-isnt-the-first-global-pandemic-and-it-wont-be-the-last-heres-what-weve-learned-from-4-others-throughout-history-136231 (August 25, 2023)

Holmes, W., Bialik, M. ve Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Boston, MA: Center for Curriculum Redesign.

Houlden, S., & Veletsianos, G. (2020). Coronavirus pushes universities to switch to online classes–but are they ready. The Conversation, 12, 923-945.

Johnson, L., Becker, S. A., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2016). NMC horizon report: 2016 higher education edition (pp. 1-50). The New Media Consortium.

Kergel, D., & Heidkamp, B. (2018). The Digital Turn in Higher Education Towards a Remix Culture and Collaborative Authorship. In D. Kergel, B. Heidkamp, P.K. Telléus, T. Rachwal, & S. Nowakowski (Eds), The Digital Turn in Higher Education (pp. 15-22). Wiesbaden: Springer VS.

Kodama, M. (2020). Digitally transforming work styles in an era of infectious disease. International Journal of Information Management.

Krishnamurthy, S. (2020). The future of business education: A commentary in the shadow of the Covid-19 pandemic. Journal of Business Research, 1-5.

Letheren, K., Bennetta , R. R., & Whittaker, L. (2020). Black, White or Grey Magic? Our future with artificial intelligence. Journal of Marketing Management, 216-232.

Lipko, K. (2016). Meet Jill Watson: Georgia Tech's first AI teaching assistant. Retrieved from Georgia Tech: https://pe.gatech.edu/blog/meet-jill-watson-georgia-techs-first-ai-teaching-assistant (August 20, 2023)

McKenzie, L. (2018). Pushing the boundaries of learning with AI. Inside Higher Education. Retrieved from https://www.insidehighered.com/digital-learning/article/ 2018/09/26/academics-push-expand-use-ai-higher-ed-teaching-and-learning

Meador, M. (2019, June 26). The future of work: Humans and machines. Retrieved from https://www.quantifiedcommunications.com/blog/future-of-work-humansand-machines

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. Teachers College Record. Teachers College Record.

Metz, C. (2019). DeepMind can now beat us at multiplayer games, too. New York Times. Retrieved from https://www.nytimes.com/2019/05/30/science/deep-mind-artificialintelligence.html

Mhlanga, D., & Moloi, T. (2020). COVID-19 and the Digital Transformation of Education: What Are We Learning on 4IR in South Africa?. Education Sciences, 10(7), 180.

Moodle. (2020). Online learning history. Retrieved from https://docs.moodle.org/23/en/Online_Learning_ History

Narai, Y. N. (2018). 21 Lessons for the 21st century (p. 265). New York, NY: Random House.

Norris, D. M., & Lefrere, P. (2011). Transformation through expeditionary change using online learning and competence-building technologies. Research in Learning Technology, 61-72.

Organisation for Economic Co-operation and Development (OECD). (2019). OECD skills outlook 2019: thriving in a digital world. Retrieved from OECD: https://read.oecd-ilibrary.org/education/oecd-skills-outlook-2019_df80bc12-en (August 25, 2023)

Pence, H. E. (2019). Artificial intelligence in higher education: New wine in old wineskins? Journal of Educational Technology Systems, 48(1), 5-13. doi:10.1177/0047239519865577

Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. Research and Practice in Technology Enhanced Learning, 12(1), 1-13.

Rejeb, A., Rejeb, K., Simske, S., Treiblmaier, H., & Zailani, S. (2022). The big picture on the internet of things and the smart city: a review of what we know and what we need to know. Internet of Things.

Rayome, A. D. (2018). 6 AI technologies changing project management. Retrieved from https://www.techrepublic.com/article/6-ai-technologies-changing-proj ect-management/

Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. EDUCAUSE review, 46(5), 30.

Setzekorn, K. (2020). Socioeconomics, diversity, and the politics of online education. Pensilvanya, USA: IGI Global publishing

Spector, J. M., & Ma, S. (2019). Inquiry and critical thinking skills for the next generation: from artificial intelligence back to human intelligence. Smart Learning Environments, 6(1), 1-11.

Sousa, M. J., Carmo, M., Gonçalves, A. C., Cruz, R., & Martins, J. M. (2019). Creating knowledge and entrepreneurial capacity for HE students with digital education methodologies: Differences in the perceptions of students and entrepreneurs. Journal of Business Research.

Taşcı, G., & Çelebi, M. (2020). Eğitimde yeni bir paradigma: "Yükseköğretimde yapay zekâ". OPUS International Journal of Society Researches, 16(29), 2346-2370

Tavares, M. C., Azevedo, G., & Marques, R. P. (2022). The challenges and opportunities of era 5.0 for a more humanistic and sustainable society—a literature review. Societies, 12(6), 149..

Tayşir, E. A. (2019). Bu Tez Nasıl Bitecek? Istanbul: İletişim.

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. Education and Information Technologie

Toprak, M. (2018). Ekonomilerin yükseliş ve düşüşü. In book of Türkiye Ekonomisi, Eskisehir Anadolu University Press, 177- 216.

Toprak, M., Bayraktar, Y., & Özyılmaz, A. (2020). The COVID-19 Pandemic and The Digital Transformation in Turkish Higher Education: An Evaluation From The Perspective of Industry 4.0 and Society 5.0. The COVID-19 Pandemic and Its Economic,Social, and Political Impacts, Istanbul University Press, 167-185.

UNESCO (2017). Data Revolution to measure equity in education for SDGs #CIES2017.3 Mar 2017. http://www.iiep.unesco.org/en/data-revolution-measure-equity-educationsdgs-cies2017-3886

UNESCO (2020b). Adverse consequences of school closures. Paris, France: UNESCO. Retrieved from https://en.unesco.org/covid19/educationresponse/consequences

UNESCO (2020c). Coronavirus deprives nearly 300 million students of their schooling. Paris, France: UNESCO. Retrieved from https://en.unesco.org/covid19/educationresponse

Venkatesh, V. (2020). Impacts of COVID-19: A research agenda to support people in their fight.
International Journal of Information Management.

Wang, L., & Wang, J. (2020). Research on Educational Evaluation in the Era of Artificial Intelligence. International Journal of Frontiers in Sociology, 2(3).

Zeide, E. (2019). Artificial intelligence in higher education: Applications, promise and perils, and ethical questions. Educause Review, 54(3).

Ziyu, Z. (2020). Distance learning during COVID-19 worsens educational inequality. Retrieved, from: https://news. cgtn. com.