International Journal of Digital Content Management (IJDCM)
Vol. 5, No. 10, Autumn & Winter 2025; P 163-196
dcm.atu.ac.ir
DOI: 10.22054/dcm.2024.78169.1234

ATU PRESS

ISSN: 2717-3305 eISSN: 2717-3313 Submit Date: 08-02-2024 Revise Date: 13-06-2024 Accept Date: 28-08-2024 Original Research

Analyzing the Dimensions of Digital Transformation in Education with the Approach of the Roadmap

Zahra Gholamzadeh — Ph.D. Candidate in Technology Management, Department of Technology Management, Science and Research Branch, Islamic Azad University, Tehran, Iran

Abbas Khamseh * — Associate Professor, Department of Industrial Management, Karaj Branch, Islamic Azad University, Karaj, Iran

Mohammadreza Parsanejad — Assistant Professor, Department of Economics and Progress Engineering, University of Science and Technology, Tehran, Iran

Abstract

Purpose: The purpose of the current research is to extract the components and dimensions of digital transformation and determine the levels and sequence of dimensions in Iran's education and upbringing, for the planning and implementation roadmap.

Method: This research has a mixed approach (qualitative-quantitative). The qualitative section was able to extract the components of digital transformation by searching for authentic Persian and English articles published in the last ten years. With the help of seven experts, the digital transformation components were classified into eight dimensions in the form of 109 identified sub-components using the ISM method. Dimension levels were determined by SSIM matrix calculations in the quantitative part. MICMAC software version 5.3.0 was used to calculate the impact of relationships.

* Corresponding Author: abbas.khamseh@kiau.ac.ir

How to Cite: Gholamzadeh, Z., Khamseh, A., Parsanejad, M. (2025). Analyzing the Dimensions of Digital Transformation in Education with the Approach of the Roadmap, International Journal of Digital Content Management (IJDCM), 5(10), 163-196. DOI: 10.22054/dcm.2024.78169.1234

Findings: Based on the opinion of experts and the results of ISM calculations, the identified dimensions including: institutional, education, technology, infrastructural, social, cultural and economic were placed in four levels.
Conclusion: According to experts, the institutional dimension, being placed at the fourth level, has the greatest impact on digital transformation in Iran's education. Therefore, it is one of the key dimensions to achieve digital educational transformation that is placed at the first level of the model. According to the results of ISM, the economic and cultural dimensions were placed at the third level. Also, in analyzing the impact of relationships between dimensions using MICMAC software, the results indicate that the institutional dimension has a significant impact on infrastructure development.

Keywords: Industry 5.0, educational digital transformation, personalization of education, artificial intelligence, Iran's education.

Introduction

By replacing Industry 5.0 with Industry 4.0 and placing humans at the center of innovation and finding the importance of human skills in interacting with robots, machines, computers, artificial intelligence, etc., planning for digital transformation in various fields, has become very important. To achieve long-term goals and plans, universities and all educational fields, including schools, must take full advantage of digital transformation (Carayannis et al., 2022).

Also, considering that nowadays the use of smart technologies such as: online educational platforms based on artificial intelligence, robots, the use of augmented reality and virtual reality in education, etc. make the learning space different, Therefore, careful planning to use these technologies in education seems very necessary. Since new digital technologies are developing day by day and due to their use in personalizing education, developing digital skills, and growing educational success of students (Carmona et al., 2023; Neborsky et al., 2020). Therefore, digital transformation and changing educational approaches based on this paradigm are one of the requirements of the future (Safonov et al., 2022).

The fundamental transformation document of Iran's education highlights the significance of acquiring new technologies and using information technology in schools. It is crucial to pay attention to the use of digital technologies in education, as shown by reviewing and studying the upstream documents in Iran. Based on the study of some research in the field of digital transformation in Iran's education, it can be concluded that the use of technology in the classroom is on the rise. Numerous researchers have pointed out the advantages of technology in improving the learning process, such as increasing student engagement and extending access to educational resources. The main obstacle to achieving digital transformation in Iran's education is that: there are challenges for accepting digital technologies in Iran's educational system. Problems include inadequate infrastructure, teacher and student resistance, and concerns about the impact on traditional teaching methods. The main challenge is the lack of a comprehensive and systematic approach to digital transformation in Iran's education (Keshmiri & Moradi, 2021).

The results of both domestic and foreign research indicate that industry 5.0 technologies have been studied as digital technologies in education and learning processes in certain countries. But a larger policy has been neglected to improve position in the digital transformation

(García-Peñalvo, 2021). Some countries have neglected to pay attention to the different dimensions and requirements of digital transformation, Therefore, we see scattered researches in the field of education in this regard.

After reviewing the documents, we have observed that there is an exaggerated focus on technology in digital transformation in Iran's education, while other important aspects are being neglected in governmental planning. In other words, the policies for digital transformation do not consider all the relevant dimensions. The social, cultural, and economic aspects are not being taken into account during the planning and execution of these policies. As a result of scattered planning, the outcomes in education have been weak despite advancements in certain technological fields. Therefore, our goal is to include all dimensions in Iran's digital transformation roadmap. We plan to identify the educational digital transformation criteria using the Meta synthesis methodology, categorize them with the help of experts, and finally determine the sequence of actions using Interpretive Structural Modeling (ISM). Our aim is to propose an integrated model in the form of a comprehensive roadmap. The innovation of the current research is paying attention to the comprehensive approach in the digital transformation roadmap of Iran's education and determining the priority of the sequence of dimensions in order to plan the implementation and reach the desired level.

Literature Review

National approach for the digital transformation of education

In the national documents of some countries, the importance of digital transformation in education has been noted as one of the trends affecting the future technologies.

Zhou et al. (2023), in their research, have pointed to the policy of the Chinese government in global cooperation to reach the desired level of digital transformation in the field of education and the change of educational techniques. The perspectives due to digital transformation has been considered as a factor for improving the quality of education and digital technologies have been considered as a factor for changing educational paradigms. Further, researchers have stated that: the digital transformation of education is a comprehensive campaign that includes reforming educational concepts, establishing network work infrastructure, building educational platforms, selecting educational resources, using digital tools, evaluating digital applications, training teachers, and deep

integration of digital technology in education. In China's National Action Plan and China's Education Modernization 2035, it is stated that: Integrating artificial intelligence, big data and other information technologies in deep teaching and learning, developing lifelong digital education and accelerating the construction of high-quality personalized learning systems; which everyone can access anytime and anywhere; It is considered as a digital transformation policy.

In the research of Rauseo et al. (2023), the importance of digital transformation in Swiss vocational schools has been mentioned. The researchers have stated that: the effects of this transformation process are not limited to the class level. Rather, it expands in different areas of the school, such as: equipment and technology, strategy and leadership, organization, staff and culture. In this study, 62 schools were evaluated and 202 school management members and 1739 teachers participated in this study. The results of the research showed that: dimensions related to digitalization, strategy and leadership as well as information technology educational support are better understood by school management members. Teachers consider the areas of digital competences, attitudes and culture to be more important.

In the research of McCarthyet al., (2023), digital transformation in education is considered very important for changing the system. Researchers have stated in their research process that: targeted organizations need a clear digital transformation framework. Therefore, by examining education, the researchers have come to the conclusion that: the education organization has been able to create transparency to some extent regarding the reason and necessity of digital transformation, But the changes required to reach the desired level have not been fully and accurately clarified. Also, in choosing the appropriate technologies and solutions for the schools of the country under study, appropriate solutions and the use of appropriate systems have also been mentioned.

Since the digital transformation in Iranian schools is very important due to its impact on education and the teaching-learning process, the researchers conducted in Iran have mostly focused on this field. In their research, Khanifar and Ghofrani (2019) listed attention to digital transformation and its realization as one of the main tasks of the Ministry of Education of Iran to achieve future goals at the global level. Researchers have acknowledged that: due to the effective position of education in society, the attitude and technological capability of teachers who are directly responsible for the task of educating students plays a significant

role in the achievement of the educational organization's goals for the development of society.

International approach for digital transformation in education

In recent years, the issue of digital transformation in international documents has also received attention. Digital transformation of education is a key agenda for many countries around the world. In order to achieve this transformation, national governments often develop road maps to guide the process. Research in this field shows that there is a wide range of national documents available, each of which has its own unique vision and strategies for digital transformation.

For example, the Digital Education Action Plan (2021-2027) is an EU policy initiative, which sets a common vision of high-quality, inclusive and accessible digital education in Europe. Policymakers, academics and researchers at national, EU and international levels and Member States of the Digital Age are invited to the action plan adopted on September 30, 2020. To present their plans for further cooperation at the European level in the field of digital education to address the challenges and opportunities of the COVID-19 pandemic. This center provides thirteen strategic actions to member countries.(Annette, 2021; Yanli & Danni, 2021).

In the documents of the UNESCO International Organization, the importance of digital transformation, frameworks of schools connected to the Internet and distance education are emphasized, and the necessity of paying attention to the four-fold approach: map, connection, financial and empowerment, to reach the desired level in schools has been emphasized. The school is based on integrated learning, allowing students to learn from home and access content and instructors remotely at any time. This access includes courses, support resources, technologies, media, and tools needed by individuals. This is one of the significant issues in digital transformation in schools(Sepúlveda, 2020).

Requirements and components of digital transformation

Many researches have pointed out the importance of content in digital transformation and the use of Industry 5.0 technologies to transform educational content and many articles have discussed the use of technologies such as augmented reality, virtual reality, big data, etc. in education (Engeness, 2018; Mahraz, et al., 2019; Mohamed Hashim et al., 2021). Some studies have also emphasized the importance of coordinating these technologies with the needs of the organization and choosing optimal

technologies (Heydari et al., 2023; Karbasi et al., 2022).

Personalization of education is another topic that has been mentioned in many articles. Some articles also mention the use of technologies such as artificial intelligence, big data and digital gamification to help personalize education. Also, by using digital transformation and its technologies, the learning process of each student can be personalized, including course content, study hours, teaching process, etc. (GİLLPATRİCK, 2020; Masoleh et al., 2023; Rof et al., 2020; Vindača et al., 2020).

Digital transformation strategies and the vision of the organization, mission of the organization, digital leadership, management procedures, etc., have been considered and reviewed (Balyer & Öz, 2018; Mahmoodi et al., 2023; McCarthyet al., 2023; Shirazi et al., 2021). The organization's digital values, digital agility and open innovation, networking with stakeholders, digital literacy and competencies of employees and human resources are very important (Heydari et al., 2023). Some researchers have also emphasized the importance of developing a clear vision and strategy for digital transformation in schools. Several articles have also measured the level of digital maturity in the organization (Baihaqy & Subriadi, 2023; Benavides et al., 2020; Rauseo et al., 2023; Yehya, 2021; Zhu et al., 2021).

Transformation in processes with the help of digital tools and technologies is another issue that can be effective in digitizing and increasing productivity. The use of integrated systems such as automation, educational platforms and administrative systems can be effective in school management and improving its educational management. Researches results have shown that with the introduction of integrated resource management systems, all digital processes and trends can be integrated and by connecting information, the process of evaluating students, planning human resources and teaching resources, etc., can be made automatic(Furjan, Strahonja, & Tomičić-Pupek, 2018; Kane et al., 2015; Rodríguez-Abitia & Bribiesca-Correa, 2021).

Various articles have dealt with the status of high-speed Internet access, and the necessary equipment for digital education, such as laptops, mobile phones, tablets, smart boards, etc., and also have considered the availability of the necessary infrastructure, availability of technological equipment in schools (Kovalchuk et al., 2022; García-Peñalvo, 2021; Sepulveda, 2020).

Students' qualifications and competencies, social and cultural skills, and their ability to communicate are also very important in realizing digital

competencies (Oliveira and de Souza, 2022; bin Nordin et al., 2022; Kirschner & De Bruyckere, 2017). A digital learning environment and a smart classroom are other aspects of digital transformation. Researchers have investigated the integration of Artificial Intelligence(AI) and some digital technologies with the classroom, some articles have referred to the use of artificial intelligence technology to facilitate students' learning and to design a smart classroom (Peng & Wang, 2022; Bygstad et al.; 2022; Lolic et al., 2022). To create a smart classroom, and personalize education, infrastructures such as network, hardware and software equipment, data security platforms, data Warehouse, documents, and digitization of data access are essential requirements (Grosseck et al., 2020; Balyer and Oz, 2018).

Changing approaches, methods, and organizational culture play an important role in optimizing the proper use of digital transformation capacities and digital acceptance (Tavakoli Rad and Zargaran Khozani, 2022; Shirazi et al., 2021; Modaresi et al., 2023).Cultural dimensions, including target orientation, collaborative decision-making, structured leadership, common and formal vision, and innovation culture, are important issues of digital transformation. Teachers' belief in the necessity of using digital transformation technologies in education, and its impact on learning, is very important. Some articles consider the cause of the backwardness of the education field in the effective use of digital technologies to be the factor of organizational culture, and the non-participation of managers, employees, and teachers in digital transformation programs is one of the important factors in the failure of these programs (Rodriguez Abita and Briviesca Correa, 2021; Elkordy & Iovinelli, 2021; Zhu, 2015). Digital learning self-efficacy, moral values, individual skills and readiness for change in the digitalization process are also important (Gkrimpizi et al., 2023; Morze & Strutynska, 2021; Gerlakh, 2021; Hammer, 2020; Balyer and Oz, 2018).

Economic aspects are also significant in digital transformation (Heydari et al., 2022). Digital transformation, by reducing costs, improving economic factors, and providing educational services, creates is important. In addition, another aspect of digital transformation is the costs of digital technologies, modernization of educational systems, resource limitations, internal and external financing channels, and economic barriers to digital transformation (Fernández et al., 2023; Mohammad Hashim et al., 2021; Demchenko et al., 2021; Voronin et al., 2020; Torres-Ruiz & Moreno-Ibarra, 2019; Seres et al., 2018).

Institutions such as the government is important for the policy-making of macro goals and operational plans. Digital governance in organizations and educational institutions is also one of the important components in the implementation of digital transformation, which the institutional role and government regulations and policies are very important in its advancement (AlMalki & Durugbo, 2023; Perm, 2022; Valdés et al., 2021; Benavides et al., 2020). Restrictions, rules, and government regulation are among the effective factors in the progress of digital transformation (Rodriguez Abita and Bribiesca Correa, 2021). The government's participatory policies in the education sector and educational institutions are also very important. Using of the capacity of technology companies, using the capacity of public participation, and establishing connections between influential institutions, are important factors of digital governance and policy-making (Fernández et al., 2023). Funding and government support play a significant role in removing barriers to digital transformation (Gikirimpizi et al., 2023; van der Vlies, 2020; Nouri et al., 2019).

The application of new digital technologies in education is considered one of the important components of digital transformation, so today, these technologies have been able to change pedagogy and teaching methods based on the personalization of education (Fernández et al., 2023; Quaicoe et al., 2023). Moreover, in the research conducted on the role of digital transformation in education with a pedagogical approach, active learning, game-based digital learning, digital talent identification, reverse learning, etc. (Yang, 2023; Oliveira and De Souza, 2022; Balaban et al., 2018; Balyer and Oz, 2018). The use of new technologies in the smartening of the classroom and the learning process is one of the changes caused by the digital transformation in the field of education; In the research mentioned to creating a digital educational environment, digital interactions, digital users, online class, virtual class, planning a digital educational ecosystem, etc. (Shenkoya Kim, 2023; Visvizio et al., 2023; Hashim et al., 2022; Rof et al., 2022; Privalov & Bogatyreva, 2022; Tátrai, Szűcs, 2021; Rodriguez Abita and Briviesca Correa, 2021; Keshmiri & Moradi, 2021). Other important aspects of digital transformation in education are content transformation, curriculum transformation, and the integrated use of digital technologies in the field of educational content (Giang et al., 2021; Begicevic Redjep, 2021; Kassymova et al., 2020). Digital evaluation using new digital technologies, digital educational innovation, and the use of artificial intelligence in the platforms of teachers and students, etc., are important (Grasek et al., 2020; Firdaus et al., 2023).

Social values and stimulus can play a great role in digital transformation. It is very important to pay attention to building social capital in digital transformation. Social innovation, as the starting point of social and public benefit, which supports people in organizations, communities, and society, is also considered an important factor (Kaputa et al., 2022; Kazakova, 2020; Santos et al., 2019). Strengthening social empathy, social communication, and using digital platforms for personal communication are among other social issues related to digital transformation (Oliveira and de Souza, 2022; Morse and Strutinska, 2021; Kapur et al., 2018; Balyre and Oz, 2018). Furthermore, digital transformation, through education, affects social development, educational justice, and poverty alleviation, etc. (Bozkurt & Sharma, 2022; Kapur et al., 2018).

Therefore, according to the above research, it can be seen that the digital transformation in education is not a purely technological approach, and achieving its desired level requires a comprehensive approach in various fields, the components of which must be planned and implemented purposefully.

Method

This research has used Interpretive Structural Modeling (ISM) to formulate the dimensions of digital transformation and analyze its relationships. The introduced ISM by Warfield (1975-1976) is an interactive learning process in which a set of different and related elements and dimensions will be structured in a comprehensive systematic model. In other words, Interpretive Structural Modeling is an interactive learning process, which, through the interpretation of the expert's opinions, determines the relationship between the dimensions of a problem, specifies the levels and sequence of each of them. (Figure 1).

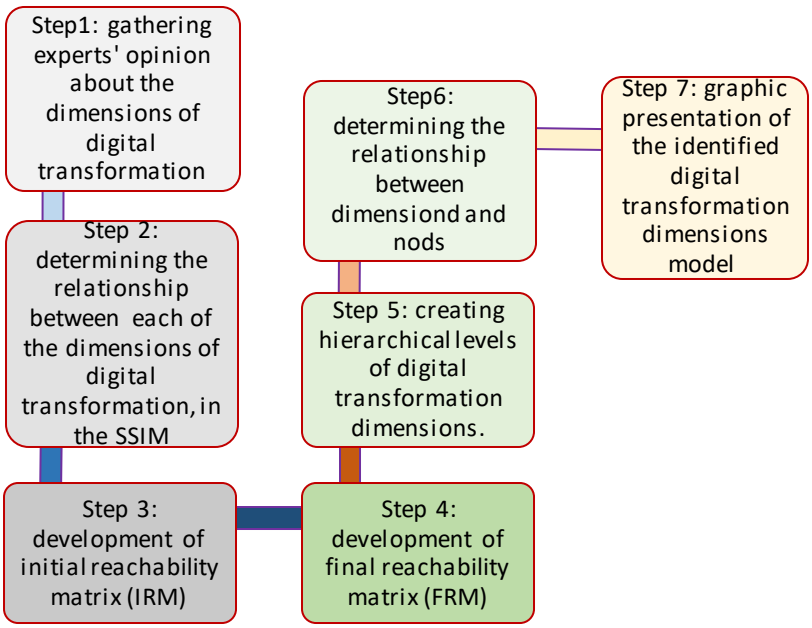

Figure 1. Process of the ISM method

The present study has a mixed approach (qualitative-quantitative), and in the qualitative part, the research components have been extracted by reviewing the research literature and library review of authoritative Persian and English articles published in the last 10 years (The article was founded from Google Scholar, Science Direct, Springer, ERIC, ELSEVIER, RESEARCH GATE, NoorMags, SID and Magiran databases). The reason for choosing this time interval was the quality of published articles, the frequency of research on digital transformation, and the targeted focus of research in the field of education. We chose the meta-synthesis approach for this section. The main question of this research is: "What are the main indicators of digital transformation in education?"

In order to conduct research on the objectives and main problem, the following keywords have been searched: "digital transformation dimensions", "digital leadership", "digital maturity", "digital transformation in education", "educational digital transformation", "digital innovation", "digital innovation roadmap", "digital readiness", "digital transformation ecosystem", and "digital leadership". A total of 659 articles were reviewed, and 65 final articles were selected (appendix1). Kappa coefficient utilized for the reliability assessing of this research the with

SPSS software. The calculations indicated a value of 0.616 and Sig 0.03(less than 0.05), indicating the research has good internal reliability and good agreement. Then, 109 components were extracted in the field of digital transformation in education, which were sorted and categorized into 8 dimensions based on the opinions of experts with interview and interactive conversation. In the quantitative part of the research, to determine the sequence of effective dimensions of the digital transformation roadmap in Iran's education, 8 dimensions identified by the ISM method (technology, infrastructure, cultural, organizational, education, social, economic, and institutional) were measured by questionnaire. In this research, the opinions of seven experts, who were selected by Snowball sampling were received. The specialized information of the experts is shown in Table 1.

This research is practical in terms of purpose, and its results have been examined regarding the sequence of dimensions of digital transformation in Iran's education. The main purpose of the research is to respond to the executive and the implementation sequence of every aspect of digital transformation in Iran's education. In this research, when the indices were categorized in the form of 8 dimensions identified by experts (Table 2), the relationships between the research factors were determined by experts, in pairs, by applying ISM. Then, by determining the relationships between the variables, and converting the relationship symbols of the SSIM matrix to zero and one, we reached the reachability matrix, finally, due to the internal consistency between the components, the Final Reachability Matrix will be specified to determine the specified component levels and will be achieved to leveling and interactive network, of effective dimensions on digital transformation in Iran's education.

Table 1. Characteristics of experts

Expertise	Job, And Work Experience	Education	Tenure (Years)
Policy making in education	A member of directors board of the digital technology Knowledge enterprise - university and school teacher	Ph.D.	24
Artificial intelligence	CEO of Digital Platforms Knowledge Enterprise - Faculty member of the Research Institute for Information and	Ph.D.	19

	Communication Technology - university teacher		
Policy making in education	Member of the editorial board of Iranian education textbooks, university and school teacher	Ph.D.	23
strategic planning	Work experience in the Ministry of Education of Iran - University teacher - policy making in education	Ph.D.	30
New technologies researcher	Designing a strategic plan in the field of digital transformation in Iran - University teacher	Ph.D.	10
Management of technology – decision-making	Member of the technology lab design team at the school - school principal	Masters	20
Management of technology – decision-making	School principal	Masters	21

Table 2. Dimensions of digital transformation in education

Dimension	Indicator	Researcher/ Year	The frequency of articles
Technology	Transformation in content - digital technologies of gamification-Integration of augmented reality, virtual reality, Internet of Things, etc. technologies in teaching-The use of artificial intelligence and data mining in the personalization of education- Using digital technologies and platforms in virtual education- Educational platforms for personalized courses- Platforms for teachers- Using technology in educational digital transformation	Oliveira & de SOUZA, (2022)- Mohamed Hashim, et al., (2022)-Bozkurt & Sharma, (2022)- GİLLPATRİCK, (2020)- Rof et al., (2022)- Morze & Strutynska, (2021)- Vindača et al., (2020)- Mahraz et al., (2019)- Engeness, (2018)-Balyer & Öz, (2018)- Tavakoli Rad and Zargaran Khozani, (2022) - Karbasi et al., (2022) - Heydari et al., (2022)	13

Organization	Digital transformation policies- Digital transformation missions- Digital transformation strategies- The vision of the organization- Management procedures- Digital decision-making processes- Digital maturity- Digital leadership- Organizational processes and resource integration- Digital processes- Competencies of a digital CEO- HR digital readiness- Organization's digital programs for stakeholders- Value map of digitalization for the organization- Open digital innovation- Networking with stakeholders- Digital literacy- Digital competencies of employees- Structure and reduction of organizational hierarchy	Rauseo et al., (2023) - McCarthy, et al. (2023)- Baihaqy & Subriadi, (2023)- Oliveira & de SOUZA, (2022)- Hashim et al., (2022)- Yehya, (2021)- Rodríguez-Abitia & Bribiesca-Correa, (2021)- X. Zhu, Ge, & Wang, (2021)-Benavides, et al, (2020)- Tomičić-Pupek, (2018)- Balyer & Öz, (2018)- Pihir, et al, (2018)- Kane, et al,.(2015)- Heiydari et al., (2022)- Mahmoudi, et al., (2022)- Shirazi, et al., (2021)	16
Infrastructure	Equipment- High-speed internet, mobile, tablet, and laptop- Educational platforms for teachers and students- Smart classroom equipment-Network infrastructure, data security- Data warehouse, documentation, and digitization of data access	Kovalchuk et al., (2022) -Oliveira & de SOUZA, (2022)- bin Nordin et al., (2022)- Bygstad, et al., (2022)- Lolic, et al, (2022)- Yuan, (2022)- Peng & Wang, (2022)- García-Peñalvo, (2021)-Grosseck, et al., (2020)- Sepúlveda, (2020)- Balyer & Öz, (2018)- Kirschner & De Bruyckere, (2017)	12

Cultural	Interactive culture- Attitudes and beliefs- Methods and procedures- Goal orientation- Collaborative decision making- Innovation orientation- Structured leadership- Supportive leadership- Shared and official vision, culture of innovation- Digital experiences of users- Digital reception- Digital learning self-efficacy- Moral Values	Gkrimpizi, et al., (2023)- Gerlakh,.et al. (2021)-Rodríguez-Abitia & Bribiesca-Correa, (2021) - Elkordy & Iovinelli, (2021)- Morze & Strutynska, (2021)- Hammer, (2020)- Balyer & Öz, (2018)- C. Zhu, (2015)- Tavakoli Rad and Zargaran Khozani, (2022) – Shirazi et al., (2021) - Modaresi et al., (2023)	11
Economic	Cost management- Training of human resources with digital skills- Costs of technology and modernization of educational systems- external financing - Domestic financing- Productivity of digital education - digital economy- Achievements of digital innovations-Costs of digitalization of education	Fernández, et al, (2023)- Mohamed Hashim, et al., (2022)-Mohamed Hashim, et al., (2021) - Demchenko, et al., (2021)- Voronin, et al., (2020)- Torres et al. (2019)-Seres, Pavlicevic, & Tumbas, (2018)- Heydari et al., (2022)	8
Institutional	Government policies- The supportive role of the government- people's participation- Views of different stakeholders in the application of digital technologies- Digital norms, ethics, and policies- Partnership support program between companies and schools- Public and private sector participation- programs to reduce the digital divide-State legal restrictions- Governance of digital transformation- Government regulation and regulation- Digital popularization-Government support in the field of digitalization of education	Gkrimpizi, et al., (2023)-AlMalki & Durugbo, (2023)- Fernández, et al, (2023)- Prem et al, (2022)-Valdés & Cerdá Suárez, (2021)- Rodríguez-Abitia & Bribiesca-Correa, (2021) - Benavides, et al,.(2020)- van der Vlies, (2020)- Nouri et al. (2019)	9

Education	Digital blended learning- Digital educational innovation- Digital evaluation- Curriculum based on educational digital transformation strategy- Personalized training- Specialized training based on technology- Reverse education based on digital technology- Virtual educational design models- Educational pedagogy- Integrating environmental and work experiences with the digital curriculum- Creating competency-based curricula and digital educational content- Project-based learning- Context-oriented education- Smart class- Digital space- Digital think tank- Digital interactions- Digital users- Online class- Virtual class- Digital educational ecosystem- Interactive digital content- value-based digital content- Active learning- Game-based digital learning- Digital talent identification- Digital problem-based learning- Interactive digital learning- Project-based digital learning- Digitalization of student learning analysis- Integration of digital technologies in educational progress	Fernández, et al, (2023)-Quaicoe, et al., (2023)- Shenkoya Kim, (2023)- Visvizi,et al,. (2023)- Yang, (2023)-Firdaus, et al, (2023)-Oliveira & de SOUZA, (2022)-Hashim, et al., (2022)-Rof, et al, (2022)-Privalov & Bogatyreva, (2022)- Giang et al, (2021)- Redjep et al, (2021)-Tátrai, et al. (2021)-Grosseck, et al., (2020)- Kassymova et al., (2020)-Balyer & Öz, (2018)-Balaban et al, (2018)- Keshmiri and Moradi, (2021)	18
Social	Social values driving digital innovation- Social innovation- Building digital social capital- Digital interactions- Digital social communication- Digital personal communication in education- Digital social development- Native digital social needs of each generation- Digital social media	Oliveira & de SOUZA, (2022)-Bozkurt & Sharma, (2022)-Kaputa, et al., (2022)-Hashim, et al., (2022)-Morze & Strutynska, (2021)-Kazakova, (2020)-Santos, et al., (2019)-Kapur, et al., (2018)-Balyer & Öz, (2018)	9

Findings

After conducting the research, experts categorized the effective indices on digital transformation in education into 8 components or dimensions as detailed in Table 3.

Table 3. Digital transformation indices in education

Dimension	Acronym
Cultural	C1
Technology	C2
Infrastructure	C3
Organizational	C4
Economic	C5
Institutional	C6
Education	C7
Social	C8

In this research, to obtain the SSIM matrix, a pairwise comparison questionnaire was provided to the experts, and it was completed based on the following relationships:

1: one-way communication from i to j.
-1: one-way communication from j to i.
0: there is no relationship between i and j.
2: There is a two-way relationship between i and j.

In the completed questionnaires, for the cells where there was disagreement, experts were interviewed, and a consensus of opinions was obtained, the results of which are displayed in Table 4.

Table 4. Structural Self-Interaction Matrix (SSIM)

C-8	C-7	C-6	C-5	C-4	C-3	C-2	C-1	
1	1	-1	2	1	0	0		C-1
0	1	0	-1	0	0		0	C-2
0	1	0	-1	0		0	0	C-3
0	1	0	0		0	0	-1	C-4
0	0	-1		0	1	1	2	C-5
0	0		1	0	0	0	1	C-6
-1		0	0	-1	-1	-1	-1	C-7
	1	0	0	0	0	0	-1	C-8

To create the initial reachability matrix, the table houses' numbers were converted to 0, 1 based on their conversion. In this way, the houses with numbers 1 and 2 received the number 1, while the houses with numbers 0 and 1 received the number 0. Table 5 displays the matrix that has been

created.

Table 5. Initial Reachability Matrix (IRM)

C-8	C-7	C-6	C-5	C-4	C-3	C-2	C-1	
1	1	0	1	1	0	0	0	C-1
0	1	0	0	0	0	0	0	C-2
0	1	0	0	0	0	0	0	C-3
0	1	0	0	0	0	0	0	C-4
0	0	0	0	0	1	1	1	C-5
0	0	0	1	0	0	0	1	C-6
0	0	0	0	0	0	0	0	C-7
0	1	0	0	0	0	0	0	C-8

After forming the initial access matrix, transferability relationships between the variables were determined and the final matrix was obtained. The final reachability matrix is formed in such a way that each of r_{ij} arrays is equal to one when a r_i element accesses a r_j element with any length. Otherwise, it is equal to zero. Using Euler's theory, we add the adjacency matrix to the unit matrix to obtain the reachability matrix. If the elements of the matrix remain unchanged, we raise this matrix to the power of n. The following formula shows the method of determining the reachability matrix using the adjacency matrix:

The first stage I+A: and the second stage: $M=(A+I)^n$

A matrix is the initial reachability matrix, I is the identity matrix, and M is the final reachability matrix. The basis is the operation of exponentiation of the matrix that follows the Boolean rule: 1x1=1 and 1+1=1, the result of the calculations can be seen in table number 6. In the final matrix, the sum of the row numbers, influence, and column numbers also show dependence, which is displayed in Table 6.

Table 6. Final Reachability Matrix (FRM)

Convergence	**C-8**	**C-7**	**C-6**	**C-5**	**C-4**	**C-3**	**C-2**	**C-1**	
7	1	1	0	1	1	1	1	1	**C-1**
2	0	1	0	0	0	0	1	0	**C-2**
2	0	1	0	0	0	1	0	0	**C-3**
2	0	1	0	0	1	0	0	0	**C-4**
7	1	1	0	1	1	1	1	1	**C-5**
8	1	1	1	1	1	1	1	1	**C-6**
1	0	1	0	0	0	0	0	0	**C-7**
2	1	1	0	0	0	0	0	0	**C-8**
	4	8	1	3	4	4	4	3	**Dependency**

To determine the levels of each dimension of the research, it is necessary to determine its output and input set in the next step. The output set of a variable includes the components of the system that originate from it. The input set of a variable includes the components of the system that lead to that component. The sharing of these two sets is determined after determining two sets of input and output. The first variable with an equal share of two sets of input and output will be eliminated from the calculations. Therefore, the first level's elements will have the most impact in the model. The results of the calculations to determine the levels are displayed in tables No. 7, 8, 9, 10 and 11.

Table 7. Determining the levels of level one variables

Subscription collection	Preliminary collection	Received collection	NO	itn: 1
C-1C-5	C-1C-5C-6	C-1C-2C-3C-4C-5C-7C-8	1	
C-2	C-1C-2C-5C-6	C-2C-7	2	
C-3	C-1C-3C-5C-6	C-3C-7	3	
C-4	C-1C-4C-5C-6	C-4C-7	4	
C-1C-5	C-1C-5C-6	C-1C-2C-3C-4C-5C-7C-8	5	
C-6	C-6	C-1C-2C-3C-4C-5C-6C-7C-8	6	
C-7	C-1C-2C-3C-4C-5C-6C-7C-8	C-7	7	Exsit > Level 1
C-8	C-1C-5C-6C-8	C-7C-8	8	

Table 8. Determining the levels of level two variables

Subscription collection	Preliminary collection	Received collection	NO	itn: 2
C-1C-5	C-1C-5C-6	C-1C-2C-3C-4C-5C-8	1	
C-2	C-1C-2C-5C-6	C-2	2	Exsit > Level 2
C-3	C-1C-3C-5C-6	C-3	3	Exsit > Level 2
C-4	C-1C-4C-5C-6	C-4	4	Exsit > Level 2
C-1C-5	C-1C-5C-6	C-1C-2C-3C-4C-5C-8	5	
C-6	C-6	C-1C-2C-3C-4C-5C-6C-8	6	
C-8	C-1C-5C-6C-8	C-8	8	Exsit > Level 2

Table 9. Determining the levels of level three variables

Subscription collection	Preliminary collection	Received collection	NO	itn: 3
C-1C-5	C-1C-5C-6	C-1C-5	1	Exsit > Level 3
C-1C-5	C-1C-5C-6	C-1C-5	5	Exsit > Level 3
C-6	C-6	C-1C-5C-6	6	

Table 10. Determining the levels of level four variables

Subscription collection	Preliminary collection	Received collection	NO	itn: 4
C-6	C-6	C-6	6	Exsit > Level 4

Table 11. Levels of dimensions of digital transformation in education

			C-7	Level 1
C-8	C-4	C-3	C-2	Level 2
		C-5	C-1	Level 3
			C-6	Level 4

Based on the results obtained from the above calculations, the final model of the research is displayed in the form of Figure 2. The institutional dimension being placed at level 4 will have the most significant impact on digital transformation in Iran's education, as can be seen. At level one, educational transformation is the most effective dimension.

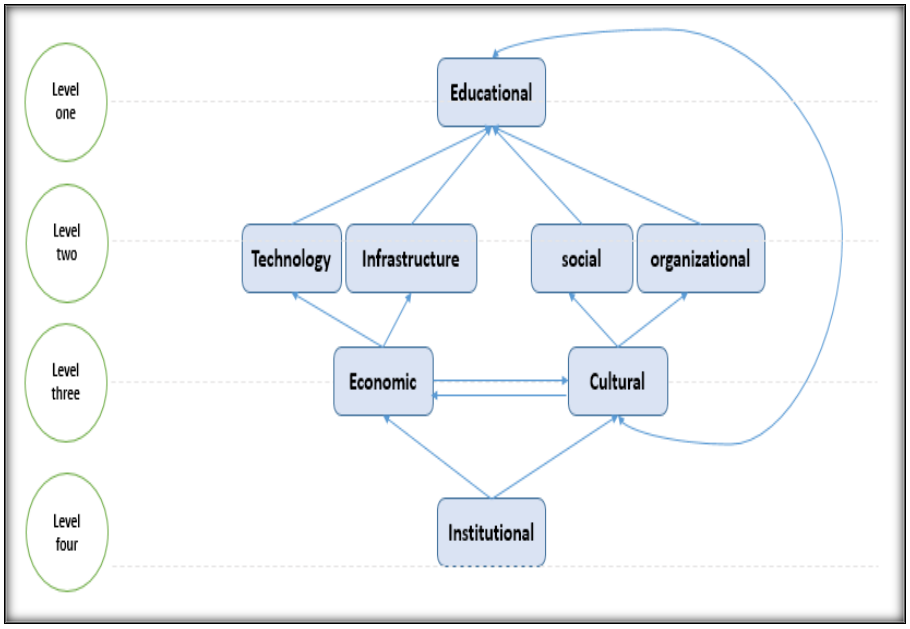

Figure 2. Model of digital transformation roadmap in education

MICMAC Analysis

MICMAC analysis is used to measure variable strength. Variables with high relationship intensity receive the number 3, medium relationship the number 2, and low relationship the number 1. In each house of the matrix, the variables that have the potential to influence them are entered with P. In this research, MICMAC software version 5.3.0 was used for MICMAC analysis. Experts have evaluated the impact of the connections between variables. The final matrix was calculated in houses with discrepancies based on frequency, and the results are displayed in Table 12 and Figure 3.

In Figure 3, the left and upper areas are independent variables that have a very high impact and influence and are considered as driving variables. Variable C6 (institutional) is considered to be the driver with the highest impact, as can be seen in Figure 3. Government laws, policies, and goals play a significant role in the digital transformation of education in Iran. The institution variable C5 (economic), which is close to the border of the upper right area, can have an impact on the digital transformation in education and act as a strong driver, also this variable has a high influence of government policies. The upper right area indicates linked variables that somehow have a high effect on other variables and they themselves have high effectiveness, so changes in them can lead to changes in the entire

system. As can be seen, the variable C1 (cultural) is located at the border of this section. Therefore, it can affect the path of organizational and social developments, and cultural dimensions are also influenced by policies, goals and laws, especially government laws.

The lower right area shows variables that have very high dependence and low influence. As can be seen, variable C7 (educational) is placed at this level with the highest dependence on other variables and the requirement of educational transformation is primarily organizational transformation and cultural, infrastructural and technological transformation. Variable C2 (technology) is also highly dependent, under the influence of economic and institutional development. Variable C2 (technology) is also highly dependent, under the influence of economic and institutional development. Variable C3 (infrastructure) and C4 (organization) are at the medium level of dependence, and variable C8 (social) is located in the left and lower region and it is part of the autonomous variables that will have little effect on the model.

Table 12. The final matrix of the impact intensity of the variables

.	1 : C1	2 : C2	3 : C3	4 : C4	5 : C5	6 : C6	7 : C7	8 : C8
1 : C1	0	2	1	3	3	0	2	1
2 : C2	0	0	0	0	0	0	2	0
3 : C3	0	2	0	0	0	0	2	0
4 : C4	1	2	0	0	0	0	3	P
5 : C5	2	3	3	2	0	0	2	1
6 : C6	3	3	3	2	3	0	2	1
7 : C7	1	0	0	0	0	0	0	0
8 : C8	0	0	0	0	0	0	1	0

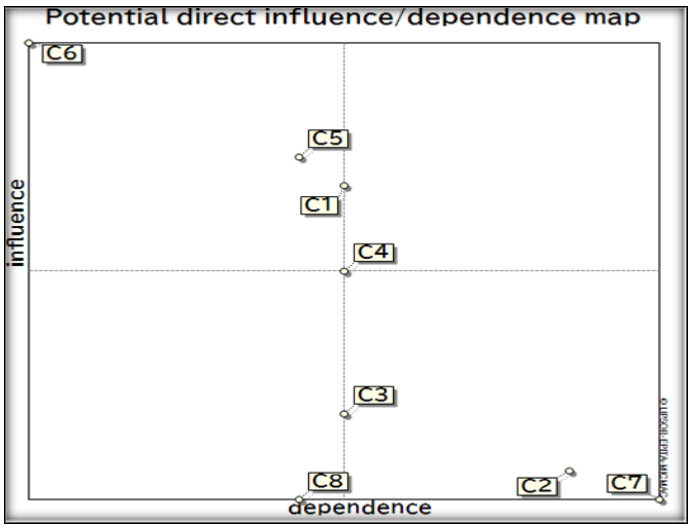

Figure 3. MICMAC matrix of influence intensity and dependence of digital transformation dimensions

In MICMAC analysis, results showed that the infrastructural dimension is greatly affected by the economic dimension due to need to provide financial resources (Figure 4). Also educational dimension is affected by institutional dimension (Figure 5).

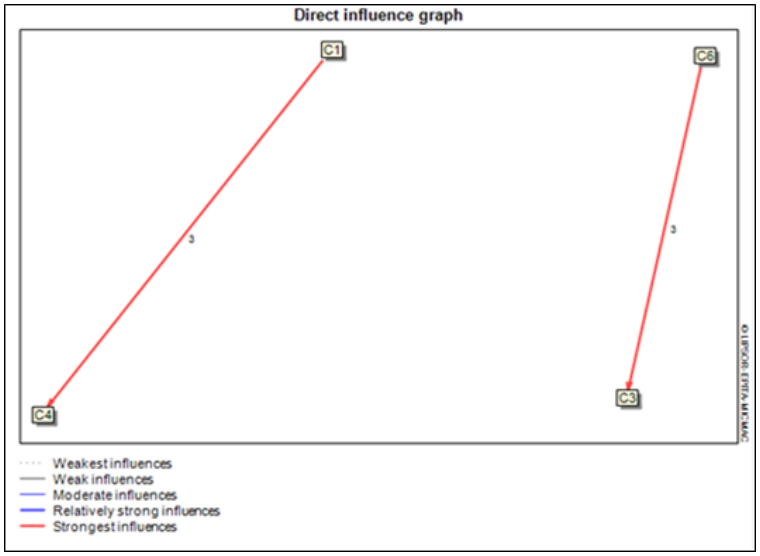

Figure 4. Diagram of the most direct effects of dimensions

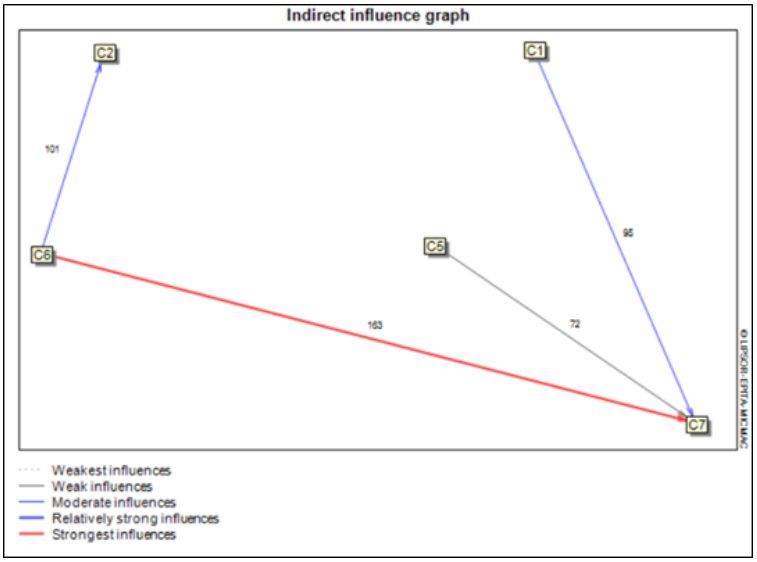

Figure 5. Diagram of the most indirect effects of dimensions

Conclusion

In the present study, the components of digital transformation were searched in the research literature and the extracted components were categorized by experts in the form of 8 dimensions for digital transformation roadmap in Iran's education. This involved categorizing the components into eight dimensions, namely technology, culture, organization, social, economic, institutional, infrastructural, and education. The study found that the institutional dimension strongly influences other dimensions of digital transformation in Iran's education. This finding is supported by other researchers (McCarthy et al., 2023; Asl & Kiamehr, 2023; Sahraei, 2023). The government can accelerate digital transformation through financial support, policy-making, legislation, and regulation (Yuan et al., 2023; Sepúlveda, 2020). Additionally, the government can leverage its resources to promote educational digital transformation and the integration of new technologies, such as artificial intelligence, by fostering collaboration between technology and knowledge-based companies and the education sector (Alenezi, 2023; Khanifar and Ghofrani, 2019).

As can be seen in the results of the ISM matrix and the analysis of MICMAC, the economic dimension plays an important role by being placed at the third level and as a connecting component. Since in order to reach the desired level of digital transformation in education, the economic

aspect is also very important and acts as a strong driver. If the economic costs of digital innovations, the achievements of digitalization of education and school management are not estimated correctly, it will slow down the path of movement. Also, the economic dimension has a great impact on infrastructure development and technology development, which the government can act as a stimulus for these dimensions with the right policy (Alenezi, 2023; Fernández et al., 2023).

Technological, organizational, social and infrastructural dimensions are also very important in digital transformation (Edelmann, et al., 2023; Reis & Melão, 2023). Therefore, these dimensions cannot be ignored in the digital transformation in education. As it was obtained from the results of this research in ISM and MICMAC analysis, these dimensions as dependent dimensions are influenced by institutional policies, cultural and economic developments. The organizational dimension, as the most effective factor in the digital educational transformation, requires a change in digital policy and vision, digital senior management, changes in processes and its digitization, and providing human resources with digital qualifications in the organization. If the components of digital transformation are realized in an educational organization or academic institution, it will be possible to achieve educational digital transformation at a higher quality level (Alenezi, 2023; Hannan, 2023).

The infrastructural dimension, requires the provision of network, high-speed internet, hardware and equipment required for digital technologies, personal laptops and tablets, and other digital education equipment. Therefore, due to the importance of its financial aspects, this dimension is affected by the economic dimension and the supporting role of the government in providing the required infrastructure in this sector is also significant (Timotheou et al., 2023).

The results of this research showed that the educational dimension, is the most dependent dimension in the field of digital transformation in Iran's education, that many components play a role in the realization of educational digital transformation, among these things, we can mention: support of families, digital needs of students, changes in the curriculum based on digitization and personalization of education, etc. (Alenezi, 2023;Hatami et al ,2023).

Therefore, according to the analysis of MICMAC, it can be concluded that in order to reach the optimal level of educational transformation, such as: personalization of education, creation of smart classrooms, improvement of the level of digital learning based on artificial intelligence,

etc., Iran's education needs policy and It is a serious support of the government and the government's role in developing the digital technologies needed to improve the learning process is crucial.

Therefore, the digital transformation in Iran's education requires comprehensive attention to institutional, cultural, economic, social, organizational, infrastructure, technological and educational dimensions and paying attention to the levels and sequence of each of the dimensions and executive planning for the realization of the components of each dimension is very important and is considered a factor for success in achieving the desired level of digital transformation in education.

CONFLICT OF INTEREST: The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

References

Alenezi, M. (2023). Digital Learning and Digital Institution in Higher Education. *Education Sciences, 13*(1), 88.

AlMalki, H. A., & Durugbo, C. M. (2023). Evaluating critical institutional factors of Industry 4.0 for education reform. Technological Forecasting and Social Change, 188, 122327.

Annette, L. (2021). A digital learning future. *Impact, 2021*(3), 4-5.

Aras, A., & Büyüközkan, G. (2023). Digital Transformation Journey Guidance: A Holistic Digital Maturity Model Based on a Systematic Literature Review. *Systems, 11*(4), 213.

Asl, S. Z., & Kiamehr, M. (2023). The Effect of Ethics-Oriented Leadership and Political Skills of Digital Organizational Developments on Accounting Students' Perceptions. *International Journal of Digital Content Management, 4*(2), 1-20.

Balaban, I., Redjep, N. B., & Calopa, M. K. (2018). The Analysis of Digital Maturity of Schools in Croatia. International Journal of Emerging Technologies in Learning, 13(6).

Begicevic Redjep, N., Balaban, I., & Zugec, B. (2021). Assessing digital maturity of schools: framework and instrument. Technology, Pedagogy and Education, 30(5), 643-658.

Baihaqy, A., & Subriadi, A. P. (2023). Development of Digital Transformation Maturity Measurements: A Systematic Literature Review. *Journal of Nonformal Education, 9*(1).

Balyer, A., & Öz, Ö. (2018). Academicians' Views on Digital Transformation in Education. *International Online Journal of Education and Teaching, 5*(4), 809-830.

Benavides, L. M. C., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors, 20*(11), 3291.

bin Nordin, M. N., Maidin, S. S., Rajoo, M., Mahmod, M., Jani, W. N. F. A., Yusoh, M. P., . . . Mosbiran, N. F. (2022). International Frameworks For 21st Century Competences: Comparative Education. resmilitaris, 12(2), 7332-7344.

Bozkurt, A., & Sharma, R. C. (2022). Digital transformation and the way we (mis) interpret technology. Asian Journal of Distance Education, 17(1).

Broo, D. G., Kaynak, O., & Sait, S. M. (2022). Rethinking engineering education at the age of industry 5.0. *Journal of Industrial Information Integration, 25*, 100311.

Bygstad, B., Øvrelid, E., Ludvigsen, S., & Dæhlen, M. (2022). From dual digitalization to digital learning space: Exploring the digital transformation of higher education. Computers & Education, 182, 104463.

Carayannis, E. G., & Morawska-Jancelewicz, J. (2022). The futures of Europe: Society 5.0 and Industry 5.0 as driving forces of future universities. Journal of the Knowledge Economy, 1-27.

Carmona, M. E. D. P., Carmona, H. D. P., & Calero, E. M. C. (2023). Digital Transformation and Education. A Technical Point of View.

Demchenko, M. V., Gulieva, M. E., Larina, T. V., & Simaeva, E. P. (2021). Digital Transformation of Legal Education: Problems, Risks and Prospects. European Journal of Contemporary Education, 10(2), 297-307.

Edelmann, N., Mergel, I., & Lampoltshammer, T. (2023). Competences that Foster digital transformation of public administrations: An Austrian case study. Administrative Sciences, 13(2), 44.

Elkordy, A., & Iovinelli, J. (2021). Competencies, culture, and change: A model for digital transformation in K-12 educational contexts. Digital transformation of learning organizations, 203-218.

Engeness, I. (2018). Learning and Teaching with Digital Tools: Insights for Learning Arising from the Cultural-Historical Theory.

Fernández, A., Gómez, B., Binjaku, K., & Meçe, E. K. (2023). Digital transformation initiatives in higher education institutions: A multivocal literature review. *Education and Information Technologies*, 1-32.

Firdaus, R. A., Intani, Y. D. C., Munandar, A., Romadhon, S., & Pasaribu, P. N. (2023). Factors Affecting The Readiness of the Dwiwarna High Schools for Industry 4.0. Manager, 6(3), 48-63.

Furjan, M. T., Strahonja, V., & Tomičić-Pupek, K. (2018). *Framing the digital transformation of educational institutions.* Paper presented at the Central European Conference on Information and Intelligent Systems.

Gerlakh, I., Galustov, A., Egizaryants, M., & Tvelova, I. (2022). Digital Transformation of Education: Comparative Analysis of Students and Their Parents' Survey Results. Paper presented at the IX International Scientific and Practical Conference "Current Problems of Social and Labour Relations"(ISPC-CPSLR 2021).

Giang, N. T. H., Hai, P. T. T., Tu, N. T. T., & Tan, P. X. (2021). Exploring the readiness for digital transformation in a higher education institution towards industrial revolution 4.0. International Journal of Engineering Pedagogy, 11(2), 4-24.

GİLLPATRİCK, T. (2020). Innovation and the digital transformation of education. *The Journal of Limitless Education and Research, 5*(3), 194-201.

Gkrimpizi, T., Peristeras, V., & Magnisalis, I. (2023). Classification of Barriers to Digital Transformation in Higher Education Institutions: Systematic Literature Review. Education Sciences, 13(7), 746.

Gracia, J. (2023). ICT in the digital transformation of education in schools in Southern Spain in the context of post-pandemic learning.

Grosseck, G., Maliţa, L., & Bunoiu, M. (2020). Higher education institutions towards digital transformation—the WUT case. Paper presented at the European higher education area: Challenges for a new decade.

Hammer, M. (2020). Identifying antecedents to learning effectively with digital media: a student-centered approach. Universität Tübingen,

Hannan, S. A. (2023). Development of Digital Transformation in Higher Education Institutions. *Journal of Computer Science & Computational Mathematics, 13*(01), 1-8.

Haryanti, T., Rakhmawati, N. A., & Subriadi, A. P. (2023). The extended digital maturity model. *Big Data and Cognitive Computing, 7*(1), 17.

Hatami, J., Shahabi, S.S., Talaee. I., Sajadi, S.M., (2023). Designing and validation the optimum model of digital citizenship education curriculum with an integrated approach in high school, Journal of Management and Planning in Educational Systems, 16(31), 7.

Heydari, A., Yazdani, H., Hakim, A., Matin, H. Z., & Babashahi, J. (2023). Provide a roadmap for digital transformation in the field of human resource with a Meta-synthesis approach. *Researches of Management Organizational Resources, 12*(4), 97-118.

Hosseininasab, S. M., Shamizanjani, M., & Gholipor, A. (2021). A competency model for chief digital officer as organizational governor of digital transformation. *Journal of Information Processing and Management, 36*(3), 835-860.

Hul, S. (2022). *Cambodia: Innovation-Driven EduTech Roadmap 2030*. Paper presented at the 2022 14th International Conference on Software, Knowledge, Information Management and Applications (SKIMA).

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. *MIT Sloan Management Review*.

Kapur, R., Byfield, V., Del Frate, F., Higgins, M., & Jagannathan, S. (2018). The digital transformation of education. Earth observation open science and innovation, 25-41.

Kaputa, V., Loučanová, E., & Tejerina-Gaite, F. A. (2022). Digital transformation in higher education institutions as a driver of social oriented innovations. Social innovation in higher education, 61, 81-85.

Karbasi, S., Khorasgani, G. H., Khamseh, A., & Hafshjani, K. F. (2022). A Model for Compiling the 4.0 Generation Industry Technology Roadmap with an Smart Management Approach in Power Plant Equipment and Energy Supply Industries. *Quarterly Journal of Bi Management Studies, 11*(41), 189-220.

Kassymova, G., Akhmetova, A., Baibekova, M., Kalniyazova, A., Mazhinov, B., & Mussina, S. (2020). E-Learning environments and problem-based learning. International Journal of Advanced Science and Technology, 29(7), 346-356.

Kazakova, E. (2020). Digital transformation of pedagogical education. Yaroslavl Pedagogical Bulletin, 1(112), 8-14.

Keshmiri, S., & Moradi, S. (2021). Preparing to lead the digital transformation in schools. *Journal of School administration, 9*(2), 387-415.

Khanifar, H., & Ghofrani, A. (2021). The Digital Transformation in Teaching-Learning Process: The Student-teachers Digital Competence Assessment. *Journal of Educational and Scholastic Studies, 9*(24), 23-47.

Kirschner, P. A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. Teaching and Teacher education, 67, 135-142.

Kovalchuk, V. I., Maslich, S. V., Movchan, L. G., Soroka, V. V., Lytvynova, S. H., & Kuzminska, O. H. (2022). Digital transformation of vocational schools: problem analysis. Paper presented at the CTE Workshop Proceedings.

Lolic, T., Stefanovic, D., Dionisio, R., Dakic, D., & Havzi, S. (2022). Learning Environment Digital Transformation: Systematic Literature Review. Industrial Innovation in Digital Age, 87-94.

Mahmoodi, A., Khamseh, A., & Shakib, M. H. (2023). The Model of Innovative Social Banking Based on Digital Transformation in Iran's

Banking Industry. *Transformation Managemet Journal, 14*(2), 121-149.

Mahraz, M.-I., Benabbou, L., & Berrado, A. (2019). *A systematic literature review of digital transformation*. Paper presented at the Proceedings of the international conference on industrial engineering and operations management.

Masoleh, S. M. T., Poushaneh, K., Babadi, A. K., Zaheh, H. R., & Ramezani, A. (2023). Designing a Model for Digital Citizenship Education Curriculum for Mental Retarded Students. *International Journal of Digital Content Management, 4*(2), 21-39.

McCarthy, A. M., Maor, D., McConney, A., & Cavanaugh, C. (2023). Digital transformation in education: Critical components for leaders of system change. *Social Sciences & Humanities Open, 8*(1), 100479.

Modaresi, Y., Naghavi, M. S., Roodsaz, H., & Vanani, I. R. (2023). Designing a Conceptual Framework for the Soft Components of Digital Transformation Using Thematic Analysis. *Journal of Human Resources management, 13*(47), 57-88.

Mohamed Hashim, M. A., Tlemsani, I., & Duncan Matthews, R. (2022). A sustainable university: Digital transformation and beyond. Education and Information Technologies, 27(7), 8961-8996.

Mohamed Hashim, M. A., Tlemsani, I., & Matthews, R. (2021). Higher education strategy in digital transformation. Education and Information Technologies, 1-25.

Morze, N., & Strutynska, O. (2021). Digital transformation in society: key aspects for model development. Paper presented at the Journal of physics: Conference series.

Najafabadi, H. A., Shekarchizadeh, A., Nabiollahi, A., Khani, N., & Rastegari, H. (2019). The innovation roadmap and value creation for information goods pricing as an economic commodity. *Journal of Information Systems and Telecommunication, 7*(2), 154-164.

Neborsky, E., Boguslavsky, M., Ladyzhets, N., & Naumova, T. (2020). Digital transformation of higher education: International trends. Paper presented at the International Scientific Conference "Digitalization of Education: History, Trends and Prospects"(DETP 2020).

Nermend, M., Singh, S., & Singh, U. S. (2022). An evaluation of decision on paradigm shift in higher education by digital transformation. Procedia Computer Science, 207, 1959-1969. doi:https://doi.org/10.1016/j.procs.2022.09.255

Nouri, M., Shahhoseini, m., zanjani, M. S., & Abedin, B. (2020). Designing A Conceptual Framework for Leading Digital Transformation in Iranian Companies. *Journal of Management and Planning in Educational Systems, 12*(23), 211-242.

Oliveira, K. K. d. S., & de SOUZA, R. A. (2022). Digital transformation towards education 4.0. Informatics in Education, 21(2), 283-309.

Peng, Y., & Wang, X. (2022). Online education of a music flipped classroom based on artificial intelligence and wireless network. Wireless Communications and Mobile Computing, 2022.

Prem, E., Hardman, L., Werthner, H., & Timmers, P. (2022). Research, Innovation, and Education Roadmap for Digital Humanism. Vienna, Austria: The Digital Humanism Initiative.

Privalov, A. N., & Bogatyreva, Y. I. (2022). Pedagogical Aspects of the Ecosystem Approach to Professional Training of Staff for the Digital Transformation of the Region. Paper presented at the International Scientific and Practical Conference Strategy of Development of Regional Ecosystems "Education-Science-Industry"(ISPCR 2021).

Quaicoe, J., Ogunyemi, A., & Bauters, M. (2023). School-Based Digital Innovation Challenges and Way Forward Conversations about Digital Transformation in Education. Education Sciences, 13, 344. doi:10.3390/educsci13040344

Rauseo, M., Harder, A., Glassey-Previdoli, D., Cattaneo, A., Schumann, S., & Imboden, S. (2023). Correction: Same, but Different? Digital Transformation in Swiss Vocational Schools from the Perspectives of School Management and Teachers. *Technology, Knowledge and Learning*, 1-1.

Reis, J., & Melão, N. (2023). Digital transformation: A meta-review and guidelines for future research. *Heliyon*.

Rodríguez-Abitia, G., & Bribiesca-Correa, G. (2021). Assessing digital transformation in universities. *Future Internet, 13*(2), 52.

Rof, A., Bikfalvi, A., & Marquès, P. (2020). Digital transformation for business model innovation in higher education: Overcoming the tensions. *Sustainability, 12*(12), 4980.

Safonov, Y., Usyk, V., & Bazhenkov, I. (2022). Digital transformations of Education policy. Baltic Journal of Economic Studies, 8(2), 127-136.

Sahraei, F. (2023). Analyzing the Comprehensive Electronic Government Document of the Islamic Republic of Iran from the Perspective of Digital Government and Data Governance Indicators. *Studies the State, 9*(34), 1-34.

Sepúlveda, A. (2020). The digital transformation of education: connecting schools, empowering learners. *TIC EDUCAÇÃO, 249*.

Shirazi, M., Yazdani, H. R., & Matin, H. Z. (2021). Provide a roadmap for deployment the organizational culture required for Digital transformation with a Meta-synthesis approach. *Organizational Behavior Studies Quarterly, 10*(3), 1-22.

Santos, H., Batista, J., & Marques, R. P. (2019). Digital transformation in higher education: the use of communication technologies by students. Procedia Computer Science, 164, 123-130.

Seres, L., Pavlicevic, V., & Tumbas, P. (2018). Digital transformation of higher education: Competing on analytics. Paper presented at the INTED2018 Proceedings.

Sepúlveda, A. (2020). The digital transformation of education: connecting schools, empowering learners. TIC EDUCAÇÃO, 249.

Shenkoya, T., & Kim, E. (2023). Sustainability in higher education: digital transformation of the fourth industrial revolution and its impact on open knowledge. Sustainability, 15(3), 2473.

Tavakoli Rad, Reza; Zargran Khozani, Fatemeh. (2022). Successful organizational digital transformation model. 6th international conference of interdisciplinary studies in management and engineering, University of Tehran, 26 Bahman 2022.

Tátrai, F. S., András (2021). School Innovation Roadmap. https://reflecting4change.eu/wp-content/uploads/2021/02/D3.1-Implementation-Plan.pdf.

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., . . . Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. Education and Information Technologies, 28(6), 6695-6726.

Torres-Ruiz, M., & Moreno-Ibarra, M. (2019). Challenges and opportunities in the digital transformation of the higher education institutions: The case of Mexico. Management and administration of higher education institutions at times of change, 137-149.

Valdés, K. N., & Cerdá Suárez, L. M. (2021). An institutional perspective for evaluating digital transformation in higher education: Insights from the Chilean case. Sustainability, 13(17), 9850.

van der Vlies, R. (2020). Digital strategies in education across OECD countries: Exploring education policies on digital technologies.

Vindača, O., Ļubkina, V., Žogla, I., & Prudņikova, I. (2020). Effective digital transformation in the context of higher education. Paper presented at the EDULEARN20 Proceedings.

Visvizi, A., Troisi, O., & Grimaldi, M. (2023). Exploring the drivers for digital transformation in smart education: An ecosystems approach. ITM Web Conf., 51, 01003.

Voronin, D., Saienko, V., & Tolchieva, H. (2020). Digital transformation of pedagogical education at the university. Paper presented at the International Scientific Conference “Digitalization of Education: History, Trends and Prospects”(DETP 2020).

Warfield, J. N. (1974). Developing interconnection matrices in structural modeling. IEEE Transactions on Systems, Man, and Cybernetics(1), 81-87.

Yang, Z. (2023). Digital Transformation to Advance High-Quality Development of Higher Education. Journal of Educational Technology Development and Exchange (JETDE), 15(2), 2.

Yanli, X., & Danni, L. (2021). *Prospect of Vocational Education under the Background of Digital Age: Analysis of European Union's "Digital Education Action Plan (2021-2027)".* Paper presented at the 2021 International Conference on Internet, Education and Information Technology (IEIT).

Yehya, F. M. (2021). Promising Digital Schools: An Essential Need for an Educational Revolution. *Pedagogical Research, 6*(3).

Yuan, Y.-P., Dwivedi, Y. K., Tan, G. W.-H., Cham, T.-H., Ooi, K.-B., Aw, E. C.-X., & Currie, W. (2023). Government digital transformation: understanding the role of government social media. *Government Information Quarterly, 40*(1), 101775.

Zhu, X., Ge, S., & Wang, N. (2021). Digital transformation: A systematic literature review. Computers & Industrial Engineering, 162, 107774.

Zhou, L., Meng, W., Wu, S., & Cheng, X. (2023). Development of Digital Education in the Age of Digital Transformation: Citing China's Practice in Smart Education as a Case Study. Science Insights Education Frontiers, 14(2), 2077-2092.

Appendix1:

levels	Number of reviewed articles	Number of deleted articles	Reasons for removal
Keyword search in the database	Entry of 659 articles and review of titles	Exit 361 articles	Irrelevance of the title - Repetition of articles - Publication year of English articles before 2013 - Year of publication of Persian articles before 2015- Inadequate validity of the scientific and research level of the article
Examining the articles selected in the previous stage	Entry of 298 articles and review of abstracts	Exit 102 articles	The lack of connection between the goal and the subject - non-qualitative method and research context - the impossibility of accessing the content
Examining the articles selected in the previous stage	Entry of 196 articles and review of literature, methods and findings	Exit 99 articles	lack of connection between the goal and the subject - non-qualitative method - unrelated findings and poor results
Examining the articles selected in the previous stage	Entry of 97 articles and consultations for theoretical consensus	Exit 32 articles	lack of connection between the purpose and the subject - non-qualitative method - irrelevant findings - research plan incompatible with the main purpose and context of the research, variables and model
Number of final articles	Entry of 65 selected articles		

How to Cite: Gholamzadeh, Z., Khamseh, A., Parsanejad, M. (2025). Analyzing the Dimensions of Digital Transformation in Education with the Approach of the Roadmap, International Journal of Digital Content Management (IJDCM), 5(10), 163-196. DOI: 10.22054/dcm.2024.78169.1234