

## PAPER

# A Systematic Literature Review on Digital Transformation in Higher Education: Revealing Key Success Factors

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## ABSTRACT

To answer the challenges and take advantage of opportunities in this digital era, digital transformation (DT) is carried out in various fields, including higher education. Although DT does not yet have an agreed-upon definition, several papers provide approaches to understanding it. This paper presents a systematic literature review (SLR) to understand DT in higher education by addressing the research questions of what, why, and how to conduct DT in higher education. Sixty-six papers from five digital libraries, namely IEEE Xplore, Scopus, Web of Science, SpringerLink, and ScienceDirect, are discussed in this paper. The results of the SLR reveal that in higher education, the success of DT is strongly influenced by the leadership of executive in managing the institution to overcome barriers, to adopt appropriate strategies, and to maintain a consistent approach to implementation.

## KEYWORDS

digital transformation, higher education, review, survey

## 1 INTRODUCTION

Higher education constantly faces challenges in response to global changes. The current era is characterized by rapid globalization, technological disruption, VUCA (volatility, uncertainty, complexity, and ambiguity) conditions, and new trends emerging after the COVID-19 pandemic, all of which drive these changes [1]. Various innovations are required to overcome challenges and take advantage of opportunities, as well as prepare students to tackle issues in future. The evolution of education is closely intertwined with the impact of the industrial revolution [2]. The present era of industry 4.0 focuses on the complete digitization of all physical assets and their integration into a digital ecosystem [3]. The Industrial revolution 4.0 incorporates and integrates various digital technologies such as sensors and controllers, augmented and virtual reality (AR and VR), robots, cloud computing, data analytics, Internet of services (IoS), artificial intelligence (AI), and high-performance tools to support design and production [4]. Likewise, Education 4.0 and University 4.0 leverage digital technology to adapt to

Bisri, A., Putri, A., Rosmansyah, Y. (2023). A Systematic Literature Review on Digital Transformation in Higher Education: Revealing Key Success Factors. *International Journal of Emerging Technologies in Learning (iJET)*, 18(14), pp. 164–187. <https://doi.org/10.3991/ijet.v18i14.40201>

Article submitted 2023-04-06. Resubmitted 2023-05-18. Final acceptance 2023-05-18. Final version published as submitted by the authors.

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current era. The educational era, characterized by digitalization, engagement factors, intelligent tools, and smart technologies, is often referred to as the era of smart learning environments [5]. Education 4.0 is bringing about drastic changes in the field of education [6]. It places the student at the core of the learning process, shifting the emphasis from teaching to learning, with the aim that students can gain knowledge and skills that will facilitate their self-development throughout their lives [7]. To support this transformation, universities are also undergoing a revolution. University 4.0 is characterized by the inclusion of industry as a complement to faculty, personalized learning experiences, seamless data sharing, investment in technology infrastructure, and a fee-based funding model for both offline classroom and online programs [7].

When the COVID-19 pandemic struck the world, the utilization of information and communication technology (ICT) became an imperative solution for education. Remote learning, facilitated through video conferencing and learning management systems (LMS), emerged as a popular solution to overcome the closure of schools mandated by government policies for social distancing [8], [9]. The terms digitization, digitalization, and DT are frequently employed in conjunction with the use of digital technologies [10]. Currently, DT in the field of education is a popular area of interest that has the potential to revolutionize and elevate the quality of education [11]. The pandemic accelerated DT in higher education, a process that was already underway [8], [12]. Universities have historically embraced information technology (IT) to support education, especially in the areas of individualization and distance learning [13], [14]. The utilization of digital technologies is making a noteworthy contribution to the learning process [6]. Afaishat [15] emphasized the importance of applying technology in the post-COVID-19 era to face new challenges and opportunities. Failure to do so could result in setbacks for universities, including rigid structures, inadequate responsiveness, and bureaucratic decision-making process.

DT is bringing about a transformative shift in higher education, not only in terms of how courses are taught but also in what skills must be taught to students, combining technical, managerial, and non-cognitive abilities that have not previously been recognized as important [16]. Numerous studies have shown that the use of technology has a positive influence on student performance [17]. While an official definition of DT is yet to be established, researchers define it as the use of emerging digital technologies that make it possible to improve core business and impact all facets of individual lives within an organization [18].

Benavides [19] conducted a systematic literature review before the COVID-19 pandemic, with the database search performed in April 2019. Their SLR, a qualitative analysis of 19 references obtained from two digital libraries, Scopus and Web of Science. In their research, they recommended that the need for further exploration, both conceptually and methodologically, in the area of DT adoption in higher education. They recommended a deeper examination of research related to this topic.

This paper uses a SLR method to provide a comprehensive explanation of DT in higher education, highlighting its significance and offering insights into how universities can succeed in implementing DT. By understanding the key factors that influence the success of DT, universities can develop effective strategies and maximize the benefits of digital technology in improving the quality of education.

## 2 METHOD

In this study, the Kitchenham protocol was utilized, following the stages of planning, constructing, and reporting the review [20]. During the planning stage,

the protocol for the review was developed, and the introduction provided a discussion on the objectives and rationale for conducting this SLR. The review protocol encompassed formulation of research questions and the establishment of criteria for selecting relevant studies.

## 2.1 Research question

Research questions can be determined by identifying Population, Intervention, Comparison, Outcomes, and Context (PICOC) [20]. Table 1 is the result of PICOC identification.

**Table 1.** Summary of PICOC

Population	Higher Education Institution
Intervention	Digital Transformation
Comparison	n / a
Outcomes	The right way to implement digital transformation in Higher Education Institutions for optimal impact
Context	Digital transformation in private or public higher education institutions around the world

Based on the PICOC analysis in Table 1, the research questions in this systematic literature review are:

- RQ1: What is the definition of DT?
- RQ2: Why does higher education need to implement DT?
- RQ3: How to implement DT in higher education?

## 2.2 Search process

The search process stage consists of several sub-stages, such as selecting digital libraries and determining search strings. The following digital libraries were used in this study:

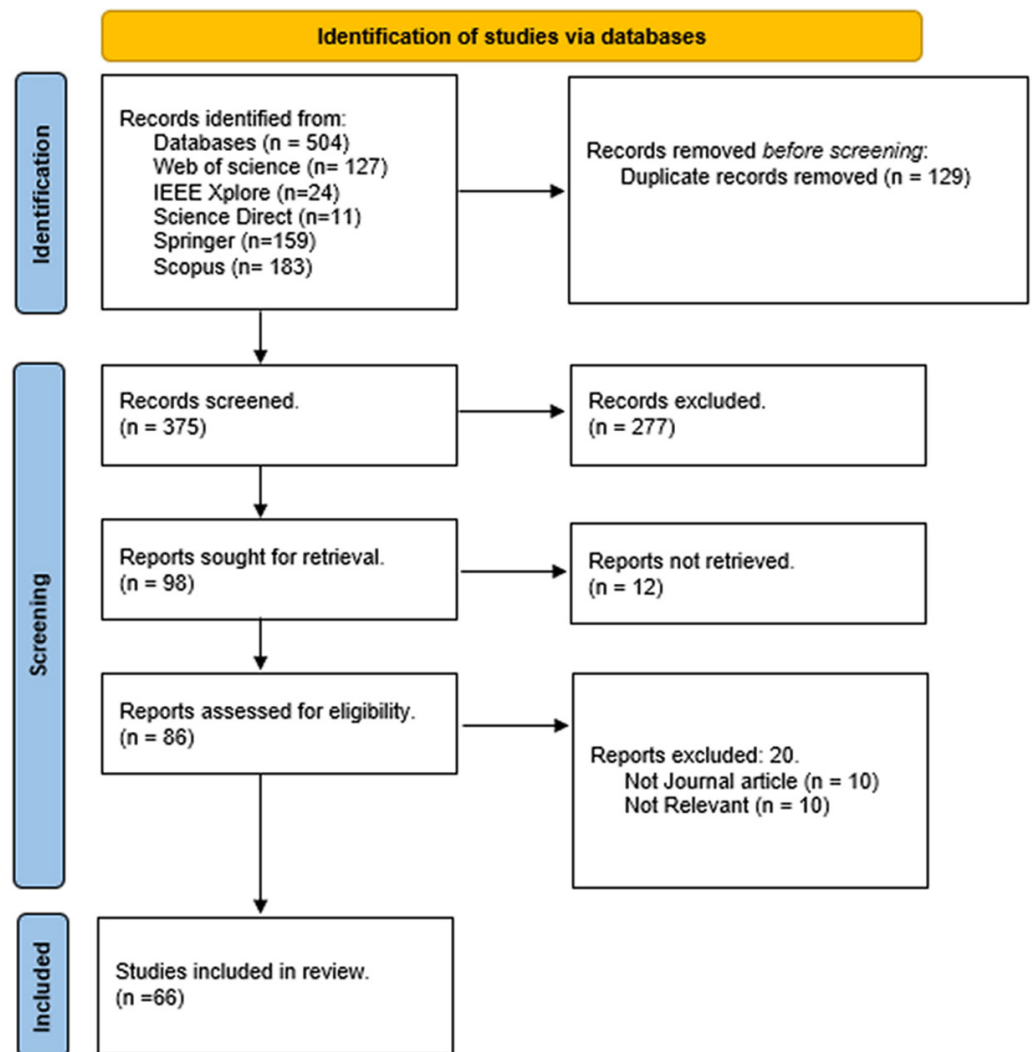
1. Web of Science ([webofscience.com](http://webofscience.com))
2. IEEE Explore ([ieeexplore.ieee.org](http://ieeexplore.ieee.org))
3. ScienceDirect ([sciencedirect.com](http://sciencedirect.com))
4. Springer Link ([link.springer.com](http://link.springer.com))
5. Scopus ([scopus.com](http://scopus.com))

Based on the PICOC analysis and considering the synonym of the search term, the following search string was used: *digital transformation AND (higher education OR university OR college OR Institute OR academic)*. The search string was applied specifically to search the database base by title. The search was conducted on December 9, 2022. In terms of reference selection, the PRISMA (Preferred Reporting Items for Systematic Reviews) guideline were followed, and the exclusion and inclusion criteria can be found in Table 2.

**Table 2.** Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Study topic	Digital transformation in higher education	Digital transformation in fields other than higher education
Language	English	Other languages, e. g. Spanish, German, Russian
Publication type	Journal article	Book section, conference paper, data article
Accessibility	Full-text article	Full-text article is not accessible

The initial search of the digital libraries yielded a total of 504 articles. Following the exclusion selection process based on the defined criteria, 66 articles were deemed and retained for this SLR. The flow of reference selection is illustrated in Figure 1.



**Fig. 1.** Search and selection strategies

### 3 RESULTS AND DISCUSSION

Figure 2 demonstrates the increasing number of articles published on the topic of DT, indicating its significance. The World Health Organization (WHO) declared

that COVID-19 was a pandemic in the first quarter of 2020 [21], which prompted governments worldwide to implement policies restricting social activities, including the economic, business, and education. As a result, millions of individuals worldwide, including workers and students, were compelled to adapt to “forced” DT [13]. In comparison to other fields, DT in higher education has generally lagged behind [13]. The changing working and learning culture necessitated by the COVID-19 pandemic has underscored the growing importance of discussions on DT. Figure 2 illustrates the continued relevance of studies related to DT in higher education.

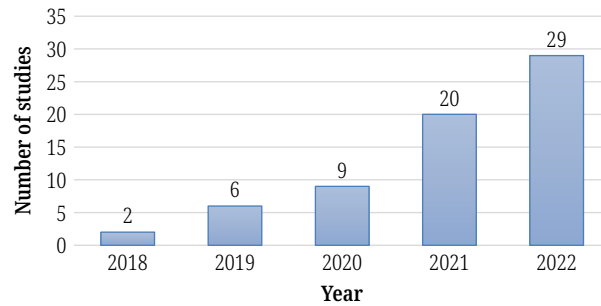


Fig. 2. Publication year of the selected studies

### 3.1 Definition of digital transformation in the context of higher education (RQ1)

Although DT is a buzzword in academia and among practitioners, there is no agreed definition of DT [10], [22]. Gong and Ribiere [10] attempted to establish a unified definition of DT by analyzing the attributes of 134 DT definitions in scientific papers. Their research yielded a comprehensive definition of DT as follows: “A fundamental change process enabled by digital technologies that aim to bring radical improvement and innovation to an entity [e.g., an organization, a business network, an industry, or society] to create value for its stakeholders by strategically leveraging its key resources and capabilities.” Their studies also sheds light on the distinctions between digitization, digitalization, and DT. Digitization refers to the process of converting information or analog signals into a digital format, enabling its storage, processing, and transmission by computers. Digitalization, on the other hand, is the use of technology that can change the pace of societal or business model change from a business perspective. These three terms are interrelated but have distinct conceptual levels [10].

In the SLR conducted for this study, a total of 28 papers offers the definition of DT. Table 3 presents the six definitions that are most relevant within the context of higher education.

Table 3. Definition of digital transformation in the context of higher education

Ref	Definition of Digital Transformation
[23]	“DT is a process that integrates digital technology in all aspects and requires changes in the areas of technology, culture, and operations, among others” [24], [25]. “In the educational subject, DT is a process that requires evolution in the way it is taught and adaptation to the new learning needs of the student.”
[26]	“The adoption of new technologies to transform education systems and services” [27]–[30]
[31]	“The conceptualization of ‘digital transformation’ for public sector organizations refers to the adoption of processes and practices to help public organizations provide social value in an increasingly digital world” [32].

(Continued)

**Table 3.** Definition of digital transformation in the context of higher education (*Continued*)

Ref	Definition of Digital Transformation
[33]	“The process of digital transformation of a university is the creation of a unique university information system that will provide unified asset data for users. This includes information about students, personnel, teachers and researchers, their publications and patents, the courses they teach and the research projects they conduct” [34].
[35]	“Total digitalization, such as digitalization of core services, academics and students with advanced digital capabilities, and decision support systems that can adapt to changing circumstances” [36]. “In higher education, digital transformation means the transformation of a digital learning environment beyond the development of information technologies.”
[37]	“Deploying/implementing new technological base mechanisms to influence the delivery of digital education.”

### 3.2 Reasons why higher education should implement digital transformation (RQ2)

The objective of DT in higher education is to achieve various benefits or impacts as illustrated in Table 4. These benefits or impacts can be seen from several perspectives, including:

#### 1. Society.

The advantages of DT in higher education from the perspective of society include increased accessibility [38], [39]. People can attend classes from anywhere, not limited by time and space. This will overcome territorial constraints [27]. Competition among higher education institutions will become tighter and broader, leading to improved quality standards of education [39], [40]. Thus, society’s right to obtain equal education will be more easily fulfilled.

#### 2. Business

From a business perspective, the benefits of DT in higher education include increased profits as well as customer satisfaction, investors, and beneficiaries [4], [37], [41]–[44]. These benefits can be achieved by enhancing or creating value [37], [41], [45], [46], developing new business models [46], spending efficiency, reducing cost [27], [35], [39], [41], [44], [46], and attracting new customers [15]. Universities that implement DT well will be able to survive and compete in the current era of business trends, which prioritize the use of advanced technology [4], [15], [37], [39], [41], [45], [47]–[51].

#### 3. Organization

DT can improve the performance, productivity, efficiency, and quality of higher education [26], [38], [39], [41], [44]–[46], [52], [53]. Traditional processes and services, including administrative processes, can be replaced with digital processes [41], [47]. By adopting digital processes, errors can be reduced, and accuracy can be increased [41], [44], [54]. Data management capabilities too will increase. Improved data management enables greater transparency within the organization and facilitates better decision-making, prediction as well as planning processes [41], [55]. From an organizational perspective, DT is not just following the trend of using technology, but fundamentally, it represents a fundamental reinvention of educational organizations [49].

#### 4. Learning process

DT can improve student experience [23], [26], [37], [39], [45], [52], [56]. It stimulates innovations in the delivery of learning materials [38], [52] and facilitates easier and broader collaboration [40]. With DT, Learning can become more student-oriented [35]. The student-oriented or student-centered approach

has been empirically proven to yield superior academic results and foster self-confidence, openness to experience, and other positive outcomes, particularly when learning occurs in an atmosphere that meets three basic conditions of attitude: realness, acceptance, and empathic understanding [57]. Ultimately, the most important goal is to improve student performance [38].

**Table 4.** Impacts of DT in higher education

Perspective				
	Society	Business	Organization	Learning Process
<b>Impact</b>	Increase accessibility [27], [38], [39], [58]	Business growth and business model innovation [4], [27], [37], [39], [43], [45], [46], [51]	Improve performance, productivity, and quality [26], [38], [39], [41], [44]	To be student-oriented [35]
	Universalize access to education [59]	Remain relevant to changing industry scenarios and trends [15], [49]	Improve efficiency [37], [39], [41], [44]–[46], [52], [53]	Improve the experience of courses, teaching materials, and the training process in general [11], [23], [39], [45], [45], [47], [52], [56]
	Decentralization of education [39]	Improve survivability / increase retention [41], [45], [50], [51]	Redefine education services and optimize operational processes [31], [35], [41], [44], [47], [49], [50], [54]	Increase student motivation, excitement, efficiency, engagement, performance, and satisfaction [11], [17], [38], [45], [60]
	Massification [47]	Improve competitiveness [4], [37], [39], [47], [48], [50], [61]	Automated processes [46]	Transformation of a digital learning environment beyond advancements in information technology [35], [27]
	Democratization of knowledge [47]	Create/enhance value [37], [39], [39], [41], [45], [46]	More data and knowledge management capabilities are introduced by digital teaching [38], [41], [55], [58]	Stimulate innovation in education [38], [52]
	Support inclusion [31], [58]	Develop a brand reputation and novelty [39]	Build foundational capabilities that support the entire structure [41], [58]	Deliver quality teaching materials and provide them with blended learning [39]
	Support equity [31]	Continuous optimization [41], [62]	Changing work [41], [47]	Improve teaching staff (knowledge, skills, and attitude) [26]
	Support lifelong learning opportunities [31]	Enhance customer expectations. [4], [42], [44]	Improve information flow management, ensuring the availability of HE [56]	improvement of instructional strategies and the enhancement of the educational procedures and curricula [56], [60]
	Increase standard quality of education [11], [39]	Attract more and better students [23]	Sustainable culture of innovation [41]	Modifying the teaching curriculum and improving access to technology-related learning resources [47]
	Create new employment [37]	Increase Satisfaction of investors and beneficiaries [41]		Increased collaboration [40], [56], [58]
		Reduce spending [27], [35], [37], [41], [44], [46]		
		Enhances the quality, performance, productivity, and viability [41]		
	Blurring competitive boundaries [40]			

### 3.3 How to implement digital transformation in higher education (RQ3)

In general, DT efforts carry inherent risks, with a substantial number, around 70% experience failure [63]. The following points need to be considered when carrying out DT in higher education to reduce risk and avoid failure.

#### 1. Approach

There are three approaches to digital transformation [35], [50], which are as follow

- Service–first transformation  
Focus on creating new educational products and transforming existing products into digital form.
- Operation–first transformation  
Transformation leads to development of new internal digital processes or the enhancement of existing ones, serving as a basis for redefining services.
- Service–operation combination  
The combination of the previous approaches seeks to integrate both service and operation aspects.

The approach has its origins in the works of Sandkhul and Lehman as documented in their paper [64]. Other papers in the field refer to operations within this approach as business processes, while services are referred as educational services [26], [27].

#### 2. Steps

Table 5 outlines the steps required to implement DT, as discussed in the reference sources.

**Table 5.** Digital transformation steps

Ref	Steps
[65]	5-step methodological: <ul style="list-style-type: none"> <li>• Foundation</li> <li>• Siloed</li> <li>• Partially synchronized</li> <li>• Fully synchronized</li> <li>• Living DNA [66]</li> </ul>
[67]	<ul style="list-style-type: none"> <li>• Create DT vision and objectives.</li> <li>• Assess the organization's DT capability.</li> <li>• Design the end user and employee experience.</li> <li>• Review and select solutions and vendors.</li> <li>• Create the implementation roadmap.</li> <li>• Adjust organization culture and infrastructure. [68]</li> </ul>
[69]	<ul style="list-style-type: none"> <li>• DT of the university educational activities</li> <li>• DT of university research activities</li> <li>• DT of the university business activities</li> </ul>

#### 3. Strategy

Table 6 provides an overview of the reference papers in this SLR that discuss DT strategies for successful implementation.



**Table 6.** Digital transformation strategies

Ref.	Strategy
[39]	<ul style="list-style-type: none"> <li>• Increasing use of technologies</li> <li>• Ability to create values.</li> <li>• Supporting structural changes</li> <li>• Economic gains [70], [71]</li> </ul>
[17]	<ul style="list-style-type: none"> <li>• Determining the necessary technology and its impact on academic and non-academic processes</li> <li>• Involving all stakeholders during the preparation of the strategic plan</li> <li>• Consideration of security issues</li> <li>• Assuring the applicability of the strategy</li> <li>• Consideration of the cost of transformation</li> <li>• Supporting students while adopting new technologies [72]</li> </ul>
[46]	<ul style="list-style-type: none"> <li>• Organizations must improve their digital maturity.</li> <li>• Institutions that are less digitally mature tend to be more fragile.</li> <li>• Organizations or corporations with higher levels of digital maturity are generally more flexible. [73]</li> </ul>
[37]	Radical sustainable DT: <ul style="list-style-type: none"> <li>• Identification of SDT goals</li> <li>• Development of digital policies</li> <li>• Development of digital measures</li> <li>• Integration of technological capabilities</li> <li>• Development of its reporting mechanism</li> </ul>
[74]	3 phases of digital innovation in higher education <ul style="list-style-type: none"> <li>• Two separate processes (unintegrated digital resources)</li> <li>• Alignment of education and digital subjects</li> <li>• Institutionalization in a shared digital space</li> </ul>
[18]	Four-phase strategy <ul style="list-style-type: none"> <li>• Government support: Develop and publish a plan and policy.</li> <li>• Strategic management: Strengthen strategic planning, financial resources, commitment, and resistance change.</li> <li>• Functional management: development of expertise in digital transformation</li> <li>• Operational management: Strengthen operational management (develop and publish standards and guidelines), embedding ICT into educational systems</li> </ul>

Based on the strategies outlined in Table 6, there are several key considerations for ensuring the success of DT. These include vision and goals, technology, economic calculations, and relevant stakeholders involved such as government, students, teachers, and employees. Data management and analysis also play a crucial role in DT strategies [31], [75], [76].

#### 4. Model and framework

The papers in this SLR discuss various frameworks and models related to DT in higher education. These frameworks and models can be categorized into different types, including DT model, maturity model, DT framework, and integration in teaching technology framework. The dimensions of these models and frameworks are presented in Tables 7–11.

**Table 7.** Digital transformation models

Ref	Model	Dimension
[39]	The Higher Education Model of Digital Transformation	<ul style="list-style-type: none"> <li>• Distinct impactful change</li> <li>• Evolutionary learning and development</li> <li>• Entrepreneurial digital space for building advantages</li> <li>• Propelling forces of digitalization</li> </ul>
[77]	The Model of the University in the Context of the 4IR	<ul style="list-style-type: none"> <li>• Digital technology</li> <li>• Connectives theory</li> <li>• Learning ecosystem</li> </ul>
[51]	Model of the NUST MISiS Digital Transformation	<ul style="list-style-type: none"> <li>• Digital culture (of employees, academic staff, and students),</li> <li>• Digital assets (artificial intelligence, e-platforms, and digital avatars),</li> <li>• Digital business models</li> <li>• Digital company</li> </ul>
[78]	Multidimensional Integrated Model of Digital Transformation	<ul style="list-style-type: none"> <li>• Organizational dimension: <ul style="list-style-type: none"> <li>○ Digital strategy</li> <li>○ Leadership and culture</li> <li>○ Market digitalization</li> <li>○ Strengthened logistics</li> <li>○ Dynamic and digital capabilities</li> </ul> </li> <li>• Transformational objectives: <ul style="list-style-type: none"> <li>○ Value creation</li> <li>○ Technology benefit</li> <li>○ Structure agility</li> </ul> </li> <li>• Cross-sectional component: <ul style="list-style-type: none"> <li>○ Financial viability and support</li> <li>○ Innovation</li> </ul> </li> </ul>
[79]	Model of Organizational Competence for Digital Transformation [80]	<ul style="list-style-type: none"> <li>• Governance <ul style="list-style-type: none"> <li>○ Vision</li> <li>○ Strategy</li> <li>○ Leadership</li> <li>○ Ambidexterity</li> </ul> </li> <li>• Organizational alignment <ul style="list-style-type: none"> <li>○ Use of technology</li> <li>○ Change in value creation.</li> <li>○ Structural changes</li> <li>○ Financial aspects</li> <li>○ Agility</li> <li>○ Dynamic capabilities</li> </ul> </li> <li>• Culture <ul style="list-style-type: none"> <li>○ Risk</li> <li>○ Change and innovation.</li> <li>○ Organizational learning</li> <li>○ Ethics</li> <li>○ Information</li> </ul> </li> <li>• Technology <ul style="list-style-type: none"> <li>○ Technology selection</li> <li>○ Conceptualize</li> <li>○ Use of digital technologies</li> </ul> </li> <li>• Employees <ul style="list-style-type: none"> <li>○ Requirements</li> <li>○ Situation, acquisition, and development</li> <li>○ Workplaces</li> <li>○ Talent development</li> </ul> </li> </ul>

**Table 8.** Digital transformation maturity model

Ref	Model	Dimension
[50]	DT Maturity Framework for Higher Education	<ul style="list-style-type: none"> <li>• Learning and teaching processes:               <ul style="list-style-type: none"> <li>◦ Study program accreditation, teaching processes preparation and realization, teaching process assessment, and student and teacher mobility realization</li> </ul> </li> <li>• Enabling processes:               <ul style="list-style-type: none"> <li>◦ Student administration services, library services, staff provision and development services, finance and accounting services, marketing, sales, and distribution services, and procurement services</li> </ul> </li> <li>• Research processes:               <ul style="list-style-type: none"> <li>◦ Research planning, research preparation, research conduct, research outcome monitoring, research evaluation</li> </ul> </li> <li>• Planning and governance processes:               <ul style="list-style-type: none"> <li>◦ Organization management services, change and business process management, plan development, budget and fund planning, performance assets</li> </ul> </li> </ul>
[53]	DT Readiness and Maturity	<ul style="list-style-type: none"> <li>• Digital culture</li> <li>• Digital leadership</li> <li>• Resource and Commitment</li> </ul>
[81]	Model for Digital Maturity	<ul style="list-style-type: none"> <li>• Digital maturity</li> <li>• Collective entrepreneurship</li> <li>• Digital experience</li> <li>• Individual entrepreneurship</li> </ul>
[78]	Rossmann's Digital Maturity [82]	<ul style="list-style-type: none"> <li>• Strategic dimension</li> <li>• Leadership dimension</li> <li>• Market dimension</li> <li>• Operations dimension</li> <li>• People and skills dimension</li> <li>• Cultural dimension</li> <li>• Governance dimension</li> <li>• Technology dimension</li> </ul>

**Table 9.** Digital transformation business model

Ref	Model	Dimension
[83]	Envisioned Business Model of the Digitalized University	<p>Osterwalder business model canvas:</p> <ul style="list-style-type: none"> <li>• Learning value proposition:               <ul style="list-style-type: none"> <li>Clarification and reflection on the role of the HEI, the selection, distribution, and consumption of content, the design of learning methodologies and activities, assessments, student-professor interactions, and virtual campus and technology strategy.</li> </ul> </li> <li>• Value creation:               <ul style="list-style-type: none"> <li>Resources, activities, and partnerships to create this new learning value proposition; c) At the level of the value delivery: customer segments targeted, the distribution channels used, and the customer relationship developed to deliver this new learning value proposition.</li> </ul> </li> <li>• Value capture:               <ul style="list-style-type: none"> <li>Sources of revenue and cost structure associated with this new learning value proposition.</li> </ul> </li> <li>• Value communication:               <ul style="list-style-type: none"> <li>How this new learning value proposition will be translated into a highly attractive storytelling narrative that connects in both a relevant and automatic way.</li> </ul> </li> </ul>

**Table 10.** Digital transformation framework

Ref	Framework	Dimension
[52]	KPMG blueprint for digital transformation in universities [84]	<ul style="list-style-type: none"> <li>• Customers: <ul style="list-style-type: none"> <li>Students, alumni, communities, government, industry, partners</li> </ul> </li> <li>• Channels: <ul style="list-style-type: none"> <li>In-person, telephone, email, text and web chat, website, mobile apps, digital signage, social media, and contact centers</li> </ul> </li> <li>• Enterprise strategy: <ul style="list-style-type: none"> <li>Strategic ambition, planning, and measure</li> </ul> </li> <li>• Core business practice: <ul style="list-style-type: none"> <li>Curriculum and learning lifecycle, student lifecycle, support and engagement services, research lifecycle, research, and commercialization</li> </ul> </li> <li>• Advanced-data and analytics: <ul style="list-style-type: none"> <li>Visualizations and insights, scenario planning and modeling, data management, and governance</li> </ul> </li> <li>• Enabling business practice: <ul style="list-style-type: none"> <li>Enterprise technology, enterprise operations</li> </ul> </li> </ul>
	Microsoft Framework for the Transformation of Higher Education [85]	<ul style="list-style-type: none"> <li>• Student success</li> <li>• Teaching and learning</li> <li>• Academic research</li> <li>• Secure and connected campus</li> </ul>
	Google Education Transformation Framework [86]	<ul style="list-style-type: none"> <li>• Vision</li> <li>• Learning</li> <li>• Culture</li> <li>• Technology</li> <li>• Professional development</li> <li>• Funding and sustainability</li> <li>• Community engagement</li> </ul>
[12]	Digital Transformation and Academic Entrepreneurship	<ul style="list-style-type: none"> <li>• Business logic and entrepreneurial process (hard skill): <ul style="list-style-type: none"> <li>◦ Management tools</li> <li>◦ Digital process</li> <li>◦ Digital product</li> </ul> </li> <li>• Socio-cultural modifications (soft skill) <ul style="list-style-type: none"> <li>◦ Individual characteristics</li> <li>◦ Cultural characteristics</li> <li>◦ Sharing knowledge</li> </ul> </li> </ul>
[31]	Inspired by Teece's capabilities framework	<ul style="list-style-type: none"> <li>• Sensing <ul style="list-style-type: none"> <li>◦ Monitor the environment</li> <li>◦ Identifying problems</li> <li>◦ Opportunities</li> <li>◦ Understanding the market</li> </ul> </li> <li>• Seizing (designing of new business models)</li> <li>• Transforming</li> </ul>
[87]	Digital Transformation Framework [70]	<ul style="list-style-type: none"> <li>• Use of technology</li> <li>• Change in value creation</li> <li>• Structural changes</li> <li>• Financial attributes</li> </ul>

**Table 11.** Technology integration in education

Ref	Framework	Dimension / Degree
[55], [81], [88]	TPACK [89]–[91]	<ul style="list-style-type: none"> <li>• Technology</li> <li>• Pedagogy</li> <li>• Content knowledge</li> </ul>
[55], [81]	SAMR [92]	<ul style="list-style-type: none"> <li>• Substitution,</li> <li>• Augmentation</li> <li>• Modification</li> <li>• Redefinition</li> </ul>

In these SLR references, only two frameworks related to technology integration in education are discussed, namely TPACK (Technological, Pedagogical, And Content Knowledge) and SAMR (Substitution, Augmentation, Modification, Redefinition). More widely, Blundell [93] listed three categories of models and frameworks regarding technology integration in education: (i) Influences on acceptance such as CBAM (Concerns-Based Adoption Model), TAM (Technology Acceptance Model), and UTAUT (Unified Theory of Acceptance and Use of Technology). (ii) Processes used by teachers in integrating digital technology such as ACOT (Apple Classrooms of Tomorrow), ICT-CFT (Information Communication Technology Competency Framework for Teachers), and TPACK. (iii) Degrees of integration such as RAT (Replacement, Amplification, Transformation) and PICRAT (Passive, Interactive, Creative, Replacement, Amplification, Transformation), SAMR, the Pedagogy Wheel, TIM (Technology Integration Matrix), and Triple E (engage, enhance, extend learning).

In addition to the above models and frameworks, there are also several frameworks that can be used to support DT, such as the Digital Competence of Educator Framework [94], the Model for Good Data Governance Practices [44], the Artificial Intelligence Library Services Innovative Conceptual Framework (AI-LSICF) [87], a framework for understanding rapid DT [13] and a framework for identifying and prioritizing the barriers faced for the successful implementation of DT in higher education [26].

When implementing the DT with the strategies and frameworks discussed, it is also necessary to consider the key principles of effective digitalization, such as readiness, ease, openness, and trust [56], and consider some central issues when introducing technology, such as accessibility, flexibility, substitutability, and transparency considerations [95].

Higher education will encounter various challenges while implementing DT. Several references in this paper mention these challenges and propose solutions. The following are some of the main challenges.

#### 1. Human resistance to change.

Resistance to change can be experienced by students, lecturers, administrative staff, and management [17], [49], [53], [56]. This resistance can be triggered due to several factors, including satisfaction with the status quo [31], privacy concerns [17], a “24-h-accessibility” syndrome, infocipation, spamming [83], lack of experiences, lack of access so that it becomes a fear of unknown, and fear of losing jobs [49]. A few sources mention cultural and behavioral resistance as the main challenge in DT [4], [17]. Cantu, in his article, mentions the results of Saldanha’s research, which states that almost 70% of transformation failures are caused by a lack of discipline in their implementation [65]. To overcome the challenge of resistance to change, inspiring leaders are needed who can successfully explain the digital vision [52], [53]. Small pilot projects can be conducted to provide an overview of potential changes and reduce faculty doubts and fear regarding job

security [36]. Assurance of privacy is also something that needs to be considered to reduce the fear of change [17].

**2. Lack of digital capabilities.**

The lack of digital skills among lecturers and academic staff is a significant challenge in DT within higher education [17], [31], [50], [53], [96]. Students need to adapt to the habit of solving learning problems when transitioning from on-campus offline learning to online learning [97]. Considering that students are already digital natives, it is imperative for lecturers to enhance their teaching abilities by leveraging digital technology in imaginative and inventive ways [52]. Higher education needs to conduct continuous training for related new technology in order to improve digital capabilities [83].

**3. Lack of pedagogical innovation.**

DT enables students to be more globalized. Teachers are required to make various innovations to make learning more attractive and interactive by utilizing technology [38], [50], [78], [83]. To meet these demands, teachers must be more open to other teaching models and dare to experiment [83]. In some universities, teachers only employ digital tools for organizing and downloading their teaching materials. Teachers more often use them for class organization mechanisms rather than promote improved learning technologies [98]. Teachers generally lack sufficient knowledge about the potential of technology applications or may even be unwilling to familiarize themselves with new technologies [98].

**4. Rethinking business model.**

One of the biggest challenges in implementing DT within higher education is effectively harnessing all the opportunities and potential provided by the wealth of DT, while completely rethinking the business model and transforming operations throughout the value chain [52]. It is necessary to have a common understanding of the benefits and process of DT for universities and market players, as well as other public sectors. Therefore, a “skeleton” framework is needed that can direct the positive impacts of DT for the benefit of higher education institution and the economy as a whole [33].

**5. Inadequate leadership practice.**

The right attitude and support from leaders are essential for successful implementation of DT in higher education [31], [56]. Strong leadership can reduce barriers in the adoption of new technologies in higher education and can be a success factor in improving learning schemes by introducing new technologies [38]. According to Wade and Shan’s research, employee connectedness and responsive leadership are two key factors that significantly impact digital innovation within an organization [46].

**6. Financial challenge.**

The financial perspective poses challenges such as required expenses, the decline of established revenue streams, and the search for new sources of revenue [17], [40], [50]. Educational institutions usually miscalculate the business and return of investment (ROI) [52]. When investing in digital capabilities, it is important to consider various factors. It includes evolving actions that are slow to develop or difficult to measure, such as time and cost savings from more efficient operations and automation. Another aspect to consider is increased retention and timely graduation rates that result from a better student learning experience [36].

**7. Lack of organizational strategy.**

One of the challenges often faced in adopting digital technology is the lack of organizational strategy [31]. Priority setting and decentralization

decision-making need to be a concern in setting organizational strategy because it can be an inhibiting factor in the DT process [37], [52], [83].

Table 12 presents an overview of the challenges of DT within higher education and the proposed solutions.

**Table 12.** Challenges of DT within higher education and the proposed solutions

Challenge	Proposed Solution
Human Resistance to Change [4], [17], [31], [49], [50], [52], [56], [76], [78], [99], [100]	<ul style="list-style-type: none"> <li>• Motivate employees to promote a vision of digital maturity [52].</li> <li>• Pilot projects can be conducted to provide an overview of potential changes and reduce faculty doubts and fear regarding job security [52].</li> <li>• Educating educational professionals about the benefits of technology and reducing job insecurity [52].</li> <li>• Meetings initiated by the leaders to introduce and explain digital transformation play an important role in creating a digital culture [53].</li> <li>• Stakeholders must have a plan to provide assurance regarding protecting privacy and security of both teacher and student data [17].</li> <li>• Some training is recommended to reduce resistance [35].</li> <li>• Design a technological model to establish guidelines, norms, and a concise action plan [83].</li> <li>• Provides individualized and micro-segmented sources of relevant information [83].</li> </ul>
Digital Capabilities [8], [17], [22], [31], [50], [52], [53], [56], [88], [96], [97], [100]–[103]	<ul style="list-style-type: none"> <li>• Since most of the present day students are digital natives, teachers need to be more imaginative and inventive in their digital teaching skills [52].</li> <li>• Due to generational differences between students and faculty in adopting technology, there is a need for policies that support infrastructure and creative learning arrangements to address changing trends in expertise [52].</li> <li>• Faculty must adapt and learn the use of technology [52].</li> <li>• Training must be provided to faculty [8], [22], [52], [103]</li> </ul>
Pedagogical Innovation [8], [22], [38], [49], [56], [88], [94], [96], [98], [103]–[105]	<ul style="list-style-type: none"> <li>• A digital teaching culture must be developed [96].</li> <li>• Teachers should be more open to new learning models and dare to invest in innovation and experimentation. [83], [103].</li> <li>• Management should receive feedback and analyze information from teachers and students, both formally and informally, about difficulties in using technology in learning to develop effective digital learning [98], [104].</li> <li>• Digital learning encompasses more than technical innovations; it necessitates academic, organizational, and structural changes [98], [103].</li> </ul>
Rethinking Business Model [50], [52], [79], [95]	<ul style="list-style-type: none"> <li>• Develop a partnership and collaborative mindset [83].</li> <li>• Develop a customer-centric mentality to design compelling offerings and experiences [83].</li> <li>• Define a clear technology model, prioritize technology decisions, monitor and automate as much as possible [83].</li> <li>• A "skeleton" is needed to drive the positive impacts of DT for higher education institutions and the economy as a whole [33].</li> </ul>
Leadership [17], [31], [46], [50], [78], [100]	<ul style="list-style-type: none"> <li>• Employee connectedness and responsive leadership [46]</li> <li>• Transformational style leadership [38]</li> </ul>
Financial Challenges [17], [22], [52], [56], [76], [101]	<ul style="list-style-type: none"> <li>• Business cases for basic digital abilities should be considered for actions that are evolving slowly or are difficult to quantify [52].</li> <li>• Develop new strategies to reach international markets [83].</li> <li>• Cost savings by digitizing services [83].</li> <li>• Develop new types of offerings to increase appeal (e.g., virtual) [83].</li> <li>• Reduce old sources of costs [83].</li> <li>• Promoting the advantages of digitization, providing coaching, and establishing referents [83].</li> </ul>
Organizational strategy [22], [31], [38], [74], [100]	<ul style="list-style-type: none"> <li>• Develop an investment strategy for digital technology that is prioritized, along with a transformational road map [52]</li> <li>• Benchmarking international top referents [83]</li> <li>• Heavin and Power suggested a guide for decision support that assists managers in effectively addressing the challenges that arise in relation to various types of tasks at different decision levels. These levels include strategic, tactical, and operational decisions[17].</li> <li>• The internal control system with key indicators such as risks can be the basis for the educational management system at the university and the basis for ensuring the security and sustainability of its digitalization process [68].</li> </ul>

One of the references in this SLR defines challenges, risks, difficulties, obstacles, or restrictions as barriers [26]. In that paper, barriers are categorized into four perspectives, namely contextual, social, technical, and cultural. In another paper, Aditya [106] classifies these barriers into nine categories, that includes vision, strategy and policy, resources, leadership, skills and knowledge, technology, adaptability, resistance to change, and government and economic factors.

## 4 CONCLUSION

Digital transformation has become an inevitable aspect of higher education in today's world. It extends beyond merely digitizing manual processes and instead entails a fundamental change process enabled by digital technologies that aims to bring radical improvement and innovation to an entity. Teachers not only utilize digital technology to present their teaching materials but also utilize it to foster innovative learning approaches. The key benefits of DT in higher education include improved quality of education, enhanced student performance, and increased retention of the higher education institution. There are multiple models and frameworks already available that can be used to implement DT. Some of the prime challenges in implementing DT within higher education, such as human resistance to change, lack of digital capabilities, lack of pedagogical innovation, rethinking business models, inadequate leadership practices, financial challenges, and lack of organizational strategy. Several references in this paper propose solutions that can be used to deal with these challenges.

According to Liebowitz [75], the success factors of DT in higher education are active participation from consumers, data, and its analysis, change management processes, and innovation. Meanwhile, according to Laorach and Tuamsuk [100], the six factors influencing the success of DT in higher education are digital culture, digital strategies, management process, organization leaders, digital technologies, and staff. Aditya [26] pointed out that readiness to overcome obstacles is important, and awareness of policymakers is the main key to supporting the successful implementation of DT. Furthermore, Saldanha observes that almost 70% of transformation failures are caused by a lack of discipline in its implementation [66]. Above all, leadership is an important concern, as it is not only one of the challenges, but some sources also cite it as a key factor in the success of DT implementation [17], [26], [38], [46], [53], [65]. In summary, leadership, the ability to overcome obstacles, implement the right strategy, and be consistent in their implementation are key factors for the success of DT within higher education.

The results of this SLR found several frameworks related to DT within higher education. More in-depth research is needed on these frameworks so that it can help in the development of a comprehensive framework that is right for the application of DT in higher education. This would ultimately lead to optimal results and increased efficiency throughout the process.

## 5 ACKNOWLEDGMENT

The authors would like to thank the Ministry of Communication and Information of the Republic of Indonesia, the P2MI-STEI Program of Bandung Institute of Technology, and the National Research and Innovation Agency for their assistance and support during the research.



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