

# Digital Transformation Readiness in Education: A Review

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**Abstract**—Digital transformation has attracted worldwide attention, while education has become the main target for its development. The use of digital transformation in learning facilitates the transition from a face-to-face education system to one based on distance learning. This article used a systematic literature review method to analyze digital transformation readiness in the education sector. We employed the PRISMA approach to select articles and undertook thematic analysis to analyze the data. The data analysis focuses on students’ perceptions and the preparations that teachers and universities must undertake in readiness for digital transformation.

**Index Terms**—Digital transformation, educational institutions readiness, students perception, teacher preparedness.

## I. INTRODUCTION

Along with the development of digital technology, digital platforms have become essential tools for human survival in areas such as communication support, product manufacturing process support, and the seamless provision of services free from the limitations previously imposed by different time zones and countries. The internet is a prime example—anyone can use the internet to exchange and find information anytime and anywhere. As a result, it has become a basic necessity for everyone living in the present era. It is also the main reason why Google, Microsoft, Open Content Alliance, and other large companies are investing heavily and working closely with libraries to digitize printed sources [1].

Digital transformation involves the conversion of all kinds of information into a digital language [2]. However, this is not the same as converting a whiteboard into a projector or a book into a PDF; these are examples of change using digital tools and not digital transformation. After all, digital transformation concerns the ability to integrate and utilize digital technology within our daily lives [3].

Recently, digital transformation has attracted worldwide attention. Its development potential has a significant impact on products, innovation processes, and business models [4]. Increasing digital technology allows for generalization of data that can later be used as a decision-making tool. Thus, the increasing adoption of digital technology also can lead to performance improvements across different industries, the emergence of new quality methods, and communication through the digital world.

Education has become the main target for the development of digital transformation, moving in line with the

development of the education system [5]. Furthermore, educational institutions can adjust and design the education system according to current conditions. An education system based solely on face-to-face learning can thus use digital transformation to switch to one based on distance learning.

Digital transformation represents both a challenge and an opportunity for the education sector. Three factors influence the digital transformation of the education sector: students, teachers, and educational institutions. Digital transformation in education involves not only the use of digital devices for learning—it entails a change in the learning system. All stakeholders, especially students, teachers, and institutions, are involved in the process, so everyone must be ready. This article will explore the literature to uncover aspects of digital transformation, notably the pros and cons that educational institutions should anticipate before embarking on digital transformation.

## II. METHOD

Since the term was first coined in the 1990s [6], digital transformation has come to be understood as a systemic change that involves four entities: humans, hardware, software, and infrastructure. Therefore, it is necessary to conduct an exhaustive literature review to understand it.

This study was conducted using a systematic literature review framework [7] and followed the PRISMA approach [8] to article selection. The Scopus database was used with the following keywords: **TITLE-ABS-KEY (digital AND transformation) AND TITLE-ABS-KEY (education)**. These searches aimed to find articles that pointed directly to digital transformation in education. The criteria for eligible documents were articles published between 2016 and 2021.

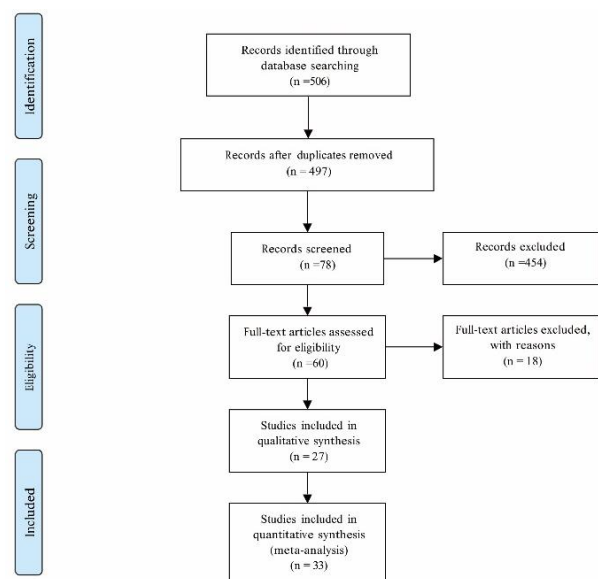


Fig. 1. PRISMA flow diagram for article selection.

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As depicted in Fig. 1, the article selection process involved searching the Scopus database using related keywords, which resulted in 2,451 articles. These were then filtered by date of publication, from 2016 to June 2021, and by document type, resulting in 506 articles. Screening also focused on the content of the articles. A total of 78 articles were considered relevant to the theme. The final step involved carefully selecting articles by reading them individually, which produced 60 articles that met the eligibility criteria.

This section examines the details of the 60 articles published between 2016 and 2021. As shown in Fig. 2, the largest number of articles, 21 in total, were published in 2020. We found 14 articles for each of 2019 and 2021. In contrast, there were only four articles in 2018 and three articles for each of 2017 and 2016. The results show that digital transformation publications began to grow in popularity in 2016 and continued to expand until 2021.

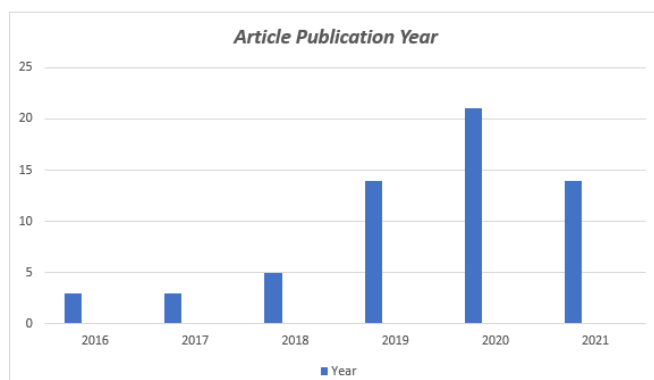


Fig. 2. Article publication year bar diagram.

We did not select the articles by their educational level during the data selection. However, we subsequently identified that 78,3% of the articles were at the higher education level, 3,3% were at the primary education level, 8,3% were at the secondary education level, and 10% of the articles did not specify the level of education. It would thus appear that digital transformation has been more popular at the higher education level.

The research seeks to answer the questions raised in conjunction with the challenges and opportunities of digital transformation in education. The exploration will focus on the opportunities and challenges as formulated into the following three research questions: What are students' perceptions of implementing digital transformation? How ready are teachers in facing digital transformation? How prepared are educational institutions in the face of digital transformation?

Following the process described by Braun and Clark [9], we use an inductive thematic approach to identify the common themes identified in each article. This process involves six stages: familiarization, generating, searching themes, reviewing themes, defining and naming themes, and reporting. During the study selection, the familiarization stage was undertaken in line with the process shown in the PRISMA flow diagram. We then used generating, searching, reviewing, defining, and naming to create a matrix concept. This process resulted in three main themes: student, teacher, and institution. We will discuss these three themes in more depth in the Results and Discussion section.

### III. RESULT AND DISCUSSION

The research on digital transformation in education is very diverse. It includes learning strategies in its application [10]-[13] the influence of its development on educational institutions [14]-[16], the perceptions of students [17] and teachers [18], and views of the future development of digital transformation in the education sector [19], [20]. This systematic literature review discusses the preparations needed to welcome digital transformation in the education sector. It focuses on the perceptions of students as implementers and the readiness of teachers and educational institutions to accept digitalization.

#### A. Students' Perceptions of Digital Transformation Implementation

Table I contains 6 themes related to the perceptions of students when facing digital transformation. We chose 6 themes based on the pros and cons as perceived by students who have experienced digital transformation in education. The six themes are learning equipment (4%), self-paced learning (17%), individualization (15%), flexibility of learning (13%), openness to new teaching concepts (10%), and student teamwork (8%). Self-paced learning was found to be the most popular theme.

TABLE I: SUMMARY OF STUDENTS' PERCEPTIONS

Theme	Number of Articles
Learning equipment	3
Self-paced learning	10
Individualization	9
Flexibility of learning	8
Openness to new teaching concepts	6
Student teamwork	5

Nowadays, society tends to have a lot of demand for education aspect. Education is currently required to provide various kinds of valuable knowledge for individuals in the social environment. [21] stated that the key to successful learning is to focus on students who continually improve and develop themselves in education. Therefore, we can measure digital transformation readiness from the perspective of students who have accepted it.

An essential aspect of implementing digital transformation in education is the availability of learning tools, which are required to change the learning system from face-to-face learning to distance learning [22]. Iivari, *et al.* [3] stated that some students had difficulty accessing the internet, devices, and online applications—especially students in remote areas. Students in remote areas have more limited access to electricity, internet connections, and technology facilities than students in the capital city [23]. This limitation means that students in remote areas are unable to participate in learning because they cannot go online.

In self-paced learning opportunities, students' abilities are influential in implementing digital transformation [24]. Korepin, *et al.* [25] found that internet users aged 18–24 years use the internet to learn independently. Digital transformation in education makes students feel happy and enables them to learn independently through their experiences [26], [27]. Students can regulate their study time and develop appropriate learning patterns [28]. However, to

succeed in digital transformation, they must also be more independent and apply the “do-it-yourself” concept [10]. Students can find out how learning occurs, and most importantly, students can reflect on their own experiences [29]. In addition, self-paced learning has an impact on students’ self-confidence. Students feel more confident after using this new learning method because they have completed the course themselves [30]-[32]. Self-paced learning also trains students to think critically, have a sense of responsibility, and empathize with others when working on group assignments [33].

For students, digital transformation can be a solution or a problem. Some students enjoy the learning activity associated with digital transformation. Millennial students, for example, have begun to prioritize themselves in developing their professional skills [34]. The use of technology in education is more effective for improving their abilities [26], fostering motivation [35], [36], and is suitable for all individuals [37]. Technology use can also be a game-changer in terms of improving students’ mood in learning [38]. However, the switch to using technology in education has also had substantial downsides for some students [26]. While students tend to be noticed by the teacher [39], digital transformation results in only limited student–teacher interaction. Piyatamrong, *et al.* [40] asserted that the use of technology results in students losing the opportunity to learn and interact socially.

Flexible learning is the essence of digital transformation. Flexibility of learning refers to learning that is carried out according to individual requests. Students can choose their subjects [37], [41], learn without limitations on time and place [31], [42], and can exchange ideas and materials through the cloud [43], [44]. Students and teachers together agree on study time. Gonçalves, *et al.* [45] stated that flexibility of learning enables teachers and students to be connected anytime and anywhere. This type of system eliminates time and place constraints from the learning process. Schools are no longer the only place for teaching and learning activities, and school textbooks are no longer the only source of student knowledge. Students can also use their mobile phones or computers to source their learning material. They can then save and share it with other students [41].

Students are open to new learning concepts and do not feel disadvantaged within the digital learning process. They tend to accept and be open to all new things developed by the school [46]. Students have also stated that they find learning online more satisfying [45]. They benefit from more knowledge when using an online system compared to being in class. With the development of remote applications, students have found that this pattern of learning saves time and improves the education system in their schools [47]. Students also feel that the process of obtaining information is easy and fast.

The basis of learning is an exchange of information and resources. The digital transformation system enables students to share material and discussions without disruption during class [44]. Digital learning tools also have a knowledge-sharing feature with colleagues [48]. Students can thus collaborate with their colleagues without having to meet. Altunay [33] stated that collaboration between students

is essential to increase critical reflection and self-assessment.

### B. Teachers’ Preparedness to Embrace Digital Transformation

Table II contains 4 themes related to teachers’ preparedness to embrace digital transformation. We chose 4 themes based on teachers’ preparation and the problems associated with dealing with digital transformation in education. The four themes are adapting to new technology (15%), learning content (22%), visionary teaching strategies (27%), and skill and competence (20%).

TABLE II: SUMMARY OF TEACHER PREPAREDNESS

Theme	Number of Articles
Adapting to new technology	9
Learning content	13
Visionary teaching strategies	16
Skill and competence	12

While Table II shows the four types of preparation for teachers when facing digital transformation—adapting to new technology, learning content, visionary teaching strategies, and skill and competence—the most popular theme was visionary teaching strategies.

Teachers are the trigger for developing the digitalization of services and teaching [17], [24]. Universities are advised to employ many competent teachers in order to provide education more effectively. The more capable a teacher, the more skilled they are in imparting knowledge to their students. Plotnikova [49] revealed that universities that have implemented digitalization also provide training for their teachers. Training is essential to increase work capacity and competitiveness [50]. Trained teachers can focus on creating long-term content and learning media.

Digital transformation in teaching means that teachers must use technology to solve problems and reflect on their learning activities [51]. The development of digital media poses a challenge for teachers, especially with the increasingly rapid development of technology. Teachers must learn how technology is used and how to integrate it into learning content. Amhag, *et al.* [52] stated that teachers need extensive knowledge support in developing digital learning media. Meanwhile, every teacher must create learning media as it is considered to increase students’ enthusiasm for learning. Pradana *et al.* [53] demonstrated that digital media supports mathematics learning activities by helping students solve problems. Digital learning media has also become an essential part of learning and the foundation of today’s education system [54]-[56].

Students’ ability to understand material depends on school policies and the teacher’s ability to teach [57]. The teacher’s role as an educator is therefore very important. Schools advise teachers to develop various learning strategies that explore the potential of new technologies. In Ukraine, for example, it is essential to develop digital competence before implementing digital transformation [58]. However, not all teachers agree with the application of digital technology in learning [59]. Technology is considered to be complicated and confusing, and teachers can feel that learning how to use technology requires ability and a lot of time. However, digital transformation in education is inevitable; sooner or later,

learning will be digitized. In 2020, the teaching and learning process underwent a drastic change as a result of the COVID-19 pandemic [60], [61]. Inevitably, teachers faced situations where technology was the only option and remote learning was the only solution. Consequently, teachers must learn to use technology and design new learning strategies that involve students [32], [33], [41], [48], [62]-[64].

Universities must hire many competent teachers to enable more effective education. The better a teacher's ability, the more effectively students can learn. Hamzah, *et al.* [59] showed that universities implementing digitalization provide training for their teachers. Training is essential to increase work capacity and competitiveness [34], [57], [58] and to develop competent educators [65]. Trained teachers can focus on creating long-term content and learning media. This aspect means that educator training and development is an essential element of quality education. Some schools use in-house training whereby the more skilled teachers become role models, mentors, and even ICT coordinators for other teachers who are not as competent in the use of ICT [66]. Digital transformation means that teachers both transmit information and teach how to access it [67].

### C. Educational Institutions' Readiness to Adopt Digital Transformation

Table III contains 6 themes related to the readiness of educational institutions to adopt digital transformation in education. We chose 6 themes based on institutions' preparations and digital transformation problems. The 6 themes comprise a new curriculum (23%), developing a training program (7%), creating an institute educational platform (18%), managing IT infrastructure (28%), data management (13%), and funds (5%).

TABLE III: SUMMARY OF INSTITUTIONAL PREPARATION

Theme	Number of Articles
New curriculum	14
Developing a training program	4
Creating an institute educational platform	11
Managing IT infrastructure	17
Data management	8
Funds	3

Schools must undertake a digital transformation, where the initial stage of digitalizing learning involves the implementation of digital technology into curriculum documents [68], [69]. The curriculum is a document that describes all the learning processes in schools. Curriculum development requires soft professional skills and cultural conformity in each society [70]. The digital transformation concept must also adapt to human approaches such as communication ethics, courtesy, and responsibility. According to [71], children can be protected from the negative impacts of technology by achieving the correct balance between technology and the human approach. Students and teachers must also change their mindsets around the use of digital technology. They must be positive and accept technology in learning. While students may prefer a more informal style of learning that has social media as an intermediary [32], schools still need specific standards concerning e-learning in order to support students' overall learning [72].

Improving the education system is the key to successful digital transformation [73]. Block [10] stated that universities playing an active role in the digitalization process must prepare ICT infrastructure, create educational platforms, and provide training to staff. Online education platforms enable students to become more flexible in accessing learning materials [41], [74], [75]. The Massive Online Open Course (MOOC) is one example of an innovative educational platform. MOOCs have fundamentally changed the online teaching process. Educational institutions develop MOOCs based on their understanding, teaching philosophy, and technology [76]. In this way, the development of MOOC curriculum standards is fundamental to the institution's vision and mission. Universities face critical tasks when seeking to develop an educational platform, including data management. Omar and Almaghthawi [77] stated that good data management underpins a university's digital transformation management strategy. By summarizing the amount of data, it is possible to evaluate the educational process.

Schools facilitate training programs for teachers and students to improve the quality of education. The existence of digital transformation makes teachers and students more appreciative of training programs [74], which are considered necessary to improve competence and skills for teaching and learning activities. As a result, various schools have designed IT-based training programs to support digital transformation in education [39], [59].

Digital transformation in the education system also depends on the level of ICT infrastructure in each school [78]. Yakovenko, *et al.* [79] asserted that only educational institutions with modern digital technology can compete in this era of digitalization. There has been an increase in the amount of ICT infrastructure on campus that is useful for communication systems, cultural values, and solving scientific education and technology problems [35]. A further benefit of increasing digital infrastructure is the improvement in students' learning motivation [80].

The principal barriers to the digitalization of education are a lack of human resources, lack of funds, and insufficient technological resources [81]. A lack of funds acts as a constraint on educational institutions, which means they do not prioritize spending on ICT infrastructure. A shortage of funds also renders it more likely that academic institutions will not correctly carry out the process of digital transformation.

## IV. CONCLUSION

In recent years, digital transformation has become a popular topic in various fields of life, with education a prime example. This systematic literature review has explored digital transformation readiness in the education sector. We discussed students' perceptions and the preparations teachers and universities must undertake in readiness for digital transformation.

Students, as the primary beneficiaries of learning, must accept the advent of digital transformation in their schools. They typically do not get an opportunity to prepare themselves. This systematic literature review discusses

students' perceptions of digital transformation. We identified six themes for student perceptions: learning equipment, self-paced learning, individualization, flexibility of learning, openness to new teaching concepts, and student teamwork. Among these perceptions, self-paced learning was the most evident. Students stated they liked digital transformation because they could learn independently (self-paced). They can also regulate their study time and develop appropriate learning patterns.

Teachers are the trigger for the digitalization of services and teaching. The more competent a teacher, the more skilled they are in imparting knowledge to students. Therefore, teachers must be prepared for digital transformation. We identified four themes related to teacher preparedness for digital transformation: adapting to new technology, learning content, visionary teaching strategies, and skill and competence. Visionary teaching strategies was found to be the most common type of preparation. In embarking on a process of digital change, teachers must have a range of learning strategies that explore the potential of new technologies.

Universities are prominent supporters of realizing digital transformation in education. Their support is critical to the digitalization of education. We identified six themes linked to the preparedness of educational institutions to adopt digital transformation: new curriculum, developing a training program, creating an institute educational platform, managing IT infrastructure, data management, and funds. We found that managing IT infrastructure was the most common type of preparation. This reflects the way in which implementing learning into digital technology forms the basis of digital transformation. It is therefore natural for institutions to increase ICT infrastructure in preparation for digital transformation.

In terms of its limitations, this article does not generally discuss the problems encountered in implementing digital transformation. However, we did identify certain issues, including the lack of competent human resources, funds, and insufficient IT equipment. The implementation of digital transformation requires schools to upgrade their conventional learning media to digital media. Teachers must also master emerging new technologies. Training is a key tool in overcoming teachers' reticence to implement technology in their learning. The main barrier is that teacher training and upgrades to IT infrastructure require both time and money.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

Rizka Latifah conducted the data search, constructed the matrix concepts, and wrote the initial draft.

Cucuk Budiyo reviewed the matrix concept and refined the manuscript draft.

Herman Saputro reviewed the initial manuscript.

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