



A Literature Review on Digital Transformation of Higher Education

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ABSTRACT: The COVID-19 epidemic in 2020 accelerated the digital transformation of society, and the education industry was the first to bear the brunt and responded quickly. By combing through the literature related to the digital transformation of higher education, it can see that the digital transformation of higher education is the development trend of higher education. At the same time, universities and teachers have a huge impact on the digital transformation of higher education. This study will use the method of literature review to systematically sort out the existing literature starting from the characteristics of digital education, the foundation of digital education and the digital transformation of higher education, and summarize the feasible directions for the digital transformation of higher education.

KEYWORDS: Digital Transformation of Higher Education, Digital Higher Education, Teacher Digital Literacy, Literature review

I. INTRODUCTION

In the history of the development of human society, technological updates are often accompanied by changes in education. (Secretariat of the Global MOOC and Online Education Alliance, 2023a). The emergence of the steam engine triggered the First Industrial Revolution, at which time the education was apprenticeship, training professional skills; The emergence of electricity triggered the Second Industrial Revolution, when education was mass education; The emergence of computers triggered the Third Industrial Revolution, when education was based on digital learning from online resources; The application of the Cyber Physical System triggered the Fourth Industrial Revolution, and correspondingly, the education industry also experienced another transformation (Lu et al., 2021).

The digital transformation of higher education is a systematic and complex project, not an overnight thing (Qi & Zhang, 2022). Lusk (2020) pointed out in his research that the success rate of digital students is lower than that of traditional

teaching students, and the reasons for this situation are diverse. Teachers lack online teaching technology, students lack learning motivation, and curriculum design does not conform to the digital teaching environment, all of which have a negative impact on the quality of digital teaching. At the same time, digital education also brings psychological burden to teachers and students, which has an impact on their physical health and social life (Chakraborty et al., 2021).

In 2020, the COVID-19 epidemic accelerated the digital transformation of higher education. Scholars from all over the world paid more attention to the digital transformation of higher education and discussed the digital transformation of higher education from multiple perspectives. However, the existing literature is still insufficient in systematically sorting out these research results. In order to fill this gap, this article will start from the characteristics of digital education and the digital transformation of higher education, and systematically review the research related to the digital transformation of higher education.

II. THE CHARACTERISTICS OF DIGITAL HIGHER EDUCATION

In the digital era, higher education is intelligent, diverse, flexible and personalized. It not only changes students' learning methods and teachers' teaching methods, but also puts forward new requirements for universities (Meng & Ma, 2022).

[1].TEACHING METHODS

Teaching methods is a general term for the behaviors of teachers and students in order to achieve the teaching goals when teachers and students participate in the teaching process together, and it is affected by teaching forms (Jia, 2022). Jia (2022) pointed out that teaching in the digital age is not a simple classroom migration, it is also accompanied by changes in the way teachers and students communicate and the way students learn. Similar, Wang et al. (2020) pointed out in their interpretation of "Schools of the future: Defining new models of education for the fourth industrial



revolution" that the digital transformation of higher education is a systematic project, which is the result of the joint efforts of many parties, among which including changes in teaching methods.

No matter what the teaching method is, online education or offline education is inseparable from the collision of thinking, and the transmission of knowledge depends more on the communication between people, which is also one of the important factors for the success of education (Chen, 2018). Díaz-Noguera (2022) and his team studied the impact of autonomy, motivation and digital education on online higher education during the epidemic through questionnaire surveys, they pointed out that students hope to communicate with teachers at least once a week, it can be seen that interaction is of great significance to digital education.

In the age of online education, several researchers (Nichols, 2020; Lusk, 2020; Le et al., 2022) think the quality of online education is related to the interaction between classmates and the professor. Research shows that the effective interaction between teachers and students in online education will obviously improve the learning quality of students. The scope of effective interaction is wide, including in-class questioning, after-class communication, test, and one-on-one guidance (Martin, 2020).

However, effective interaction in online education is difficult to establish. Liu and Hao (2022) studied online education from the perspective of communicative behavior. They believed that both teachers and students are hidden behind the network without physical contact. Their speech is carefully crafted and has a certain degree of camouflage, it is difficult to know the real counterpart (Liu et al., 2022). Without knowing the real situation of students, it is difficult for teachers to carry out targeted interactive communication. Thus, the important is to building trusting connections between teachers and students. Using virtual images, network language and other advanced teaching elements to make the classroom gamification can effectively shorten the distance between teachers and students, active classroom atmosphere, and make students fully into the classroom. According to China Education Online, teachers at a university in Changchun, China, use virtual technology to stimulate students' enthusiasm and initiative during their online courses which not only enhances the charm of the classroom, but also helps students concentrate and master the content of the course (Gao et al., 2022).

Due to the virtuality and distance of online education, it is difficult for teachers to control the learning status of students. Different from the traditional classroom, in online education, teachers and students are separated by electronic screens, and once the students' cameras and devices are turned off, teachers will not be able to control the students' learning status (Coman et al., 2020). Are the students listening carefully? Are students chatting with others or not in front of the screen at all? Effective interaction can bring students back to the classroom. On the other hand, Martin (2020) points out that in online education, teachers are looking at dozens or even dozens of students on an electronic screen, and it is difficult to monitor their understanding. This requires teachers to make adequate preparation, often remind students to overcome the temptation of the Internet (such as games, online shopping, etc.) to put more energy into learning, set more frequent homework deadlines to create more opportunities for students to contact teachers, all of which are ways to improve students' knowledge understanding. In order to accomplish all of this, teachers should engage and interact in a way that promotes students' careers, demonstrates their humanistic values, and builds trust between them and students (Luck, 2020).

Online education has the attribute of collaboration, not only because network technology can reduce unnecessary energy expenditure in the process of collaboration, but also expand the scope of collaboration (Chen, 2018). As the main method of online collaborative learning, online study groups have been found by some scholars (Alhammadi, 2021; Jia, 2022; Xiong, 2020) to be a feasible way to improve the quality of online education.

Jia (2022) clarified the importance of innovative interactive methods in online education from the perspective of constructivism, and the formation of study groups is a good choice. Constructivism believes that teaching is not a simple process of knowledge transfer, but a process of "growing" and "changing" students' original knowledge through the collision of thinking. The purpose of the study groups is to complete the learning task, and the process is that the members of the group questioning, exploring and developing the original knowledge (Jia, 2022). Jia (2022) pointed out that in the online education environment, the formation of a study groups is not only beneficial to students collaborative learning, and it is beneficial for teachers to guide students. He believed that teachers grouping students according to their individual differences will help teachers provide



targeted guidance and personalized help to students, thereby improving the quality of online education.

Different from Jia, Alhammadi (2021) explained that the formation of study groups can improve the quality of online education from the perspective of students' sense of responsibility and network virtuality. Alhammadi (2021) called the online study groups an internet café, and each study group has its own leader or administrator. Through interviews, he found that those students who act as group leaders will take the initiative to undertake group learning tasks, and they will take the initiative to find learning materials to promote the learning process of the group. Some students will be shy about expressing their ideas in offline study groups, but the online environment will make them feel safe and courageous to express their ideas and participate in discussions (Alhammadi, 2021).

There are many classification methods for online study groups. Xiong (2020) synthesized previous research and divided online study groups into online mutual-help group, online cooperative group and online collaborative group, and the learning modes based on these three types of groups are information transmission, knowledge transmission and knowledge generation. In-depth education pays attention to the construction of students' knowledge, so the online collaborative group has become the focus of Xiong's research. The learning abilities and learning habits of the team members in the online collaborative group are similar, and they have complete trust with each other, so they can promote each other and grow together. Like Alhammadi, Xiong (2020) believed that different roles such as team leaders should be set up in the online collaborative group to stimulate students' sense of responsibility and improve learning efficiency.

[2].MANAGEMENT MODE

With the development of society and the progress of The Times, universities also need to keep up with the pace of The Times and the change of students' learning patterns and upgrade their management mode. Especially since large-scale online education, the existing mature management mode can no longer support online education (Tang, 2022). It can not only improve the quality of teaching, but also help improve the overall quality of students by using Internet factors in management mode (Zhao, 2018). This section will elaborate from three dimensions: curriculum management, teacher management and student management.

Online education is not restricted by space and time, it saves teaching resources and breaks the universities' original course management model. For

example, in terms of teaching time, as mentioned above, Li (2021) pointed out that 15-30 minutes of online teaching is enough to make the classroom effective, and too long online teaching does not promote the learning efficiency of students and the effectiveness of teachers' work, even will cause negative impact. In terms of course resources, some courses are rich in online education resources, and some courses are lacking in online education resources. The online teaching management for different courses should be adjusted according to the actual situation (Zhao & Zhang, 2022). As of December 2022, when searching for advanced mathematics, applied psychology, college English, and quantum mechanics on MOOCs for Chinese college students, the searched course results are 1656, 1137, 264, and 439, respectively. It can be seen that there are obvious gaps in the online resources of different courses.

A study by Hu (2022) showed that objectives of online and offline education were different, which caused by the learning environment. He pointed out that the design of online courses should be completed by teachers with rich experience in online teaching, exploring and constructing online teaching resources, course objectives and teaching methods. At the same time, in terms of teaching supervision's evaluation of online courses, Hu (2022) believed that the concept should be changed, from restricting teachers and students in the traditional teaching model to serving teachers and students, collecting teachers and students' evaluations of courses, and understanding the needs of teachers and students. Provide support for the successful progress of online education. In terms of curriculum development, Zhao and Zhang (2022) showed the process of online education through repeated practice in their research. They divided the process of online education into pre-class, in-class and after-class. The pre-class part was mainly to prepare teaching materials, organize personal image, adjust teaching equipment and plan teaching environment. The in-class part was mainly to sign-in, clear teaching objectives, brief introduction of knowledge points, student discussion, teacher-student interaction, teacher explanation, summary and assignment of tasks. Among them, the clear teaching goal can be to play the pre-recorded video within 5 minutes, which can not only activate the classroom, but also reduce the workload of teachers; there are various forms of teacher-student interaction, which can be sharing experience, asking questions, or classroom test. Finally, the after-class part was student feedback, follow-up assessment,



evaluation of the course and summary of the course (Zhao & Zhang, 2022).

In many scholars' studies, it has been pointed out that teachers lack of digital literacy is one of the factors affecting the development of online education (Zhao, 2018; Coman, et al., 2020; Rajcsányi-Molnár & Bacsa-Bán, 2021; Li & Yu, 2022; Zhao & Zhang, 2022). Li and Yu (2022) believed that teachers must have adequate digital literacy to ensure the teaching process successfully in current online education. Their research showed that due to the inertia of thinking, teachers think that it was useless to add digital technology to existing courses, and it was time-consuming and labor-intensive to participate in digital technology promotion training. This phenomenon was especially obvious in offline education, and it was not related to the age gap and background of teachers (Li & Yu, 2022). Similarly, Zhao (2018) pointed out that mental inertia was one of the reasons for the differences in teacher digital literacy. Her research showed that most teachers had not changed their concepts, and still used traditional methods and rely on experience for teaching. But different idea from Li and Yu, Zhao believed that the age gap was also one of the reasons for the differences in teacher digital literacy. She pointed out that due to the age gap, older teachers did not catch the impact of the Internet on the education industry in time, and their lack of understanding of the Internet led to a slow improvement in their digital literacy (Zhao, 2018). Based on these reasons, Nichols (2020) and Tang (2022) both suggested that universities should set up teacher training courses to instruct teachers on how to apply Internet technology and how to design online courses. At the same time, there will be some emergencies in the online education process, such as platform freezing, no sound or other unexpected situations. It is an effective way for universities to set up technical teams to solve unexpected problems on the software platform for teachers in real time (Zhao & Zhang, 2022).

On the other hand, many scholars agree that online education gives teachers more tasks and increases the workload of teachers (Rajcsányi-Molnár & Bacsa-Bán, 2021; Li & Yu, 2022; Li, 2021; Jia, 2022). Rajcsányi-Molnár and Bacsa-Bán (2021) surveyed more than 1,300 international students and 125 teachers to obtain their feedback on online education. Based on the returned questionnaires, in addition to digital literacy issues, most teachers believed that in the online education, they not only undertake teaching tasks, but also increase management tasks, which undoubtedly

increased their workload dramatically. Li (2021) also pointed out that due to the need to receive skill training for online education and to make the online teaching process successfully through continuous practice, teachers need to spend more time. However, there was still ambiguity in the calculation of teacher workload during online education (Ali, 2020). How to calculate teachers' workload, maintain teachers' teaching satisfaction, and improve teachers' teaching enthusiasm are one direction for the upgrading of the management model.

In the online education, students' body and mind are being tested. Physically, in the face of long-term online learning, they have to stare at electronic products all the time, which has an impact on their health due to radiation and sedentary sitting (Tang, 2022; Chakraborty et al., 2020). Psychologically, they often feel lonely and even depressed due to worries about their studies and less communicating with partners who have common goals (Martin, 2020; Li, et al., 2022; Gao, 2021). The ability of students' autonomous learning greatly affects the quality of online education (Hu, 2022; Jia, 2022; Bao, 2020). All this raises new issues for student management in online education.

Ma (2021) conducted research on online education student management from the perspective of students' mental health. First of all, he analyzed the reasons for the frequent occurrence of students' psychological problems during online education, and then proposed strategies to strengthen students' psychological monitoring during online education. He believed that it was feasible to increase the frequency of psychological screening to find students with psychological abnormalities in time. However, psychological screening cannot guarantee 100% success. It also required the cooperation of student managers and teachers to pay attention to students with a high sense of responsibility and humanistic care (Ma, 2021). It can help students overcome psychological barriers and build a trust relationship between students, teachers and universities by the management and communication platform based on an emotion-based (Wei & Xing, 2021). This management model of humanistic care can also be called the humanistic management model. Su (2022) pointed out that the humanistic management model can mobilize students' enthusiasm for learning, better cooperate with classroom teaching, to enable students to accept knowledge from passive force-feeding to active absorption of knowledge. Moreover, this concept that everything is student-oriented and all work is for the development of students can effectively



shorten the distance between the universities and students, transform parental-style management into friend-style care, and change from the requirements of superiors and subordinates to equal communication (Su, 2022). This can effectively eliminate students' rebellious psychology, subtly make students grow into more independent and autonomous people, and can effectively improve students' psychological endurance (Wei & Xing, 2021).

A study by Zhong et al. (2021) showed that creating a good learning atmosphere can not only improve the quality of online education, but also improve the effectiveness of student management. However, creating a learning atmosphere in online education is not only the responsibility of the university, but the family is also an important part. For the development of students, the university and the family form a "university-family community". In terms of university, strengthen the connection with class cadres and give full play to the role of class cadres, ensure the attendance rate of online classes, and guide students to develop good study habits. During class, the class cadres actively interact with teachers and cooperate with teachers to maintain and create an online classroom atmosphere. In terms of family, prepare an environment suitable for online learning for students, and regularly communicate with the university about the students' learning status, so as to make the university's student management work more efficient (Zhong et al., 2021).

III. THE FOUNDATION OF DIGITAL EDUCATION

As Qi and Zhang (2022) said, education is the "online and offline blender teaching" that has developed from the "blackboard writing era" to the "multimedia interactive era". Higher education should also make corresponding changes to support the changes of the times

[1]. HARDWARE FOUNDATION – DIGITAL EDUCATION EQUIPMENT

Accordingly, education's demand for infrastructure has also changed from chalk blackboard to computer network, to intelligent software and online platform. And Han et al. (2022) expounded the support that higher education in the digital era needs to provide from the perspective of students' digital literacy. They believe that the way students learn in the digital age has undergone a fundamental change. It is no longer simply to obtain static knowledge from teachers, but the application of electronic products and the Internet has also changed the way students learn. In order to cope

with the changes of students, higher education needs to provide corresponding supporting conditions, such as smart classrooms, flipped classrooms, online education, etc. (Han et al., 2022).

Digital education requires higher infrastructure. Colleges and universities should increase investment in network platforms and build a network transmission system with high efficiency and large capacity. Only with stable hardware support can the output of modern technology be guaranteed in higher education (Shi & Nong, 2018; Yi, 2021). However, the update of information technology and the construction of network platforms require a lot of manpower, material and financial resources. For colleges and universities, the rate of renewal of information technology is low, and most colleges and universities are only superficial and have not gone deep into the core issues of information technology (Tang, 2022).

[2]. SOFTWARE FOUNDATION – TEACHER DIGITAL LITERACY

The digital transformation of higher education is facing many challenges, but most scholars believe that teacher digital literacy is the core of transformation. Yureva et al. (2020) believed that in the process of digital transformation of higher education, it is difficult to improve teacher digital literacy. Although more than half of the interviewed teachers had a positive attitude towards digital transformation of higher education, they were not ready for digital transformation, rarely apply digital awareness to teaching. At the same time, they also pointed out that students' digital awareness and ability to use various digital tools are directly related to teacher digital literacy, and teacher digital literacy plays a crucial role in the process of digital transformation in higher education (Yureva et al., 2020). Similarly, Han et al. (2022) agreed with Yureva et al. (2020), they believed that the core of the digital transformation of higher education is the digital transformation of teachers. Han et al. (2022) analyzed the core issues in the digital transformation of higher education from the perspective of the main body of learning and teaching, that is, the digital transformation of students and teachers. The digital transformation of students is the goal, and the digital transformation of teachers is the core. They believed that the improvement of teacher digital literacy is a long-term systematic project that requires the cooperation and joint efforts of the government, society, schools and teachers.

Many scholars have studied the digital literacy of teachers and given the connotation of digital literacy. Li et al. (2022) pointed out in their research that in the digital era, teacher digital



literacy should not only stay in the indicated knowledge and skills, but should be a transformation of digital thinking and the germination of innovative awareness. How to innovate the teaching mode and how to integrate digital technology into the teaching process were the problems faced by teachers to improve their digital literacy. Similarly, Qi and Zhang (2022) believed that teachers in the digital era need to improve their Internet thinking and teaching ability. They pointed out that the focus of Internet thinking is equal discourse power, and the status of students and teachers is equal, which requires teachers to make positive changes. At the same time, in the teaching process, teachers need to pay more attention to students' learning experience, increase effective interaction, and improve Internet teaching. In terms of Internet teaching ability, they believed that teachers should actively learn Internet knowledge and adapt to the new teaching environment (Qi & Zhang, 2022).

Ge and Han (2017) added what digital literacy teachers should have from the perspective of ethical cognition. They believed that in addition to the professional knowledge involved in teaching and the application of digital technology, in the digital era, teacher digital literacy should also include digital security and digital ethics literacy, as well as the literacy of correctly recognizing virtual and reality (Ge & Han, 2017). At the same time, they divided the process of improving teacher digital literacy into three stages, namely, the application stage, the deepening stage and the innovation stage. In the application stage, teachers begin to have the awareness of improving digital literacy, and they will actively apply technical tools. At this time, the digitalization of teaching is visible, that is, the application of software and technology; teachers in the deepening stage have a deep understanding of digital literacy, and can use digital literacy runs through teaching. At this time, the digitalization of teaching is invisible, and digital teaching becomes smoother; until the innovation stage, digital

transformation has begun to see scale, and teachers can actively explore, innovate, and reform higher education. facilitate its digital transformation (Ge & Han, 2017).

Scholars from Russia Kulikova et al. (2020) summarized the study of the analytical center NAFI (Moscow National Institute for Financial Research) on digital literacy of teachers. They pointed out that NAFI assessed teacher digital literacy in five dimensions, namely, information literacy, computer literacy, communication literacy, media literacy, and attitudes towards technological innovation. First of all, information literacy is from the perspective of cognition, which is the ability to distinguish and process information; computer literacy is from the perspective of operation, which is the ability to effectively operate various digital equipment; media literacy is from the perspective of information sources, considering the degree of understanding of the form and method of information dissemination; communication literacy is from the perspective of ethics and technology, which is the ability to apply network technology in line with ethics; finally, the attitude towards technological innovation is to consider the subjective understanding of individuals. In NAFI's study, the five dimensions were measured separately. The final results showed that although teacher digital literacy is generally high, the scores related to personal cognition and attitude are very low (Kulikova et al., 2020). For this reason, Kulikova et al. (2020) believed that relying on teachers to improve digital literacy is almost impossible.

Until November 2022, the Ministry of Education of China released the education industry standard of "Teacher Digital Literacy" (Ministry of Education of the People's Republic of China, 2022), and China has a basic consensus on the connotation of teacher digital literacy. The standard gives the definition and framework of digital literacy for teachers, as shown in Figure 1.

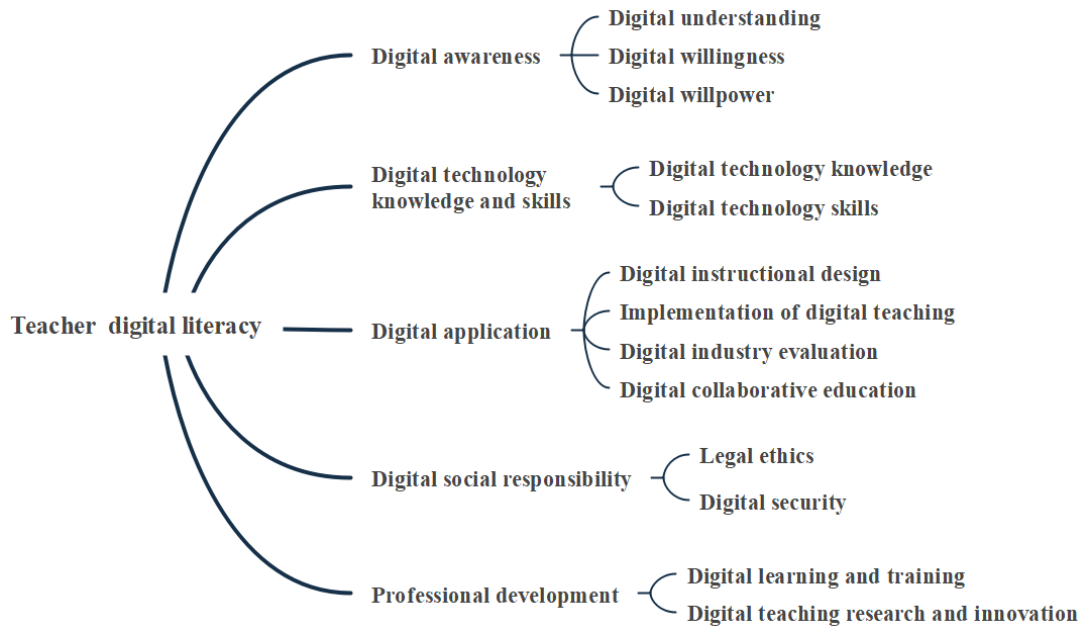


Figure 1 The Framework of Teacher Digital Literacy (Ministry of Education of the People's Republic of China, 2022)

IV. DIGITAL TRANSFORMATION OF HIGHER EDUCATION

The talents cultivated in the 4.0 stage of higher education should serve the industry 4.0, that is, possess information technology skills, innovative thinking and critical awareness. Countries and organizations around the world have realized that the current education model can no longer meet the needs of Industry 4.0, and the digital transformation of higher education is the general trend (Li et al., 2022).

[1].CURRENT SITUATION OF DIGITAL HIGHER EDUCATION

At present, many universities and educational institutions are already to educational

transformation to adapting the era of IR 4.0. The report "Schools of the Future: Defining New Models of Education for the Fourth Industrial Revolution" listed 16 cases of educational transformation in 14 developed and developing countries including the United States, the United Kingdom, Canada, Indonesia, Vietnam, and Peru et al. (World Economic Forum, 2020). At the same time, various countries and organizations around the world have also issued guidance documents related to digital transformation. The researchers compiled some representative documents, as shown in Table 1. It can be seen that the digital transformation of higher education and the cultivation of digital talents that meet the needs of the times are the general trend

Table 1 International documents on the digital transformation of education

Nation/ Organization	Document	Year
UNESCO	UNESCO ICT Competency Framework for Teachers	2011
USA	National Educational Technology	2017
Singapore	Educational Technology Plan (2020—2030)	2019
Korea	Basic Plan for Education Informatization 2019-2023	2019
European Union	Digital Education Action Plan 2021-2027	2020
Russia	Directions of the strategic transformation of the digitalization of education in relation to the field of activity of the Russian Ministry	2021



	of Education	
UK	Education technology: exploring digital maturity in schools	2022
UK	Framework for digital transformation in higher education	2023
France	Digital Education Strategy 2023-2027	2023

In December 2022, the 3rd World MOOC and Online Education Conference was held in China. After the conference, the secretariat of the global MOOC and online education alliance released "Excerpted from infinite possibilities: Report on the digital development of global higher education". The report described the future development trend of higher education and the current status of digital higher education around the world. At present, the world has noticed the importance of digital education, and has introduced policies to increase investment in digital education facilities. France even provides protection for the digitalization of higher education in the form of law (Secretariat of the Global MOOC and Online Education Alliance, 2023b). The report pointed out that the digitalization of higher education in Asia has been developing for some time, and the current digitalization process has penetrated into all areas of the education system. Digital higher education in most Asian countries has focused on promoting social and economic development through the digital transformation of higher education. With the help of international aid, a few countries have carried out higher education reform one after another. African countries and South American countries started digital higher education late. African countries have realized the importance of higher education digitalization and have issued policy reports to promote the process of higher education digitalization. The level of digital higher education in South American countries is also constantly improving, and the application of digital technology in various fields of society is also increasing. Digital higher education in European countries started earlier, and currently most countries have focused on digital platforms and digital empowerment. The North American concentration represents the core reinvention of the United States and Canada advancing digital higher education through infrastructure, curriculum, and teaching. On the other hand, Oceania has a relatively high level of digital higher education development, both in terms of digital education infrastructure and the digital level of students are among the top in the world (Secretariat of the Global MOOC and Online Education Alliance, 2023b).

Li et al. (2022) believed that higher education is affected by both internal and external factors, and the digital transformation of higher education is a process of integration of internal and external factors. Among them, the internal factors are the implementing agencies, implementers, educated persons, curriculum and evaluation system of higher education. The external factors are social needs, economic forms, government policies and technical support. Internal and external factors of higher education influence each other and lead the digital transformation of higher education (Li et al., 2022). They pointed out that there are three phases in the transformation process, namely the integration phase, the initial phase, and the advanced phase. In the integration phase, internal and external factors begin to integrate, influence each other, and change each other to match each other. From the initial construction of digital infrastructure, to the reorganization of training objectives and curriculum settings, transition to online and offline blender education. The transformation at this time is the reform of the technical level, the reform of the hardware of higher education, and then enters the primary phase of transformation, that is, the reform of the software of higher education. The transformation in the primary phase is mainly focused on majors and courses, weakening the boundaries of educational institutions, creating shared educational resources, and focusing on the individual development of students. Finally, the advanced phase of digital transformation is the reform of the core of higher education, that is, the boundaries between universities are completely broken, and all educational resources are shared (Li et al., 2022).

[2].THE PROCESS OF DIGITAL TRANSFORMATION OF HIGHER EDUCATION

And Cheng et al. (2022) analyzed the process of higher education transformation from the school level. They divided the higher education transformation process into four phases, namely the unconscious phase, the exploration phase, the early implementation phase, and the growth phase. The unconscious phase is that university leaders are ignorant of the digital transformation of higher education; the exploratory phase is that the



university leaders have plans for the digital transformation of higher education; the early implementation phase is that corresponding policies have been introduced to support digital transformation, and there are pilot practices; the growth phase is when there is a complete system to support digital transformation (Cheng et al., 2022). They believed that when the transition from the unconscious phase to the exploratory phase requires university leaders to make a master plan for digital transformation; when the exploratory phase transitions to the early implementation phase, university teachers and administrators need to raise awareness of digital transformation in higher education and make innovations; in the transition from the early implementation phase to the growth stage, the focus is on students. The goal of digital transformation is to cultivate comprehensive talents for IR 4.0. The success of the transformation depends on the quality of student output (Cheng et al., 2022)

[2]. BARRIERS TO DIGITAL TRANSFORMATION OF HIGHER EDUCATION

Barriers faced by teachers. In the process of digital transformation of higher education, teachers are faced with many challenges, such as insufficient understanding of digital transformation of higher education, insufficient technical literacy, and psychological fluctuations in the process of transformation. Firstly, Yureva et al. (2020) conducted an online survey of faculty and students to measure risks in the digital transformation of higher education. They believed that in the current higher education, most teachers do not have enough understanding of the digital transformation of higher education. In teaching, the application of digital technology is only in the initial stage, such as downloading course materials, making lesson plans or class management, which is the "multimedia application stage" mentioned above. Similarly, the research of Li and Yu (2022) showed that due to the inertia of thinking, teachers think that it is useless to add digital technology to the existing curriculum, and it is time-consuming and laborious to participate in digital technology promotion training. Secondly, technological literacy of teachers also affects the digital transformation of higher education (Yureva et al., 2020; Li et al., 2022). Li et al. (2022) pointed out that teachers' digital literacy is not just about operating electronic devices and applying teaching software, but the awareness and ability to integrate digital technology into teaching, which is a teaching ability that is coordinated with artificial intelligence. At the current stage, the digital

literacy of most teachers is not enough to support the progress of the digital transformation of higher education. Thirdly, in the process of improving teachers' digital literacy, they also have to face students, the "network natives" (Gan, 2021). Gan (2021) pointed out that teaching activities are no longer limited to traditional classrooms and syllabi, teachers will have psychological fluctuations, on the one hand from the challenges in the process of self-improvement, on the other hand from students' doubts.

Barriers faced by universities. On the one hand, the obstacles faced by universities come from inertial thinking. Li et al. (2022) pointed out in their research that the final stage of the digital transformation of higher education is to break down the barriers of educational institutions and realize the interconnection of educational resources, which is a challenge to the higher education operation model and the education system. However, the existing inertia of the current higher education system restricts the achievement of this goal. Educators still use the previous thinking to carry out higher education reforms, believing that digitalization is "technology empowerment" on the basis of the original education (Li et al., 2022). On the other hand, it comes from economic strength. Ning et al. (2022) pointed out that the foundation of the digital transformation of higher education is the basic equipment sufficient to support its transformation, and the investment in basic equipment is directly related to the economic foundation of institutions and even regions. This will inevitably lead to unbalanced development in the process of transformation. Universities in areas with better economic conditions are more likely to receive financial support and carry out digital transformation of higher education than those in areas with poor economic conditions (Ning et al., 2022). Similarly, Meng and Ma (2022) also pointed out in their research that regional economic strength is directly related to the digital transformation of higher education. Both the infrastructure and the level of teachers are related to the regional economic level (Meng & Ma, 2022).

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