Practicing Online Higher Education Facilitated by ICT in China: In the Context of COVID-19 Pandemic

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The impact of COVID-19 pandemic on higher education pushes forward the transformation of traditional in-class education to fully online education. The chapter analyzes the experience of online education firstly in literature, particularly, the external and internal elements that influence learning outcomes in flipped classrooms and Massive Open Online Courses (MOOC). Besides, the chapter also touches base on the learning behavior change in online higher education to reveal the internal driving force of self-regulation in the distancing learning environment. The results of a survey in the course of GIS for Real Estate to analyze the importance of the crucial elements in the learning practice suggest that COVID-19 pandemic has a crucial influence on the teaching-learning process. It has been also noticed that the resilience of the community to the shock of health disaster and the speed of reaction to the preparedness for the change in the broader sense is meaningful to the success of the practice of higher online education.

21.1 Introduction

COVID-19 pandemic is a devastating global crisis which has caused millions of confirmed cases and hundreds of thousands of death. It is the most serious global epidemic since the Spanish pandemic 100 years before. In China, the pandemic is a nationwide epidemic, reshaping social activities as well as causing changes in higher education. The online higher education has become a teaching-learning routine since the spring semester in 2020, influencing approximately 32 million students studying in colleges and universities. The fully online higher education causes the transformation of such a vast amount of students studying remotely from home.

There is limited information on online higher education in practice. Different from theoretical research, practical research requires a solid investigation of operations in online education, particularly, the ICT preparedness, the monitoring process, and the evaluation of performance. In general, the prerequisites of the practice influence the most in terms of successful implementation. That means the following three points are important. First, ICTs should be ready and accessible. Teachers and students have access to the internet as well as mobile devices. Second, mobile devices and online applications can be applied to the learning management system. Users' devices can access learning management systems and online applications. Third, sufficient and informative online courses should be available. Teachers have recorded teaching videos and calibrate digital materials for teaching purposes.

The practice of online higher education officially started on 1st March 2020 when the spring semester began. Up till the end of the semester in July, it has shown that the practice was generally successful. It is necessary to introduce the experience in practice and analyze the pros and cons. Therefore, the chapter focuses on the current practice of online higher education facilitated by ICT to illustrate the crucial elements of maintaining the performance in the context of the COVID-19 pandemic in China.

21.2 Literature Review

21.2.1 ICTs and Online Accessibility

It has been a long history of discussion of online higher education in theory. By definition, online education refers to educational activities in cyberspace which are facilitated by the internet, information communication technology (ICT), and geospatial information system. Due to the innovative way of remote teaching and distancing learning, online education creates the virtual reality of study anytime, anyplace for anyone. To be exact, the virtual environment bases on the internet and ICT, leveraging the advantages of flexibility, accessibility, content diversity, scalability, and cost-effectiveness in modern education. In that sense, ICTs are the fundamental instruments in the knowledge delivery, engaging teachers together with learners in problem-solving and critical thinking [1].

As remote teaching and learning require the accessibility of online courses, the ICT facilitation is critical regarding the successful performance of distancing education. It also matters the engagement of students in the technology-enriched learning environment which is important to identify and evaluate the students' needs and help teachers to calibrate the teaching content to the knowledge in their need.

Apart from the facilitation of ICT, online higher education also requires students to have strong self-directed and self-regulated inner drives. In that sense, the design of an online learning environment is crucial. The supportive online learning environment includes three layers, i.e. participants, micro-level and macro-level environments [2]. The layers overlap and cooperate in the creation of a satisfactory and accessible virtual learning environment. In the three layers, the participants are the central roles as instructors, responders, and actors; the micro-level environment refers to the learning management system (LMS) that forms the digital interactive platform; the macro-level environment consists of the cyber and digital environment and ICTs' facilitation.

As the online learning environment is important regarding course performance, the previous researches reveal the elements that foster a good environment. For example, researchers find that the appropriate instructional design of prediction, observation, explanation, and evaluation (POEE) is necessary for the inquiry learning process. Besides, the course design in the scaffolding modular structure is meaningful to a better understanding environment and it can also provide support for self-learning [3, 4]. In addition, the online self-assessment toolbox in the learning management systems (LMS) and the virtual learning environment (VLE) interface facilitates leaning performance as well [5]. Furthermore, the design of sociable environments can enhance learners' social presence and interaction, which enables confidence in the learning process [6].

21.2.2 Experience Learned from Flipped Classroom and MOOC

As discussed, the readiness of digital infrastructure is crucial regarding the preparation of online education. The ICT infrastructure requires high-speed digital signals, mobile smart devices as well as environment friendly leaning management systems (LMS). Before the pandemic, the online higher education facilitated by ICT has been prevalently used in blended learning (BL), such as flipped classroom and Massive Open Online Courses (MOOC), which is known as one of the major trends in higher education [7]. In the face of the epidemic, the former experience of flipped classroom

and MOOC is beneficial to teachers as it is helpful in terms of appropriate online resources and adjustable video courses to different levels of learners.

21.2.2.1 Flipped Classroom

The flipped classroom is a model that the in-class teaching course is deliverable outside the classroom via virtual online LMS, leaving the time in the classroom effective for questions and discussions [8]. The flipped classroom is regarded as an advanced teaching method due to the power of online teaching technology, driving the significant contribution to efficient learning outside the classroom, and leaving the time in class open for the innovative collision of deep thoughts.

There are arguments about the pros and cons of flipped classroom and experiences can be referential to online education. As the teaching content is taught in the video course, the well-designed video course is crucial to efficient learning outside the classroom. Besides, knowledge, skills, engagement with students' satisfaction, and advanced organization via e-learning management system (LMS) are the fundamental dimensions of the flipped classroom [9].

The flipped classroom emphasizes the teacher's ability of course control regarding the course design in terms of the percentage of the video course and in-class interaction, the skill of instilling various knowledge in class monitoring, the organization's ability as well as the engagement of students in the teaching-learning process. However, the flipped classroom is not the fully-online education as the part of education is still conducted in the classroom. The teachers and students still have the chance of face-to-face interaction, so traditional ways of the class organization such as group discussion can be fulfilled. The outside and inside classrooms are complementary to the goal of good performance of the learning process. Even if the failure of teaching outside the classroom fails, there are still chances of monitoring teaching outcomes. In contrast, MOOC has more common features with fully-online higher education.

21.2.2.2 MOOC

The MOOC stands for Massive Open Online Course and represents an instructional approach that provides students access to online courses from places anywhere around the world [10]. Alhazzani [11] reveals that MOOCs have a significant direct impact on higher education as it improves education outcomes [11]. Besides, studies of MOOC are contributable to online higher education as the MOOC can be the fully-online and outside the classroom. Generally, the researches touch base on the advantages of MOOC in practice regarding the sharing of high-quality education resources as well as flexible self-study via portable ICTs. In a sense, MOOC has become global evaluation criteria regarding the level of the university.

However, the difficulties of monitoring the performance of MOOC is also of great concern as it requires high self-regulation and remains uncertain of students involvement via distancing education. Researchers find that good performance of MOOC requires concerns on students' engagement in the learning process as the vast majority of students may drop out before completing courses when the loose engagement undermining learning performance [10].

Teachers' facilitation can foster a positive environment by offering informative course materials, which enables the students' engagement. Besides, the teachers' facilitation improves the efficiency of knowledge transmission and quality of interaction, which enhances the engagement, motivation, and satisfaction of students. But importantly, the students' confirmation, satisfaction, and attitude have directly or indirectly influenced the intention to continue using MOOCs [12].

It is suggested that the intention of use, interaction, engagement, motivation, and satisfaction, are the five pillars of MOOC [13]. Among those, the quality of interaction is regarded as the paramount element in solving the problem of learning retention. For example, Dai et al found that there was no direct relation of interaction quality and satisfaction with the learning experience, but the learning habit of MOOCs as a learning model could significantly increase continuance intention [14]. In addition, the interaction can promote students' attitudes and enhance their persistence. Besides, the interaction enables motivation and self-regulation, which is a positive impact on the MOOC performance as well [15].

In contrast to the flipped classroom, MOOC emphasizes the promotion of students' inner drive on learning performance through teachers' facilitation as well as mediation. The practice of two

innovative educations, reshaping students’ learning behavior, bring forward the valuable experience of online higher education.

21.2.3 Learning Behavior Change

The learning behavior change is an unavoidable challenge of fully online higher education. The open and distance online learning environment changes the traditional face-to-face mode. And the most apparent change from the students’ side is the learning behavior change. Such change also causes a change in teacher’s instruction and mediation in learning activities [16].

In the time when the teaching is in class, the students’ learning behavior is easy to predict, observe, explain, and evaluate (POEE), while online education is on the contrary. Students’ learning behavior relies on the instructions given by teachers through virtual interaction, but importantly, the inner drive of self-learning behavior plays vital roles in the learning process, which directly affects education outcomes.

Typically, the importance of learning behavior regarding the performance of online education has been illustrated by the technology acceptance model (TAM). According to the original TAM [17], the external variables function the perceived usefulness and perceived ease of use, which impact on the attitude towards behavior, and influence the behavior intention to use, and lastly the actual system use.

FIGURE 21.1
Modified TAM (Based on original TAM [17])

The external variables consist of ICT facilitation, course design, online formative assessment as well as course monitoring. Taking the online course design affecting learning behavior, for example, [18] finds that a course design enticing students’ behavior, emotional and cognitive engagements can promote achievement [18]. Among the different types of engagements, behavior engagement is relatively easier to measure and collect, especially with the help of learning management systems (LMS). [3] highlights that the learner-centered course design helps the collaborative learning and social inclusion, widening participation in education. It is also suggested that the scaffolding modular structure of the learning environment is convenient for observation and evaluation [3, 19]. Also, as regards the performance of online higher education, the online formative assessment is in need. As effective online formative assessment can foster a learner’s assessment centered focus through “formative feedback and enhanced engagement with valuable learning experiences” [20].

The internal variables, such as personal characteristics, are also focused on relevant research. For example, the learners’ characteristics have a strong influence on learning behavior, such as note-taking behavior, and the impact on learning performance during a fully online course [16]. The

strong self-determination and persistence in the learning process can assist the learning behavior and so forth [21].

21.3 Practice of Online Higher Education in China

21.3.1 Background

China started early as a certified distancing higher education. Back in 1998, the Ministry of Education officially approved Tsinghua University, Beijing University of Posts and Telecommunications, Zhejiang University, and Hunan University as the first batch of National Modern Distancing Education Pilot Universities (NMDEPU). And 68 universities have been officially approved by the Ministry of Education regarding the certified online higher education by 2019.

Meanwhile, China has a good foundation of cyber technology. The internet and mobile technology are prevalently used by Chinese entities, universities as well as individuals. And the level of digital infrastructure and the popularity of broadband has been continuously improved. The users of bandwidth 100M have surpassed 60% in 2018. Also, the 4G network coverage is remarkable. In 2019, the total number of 4G users reached 1.23 billion, covering nearly 98% of users, ranking first in the world. At the same time, the construction of new infrastructure, 5G, and gigabit optical fiber networks is in acceleration.

As the key support for the development of digital society, the leading role of broadband network and 4G fiber network becomes increasingly prominent. It provides strong support for the smooth development of online education.

21.3.2 Online Learning Environment in Practice

The learning management system (LMS) supports the online learning environment. There are three modules in the system, they are, administration module, teaching module, and learning module. And LMSs are embedded in the intranet of certain universities. The design of the learning environment is versatile due to the verified needs of users. Recently, commercial online education platforms are gradually established, which is encouraged by the Ministry of Education in the 13th five-year plan. But the commercial platforms are open to the education market and independent from universities' LMSs. Those functions of modules are slightly different as the commercial platforms emphasize more on technical services as well as flexible unified learning modules.

During the period of the pandemic, the commercial online educational platforms are in great popularity as the learning materials and video courses are enriched and well-established before the incident. Thus, the market shows a strong demand for merging the internal LMS in universities with commercial online open courses. Therefore, that type of cooperative online higher education is in rapid development.

Accordingly, the commercial platform adopts an updated marketing strategy during the epidemic, including free use and open learning resources, which attracts massive users to register in the open platforms, providing chances for the teachers to integrate video courses into their curriculum construction.

The commercial platforms support either recorded course or live broadcasting course. [Table 21.1](#) showed the features of popular platforms ICourse, Chaoxing, Yuketang, Zhihuishu, Wechat, and Tencent Meeting. They have different publishers, but all have open access to end-users. Most of them have enriched course resources, such as pre-recorded courses and sufficient learning materials. Besides, they all support desk-top and cell phone apps. But the technical maturity is slightly different. For example, not all of the platforms support live broadcasting.

21.3.3 Case Study

For the analysis of users' experience as well as the online education performance in the incorporated LMS, the chapter elaborates on a survey in this section. The course GIS for Real Estate is the investigated case.

TABLE 21.1
Commercial learning platform (Based on this research)

Name	Publisher	User access	Curriculum resources	Convenience of use	Live broadcasting	Curriculum construction	Desktop app	Mobile phone app
ICourse (https://www.icourse163.org/)	Higher Education Society & Netease	Open access (limited time)	☆☆☆☆ ☆	☆☆☆☆☆	Yes	☆☆☆☆☆	Yes	Yes
Chaoxing (http://er.ya.mooc.cn/haoxing.com/)	Beijing superstar company	Open access (limited time)	☆☆☆☆	☆☆☆☆☆	Yes	☆☆☆☆☆	Yes	Yes
Yuketang (https://www.yuketang.cn/)	Tsinghua Uni	Open access (limited time)	☆☆☆☆	☆☆☆☆☆	Yes	☆☆☆☆☆	Yes	Yes
Zhihuishu (https://www.zhihuishu.com/)	Shanghai Zhuoyue Ruixin Digital Technology Co., Ltd	Open access (limited time)	☆☆☆	☆☆☆☆☆	Yes	☆☆☆☆☆	Yes	Yes
Wechat (https://weixin.qq.com/)	Tencent group	Open access	☆	☆☆☆☆☆	Yes	☆☆☆	Yes	Yes
Tencent Meeting (https://meeting.tencent.com/)	Tencent group	Open access	☆	☆☆☆☆☆	Yes	☆☆☆	Yes	Yes

Notes: ☆ represents for the level of readiness of the curriculum on different online platforms, The marks base on the observation of users in general in this research.

The course was a selective course open to the sophomore in the major of Real Estate Development and Management. The teaching weeks were 18 weeks for 2 credits. Students needed to finish the entire online course, weekly assignment, and participate in the final exam to get the full credit. Due to the situation of the pandemic, the course had been pre-recorded in videos and uploaded to the Chaoxing Platform according to the weekly teaching schedule. The learning system recorded students' learning behavior and marked individual scores accordingly. The weekly course opened from Monday to Friday to students. The flexible learning arrangement was encouraged as a test of self-management. The teacher used an online discussion whiteboard for questions and answers of weekly learning content. Besides, the teacher also interacted face-to-face with students in the Tencent Meeting and Wechat. The final exam was conducted in the universities' LMS.

The course focused on the application of GIS analysis in real estate industry in terms of market analysis, real estate development, and property analysis. The pre-recorded videos were the main learning resources for students, which was convenient to use as a digital interpretation of the textbook. But it was not easy to trace the GIS operation online. In that case, the course gave weekly instructions in the text before the assignment, so the students could follow the instructions step by step in the GIS tool operation. The evaluation of the assignment based on the analysis outcome of the work. Also, the course used ad-hoc online meetings and group chat devices to solve students' problems.

For evaluating the performance of students, the chapter delivered a survey at the end of the semester. The class was divided into two groups. Each of them consisted of 29 students, with 58 students in total. A survey was delivered to students online at the end of the semester. The purpose of the survey was to test significant elements that influence students' performance in their learning experience.

The survey included 13 question items, those were, Satisfaction of online learning platform, Satisfaction of fully online course, Habit's influence, ICT facilitation, Personality influence, Attitude and persistence influence, Behavior influence (taking notes), Modular design, Course management, Weekly assignment, Time flexibility, Final exam, and Barriers of the online course. Among those, the first twelve questions were in a Likert 5 scale (full score 100) for the evaluation, and the last question was a structural designed semi-open question. The survey was distributed to students via the back-to-back method to ensure respondents to have no communication. The valid responses were 58. The survey result is shown as follows (Table 21.2).

TABLE 21.2

Factor loading matrix for self-evaluated online education performance (Based on the survey in this research)

No.	Question Item	Satisfaction/Importance (Score)	
		Group 1 (mean)	Group 2 (mean)
1	Satisfaction of online learning platform	82.11	88.42
2	Satisfaction of fully online course	62.91	65.91
3	Habit's influence	83.65	86.33
4	ICT facilitation	81.54	91.58
5	Personality influence	45.76	59.48
6	Attitude and persistence influence	81.6	86.8
7	Behavior influence (taking notes)	81.58	83.68
8	Modular design	89.49	94.74
9	Course management	82.14	89.99
10	Weekly assignment	85.27	91.03
11	Time flexibility	70.53	81.03
12	Final exam	84.22	81.58
13	Barriers of online course	-	-

The mean score in both groups was homogenous, without apparent variance. The top five question items (basing on the mean score) were No. 8, 10, 4, 9, and 1. The observation showed that the top items were external variables that influenced students' learning performance. In contrast, the lowest two items were No. 5 and 3, which were internal variables influencing students' performance.

Besides, the students highlighted barriers of the online course in the regard of self-regulation, eye-contact and interaction, focus and concentration of video course, in-class monitoring, learning atmosphere and efficiency, internet congestion, time management, pop-up advertisement disturbance, and reading inconvenience of the digital document.

21.4 Conclusion

COVID-19 pandemic is an overwhelming health disaster. The shock of the epidemic causes the reconsideration of building community resilience in the field of online higher education. Due to the closure of the campus, millions of university students receive online courses remotely. The fully online transformation changes the face-to-face learning process to distancing online self-study mode. The transformation is not merely a temporary change in educational evolution. It is influencing the revolution of higher education deeply.

Practicing online higher education is a predominant issue facing the epidemic. The experience shows the readiness of online education, such as ICT facilitation, video courses, online learning materials, LMS and commercial platforms, etc, is the prerequisite. Meanwhile, the external drives for interaction and engagement of students in the teaching-learning process are vital.

The lessons learned from flipped classrooms and MOOCs are that crucial elements for the improvement of learning performance are both external and internal. A good combination of external and internal drives can enhance students' learning behavior.

The case study in the chapter shows that external elements, such as modular design, weekly assignment, ICT facilitation, course management, and convenient online LMS, are the most significant elements influencing respondents' performance. Whereas, the internal drives, such as personality and learning habits, have insignificant influence. Besides, the step-by-step technical instructions to GIS operation and sufficient online interaction are crucial in the online learning environment.

The continuation of on-going research of online higher education in the reaction of health disaster will be in need, particularly, regarding building community resilience. The experience that the research learned from the practice in China shows the preparedness of ICT facilitation, flexible structure of the organization, the readiness of online course resources, effective communication of participants as well as the clear instructions to students in the GIS-related course are crucial to the successful implementation of the online higher education.

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