

Review Article

Ubiquitous e-Teaching and e-Learning: China's Massive Adoption of Online Education and Launching MOOCs Internationally during the COVID-19 Outbreak

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Received 3 September 2021; Revised 1 November 2021; Accepted 15 November 2021; Published 30 November 2021

Academic Editor: B. B. Gupta

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China had made a remarkable headway in online education provision during the first quarter of 2020 due to the coronavirus disease 2019 (COVID-19) outbreak, a global public health crisis that acted as a catalyst for the uptake in online education as a method for students' e-learning and teachers' e-teaching at a vast number of institutions worldwide. China's launching of *XuetangX Global* and *iCourse International*, two massive online open course (MOOC) platforms in April 2020 to provide distant e-learning solutions to global learners at a time they were most needed, proves to be a timely move as the global challenge caused by this pandemic turned out to be an opportunity in disguise for online education internationally. This article centers around China's opportune development in online education and launching university MOOCs internationally in the height of the worsening COVID-19 pandemic in early 2020 and examines its preparedness, implementation, and impact.

1. Introduction

Since the outbreak of the COVID-19 pandemic in early 2020, the growth of online education had reshaped the learning environment paradigm for higher education institutions (HEIs) and learners globally. HEIs were challenged with providing off-campus learning to engage students. Students were challenged, due to limited internet access or insufficient literacy to an array of telecommuting applications and software, to access and guide themselves through digital course offerings. This has been a challenge for HEIs in China, but a way that HEIs started to facilitate learning opportunities while students were unable to attend face-to-face sessions was by using online education facilities. With China launching *XuetangX Global* and *iCourse International*, two massive online open course (MOOC) platforms, students began to have access to a wider range of courses in a digital format. Such challenges had changed the way HEIs and students experience education [1–3].

Colleges and universities in many countries have grown MOOC platforms championed by renowned HEIs, both domestic and overseas. For students, they can experience the best in knowledge dissemination and have exposure to a vast knowledge reservoir that could not be possible by taking courses only from one HEI [4]. Some scholars even believe that MOOC's evolving nature leads to teaching advancements that can perform better to replace traditional teaching [5, 6]. These advancements in online teaching have prompted governments to reform their education models [7]. For each country, there is a unique integrating approach toward digital learning which is particular to their homeland HEIs and students [8], as offering MOOCs requires the implementation of evolving quality control and monitoring measures that ensures students are learning effectively [9, 10], and students need new self-learning skills to participate in a MOOC environment and to keep from dropping out [11, 12].

Flipped learning, a methodology that helps teachers prioritize active learning during class time by assigning

students lecture materials and presentations to be viewed at home or outside of class, by necessity and convenience, is found to be more preferred in currently practiced online education modes as it equips students with necessary background knowledge for the content to be covered during live sessions. Together with MOOC, they are both deemed as transformative teaching practices that are being encouraged by HEIs and government education strategies in China [7, 13, 14].

China is poised to become a MOOC powerhouse as the unique characteristics of a relatively centralized mechanism for the setting of educational policies in China are levers that will rapidly strengthen its MOOC in and after the current public health crisis. Rapid expansion had been met with effectiveness challenges at first, but government guidance and professional standards can effectuate high-quality development. Empowered by information and communication technology (ICT), MOOCs can offer new ways to promote the sharing of quality educational resources. There is a path to receive accredited education through China MOOC [15], and the MOOC can also support China's providing education internationally [16].

This article is focused on China's seminal development in online education and launching university MOOCs internationally during a worsening impact of COVID-19 globally by examining its preparedness, implementation, and possible future impact to establish the legality of this new development and maintain the contribution it makes to global higher education.

2. Related Work

Since their emergence in 2008, MOOCs have become a popular education-focused research topic. In particular, the demand for online education generated by the global COVID-19 pandemic has elevated MOOCs to the forefront of education delivery, as pointed out by a bibliometric review of latent topics and trends of the empirical MOOC literature published during 2008–2019 [17]. Universities around the world were pausing in an attempt to contain COVID-19's spread since its discovery; Chinese universities took the lead in February 2020 by canceling all in-person classes and switching to virtual classrooms as mandated by the "disrupted classes, undisrupted learning" directive of its Ministry of Education (MOE), with a wave of other institutions worldwide following suit [18]. Early in May 2021, the Australian Department of Education, Skills and Employment gave a systematic account of China's education arrangement during campus lockdown caused by COVID-19, outlining the various measures that the Chinese Government introduced that are applicable in this context of health crisis [19].

Researches on online education implementation during this pandemic have been widely conducted to study institutional practices, discipline-specific MOOC delivery, and possible methodological improvement. In [20], Bao focused on the online education of Peking University, a top university in China, presented six instructional strategies by summarizing existing online teaching experiences, and concluded with five high-impact principles for online education covering

instructional design, effective delivery, learning support, student participation, and contingency plans. In [21], Duan painted a more nuanced picture of the mental state of traumatized groups in a virtual environment after conducting a questionnaire-based survey at Communication University of China and analyzing the respondents' attitudes towards online community learning where the social presence was digitally enabled. During the 10th International Conference on Educational and Information Technology held in January 2021 [22], Mu et al. proposed an "online hybrid" teaching model of engineering drawing in the context of epidemic situation, compared online teaching with the onsite classroom teaching of the same course, and found that there was no significant difference between the two in terms of learning effect. In [18], Jiang et al. collected "best practices" reports from 40 medical schools in China and provided 12 tips to highlight strategies designed to help medical classes on site move completely online under the current pandemic, including pedagogy, counseling, motivation, ethics, assessment, and modification.

From the perspective of faculty members, the feedback was mixed and professional development was necessary to ensure satisfactory online education results. In [23], Aljaraidh conducted a case study on respondents from universities in Jordan to explore the challenges and benefits of using MOOCs in higher education, identified the possible barriers to MOOCs at Jerash University, and found that there was general acceptance by the faculty that MOOCs would be an advantage for users. However, in [24], Marek et al. discovered that most respondents experienced much higher workloads and stress than in face-to-face classes after conducting a worldwide survey to explore the experiences of higher education faculty who converted classes to distant e-learning during the COVID-19 pandemic and recommended better instructional design training on online distance learning as part of long-term professional development for the faculty. During the 2020 International Symposium on Educational Technology [25], Lu et al. also shared that many teachers lacked online teaching skills and measures to motivate students and whether the teaching quality of online classes could be equivalent to onsite classes was yet to be investigated. And in [26], Zou et al. stressed the importance of teachers in improving their online teaching pedagogies and competences and concluded that teachers' online teaching theories and practice could be effectively enhanced after taking a MOOC course titled *Online Teaching in the Epidemic Period* developed following their "object-content-develop" online course development model.

For students, their attitudes towards and learning performance in MOOCs depend largely on the content, design, and nature of the course, as well as the level of themselves. In [27], Moawad believed that the quick and sudden shift from the conventional standard teaching mode to a virtual and online framework as a preventive and precautionary measure against COVID-19 caused intense stress on students and their uncertainty over the final exam and assessments scored high as sources of anxiety. In [28], Yang and Lee found that students' continued intention of using the course and their performance were positively influenced by

the usefulness of the course and the gamification used in designing and delivering the course. In [29], Gonda et al. revealed that there is a difference between bachelor and master students in the use of MOOC, with bachelor students preferring surface learning and finding a strong correlation between MOOC and the way they were educated in secondary school, and master students prefer deep learning and make more use of the MOOC discussion forum and webinar features. According to [30, 31], the demographic characteristics of the learner such as gender, employment status, and presence of child(ren) in the household also contribute to their attitude and behavior towards MOOCs.

The vast literature on MOOCs sets the table for this paper to view the shift of MOOC development in the aftermath of the COVID-19 strike. Everything that is known of MOOC must be looked at now that the environment dynamics has changed drastically, and MOOC becomes the must-have option under current circumstances globally. Compared to previous works, this paper has several differences. First, we used a longitudinal analysis of the development of online education in China since the outbreak of COVID-19, where this pandemic hit first and worst before it was identified or surfaced in other countries. Second, we draw parallel comparison by tellingly and convincingly studying the two international MOOC platforms that China launched to serve learners overseas along with the performance of their respective domestic versions. Finally, we look systematically into the features of the two MOOC platforms in question by analyzing their background, timing, edge, strength, and influence, among others, achieving a breath not yet attempted elsewhere.

3. Milestone Launches

On April 10, 2020, the “Video Conference on Course Construction of International Platforms for Online Education by Chinese Universities” sponsored by the Department of Higher Education of China’s MOE was held in Beijing to summarize the experience of China’s online education movement during the epidemic and actively contribute to China’s strength in higher education to HEIs globally in the fight against the epidemic. It was stressed that China had made and would continue to make its share of contribution to facilitating online education in HEIs worldwide by putting forward Chinese solutions, providing Chinese technologies and sharing China’s experience. During the virtual event, Dr. Wu Yan, the Director of the Department of Higher Education in China’s Ministry of Education, announced the plan to launch two online education platforms internationally before the end of April 2020. The content can be accessed from both computers and handheld devices and is presented in English and, in some cases, also in other languages (with full English audio descriptions or at least English captions), to cater to an international audience. Online courses are mainly targeted at students and faculty at overseas HEIs, overseas Chinese individuals, Chinese students studying abroad, and the broader global learner communities. The platforms provide multiple options for registration and logging in, powered by CDN (content deliv-

ery network) services with network information security mechanisms in place. 5G technology plays an important role in heavy-duty data traffic and instant response necessitated learning scenarios.

As scheduled, China had begun to offer high-quality online courses in English to global learners via two online international MOOC platforms, *XuetangX Global* and *iCourse International*, debuted on April 20 and 28, 2020, with site URLs as <http://www.xuetangx.com/global> and <http://www.icourse163.org/mooc/en>, respectively [32, 33], to promote the vast open online courses in higher education. The two international platforms designated by China’s Ministry of Education hosted an initial batch of 302 high-quality courses. Those courses covered eight major areas from medicine, epidemic prevention, and control to engineering, technology, AI, and virtual simulation experiments.

As the latest endeavor to provide high-quality undergraduate education since Chengdu Declaration, a guideline committed to foster first-rate talents with first-rate undergraduate education and jointly issued by 150 Chinese universities at the National Working Conference on Undergraduate Education at Sichuan University in Chengdu, Sichuan province, on June 21, 2018, China’s MOE released on November 24, 2020, a list of the “initial batch of first-class national-level undergraduate courses” with a total of 5,118 entries, among which 1,875 are first-rate online courses, and as stressed by MOE, most of the latter have made a significant contribution in the unprecedented online teaching practice during the temporary closure of campuses because of COVID-19 [34]. Other entries on the list include virtual simulation-based experiment teaching, offline programs, blended online/offline programs, and social practice courses. Together, those five categories of first-class courses are dubbed as “prime courses” and represent the highest-quality undergraduate courses in China. As shown in Figure 1, the domestic versions of the platforms mentioned above, XuetangX and iCourse (China University MOOC), are the two leading MOOC platforms hosting a total of 82 percent of the 1,875 prime online courses.

4. Challenges and Opportunities

The construction of those platforms came at a time when the novel coronavirus pandemic forced the massive suspension of classes globally. On March 31, 2020, the world’s largest MOOC provider, Coursera, announced that it was offering 100 free online courses in response to COVID-19. The coronavirus pandemic has greatly increased the interest in online education, and Class Central, the world’s top search engine for free online courses, has seen a huge surge in traffic [35]. More than 950,000 teachers from 1,454 universities and colleges in China had been teaching 942,000 online courses in the first quarter of 2020, attracting 1.18 billion registrations by students [36].

After Chinese universities turned to online teaching for the new semesters amid the coronavirus pandemic, the United Nations Educational Scientific and Cultural Organization (UNESCO) echoed China’s measures and released distantly provided online education solutions for schools

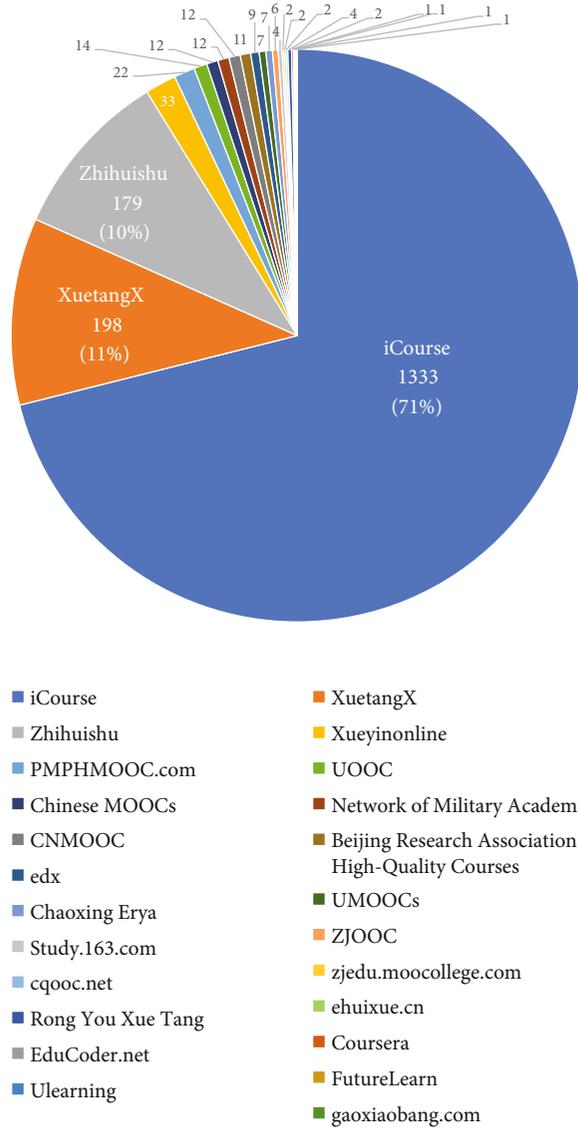


FIGURE 1: Distribution of the prime online courses on hosting MOOC platforms, compiled from MOE released data [34].

around the world, providing 27 free learning applications and platforms worldwide in the initial batch, including those recommended by China’s MOE during the coronavirus outbreak. China’s universities and education departments, such as Tsinghua University and the education department of the northeastern Heilongjiang province, had shared their experience of online teaching and learning with their overseas peers amid the outbreak.

Following its announcement on January 27, 2020, postponing the start of the spring semester for schools at all levels [37] to prevent further spread of COVID-19, China’s MOE issued instructions on February 4, 2020, on the deployment of HEI online teaching to allow students to resume their studies remotely [38]. The instructions included applying online learning and simulated experimental teaching resources to facilitate remote study, as well as

establishing plans to put online courses in place, developing evaluation plans to monitor the quality of online course offerings, classroom and examination discipline, and more.

HEIs were allowed to modify spring and fall semester schedules for the year 2020 as they deemed appropriate for their circumstances and should suspend all social activities and internships originally planned for the winter vacation period. China’s national college entrance exam, also known as *Gaokao*, had also been postponed by one month to July 7 and 8, 2020, due to the novel coronavirus disease [39].

Chinese higher education think tanks worked closely with international agencies and peers to address issues related to effective education delivery during such a challenging time.

On April 17, 2020, an international webinar entitled “Futures of Education: How to Assure Quality Higher

Education during University Closures” was held online. The webinar, organized by the Smart Learning Institute of Beijing Normal University (SLIBNU) and various agencies under UNESCO, was the third after the first one entitled “How to Keep Students Learning during Schools Disruption in COVID-19 Situation” during which *Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak* was released and the second one entitled “How to Help Children be Active Learners at Home during Educational Disruption” at which scholars, teachers, and students from severely affected countries and areas were invited to share their experiences on how to keep their students active and explore how to improve their abilities of self-learning plan and self-monitoring.

At this third webinar, experts, scholars, and policymakers from China, US, UK, Singapore, Russia, and Japan shared their experiences and discussed the topics on the futures of education, higher education, smart education, etc., with the goal of seeking prompt educational responses and developing innovative smart education. Experts shared case studies on codesigning MOOC, summarized challenges of online teaching, and discussed how to gather inspiration, generate ideas, and construct knowledge by collaborative learning. For instance, Zhan Tao, Director of UNESCO Institute for Information Technologies in Education (UNESCO IITE), remarked that as a result of the epidemic, the education sector has ushered in digital reforms much earlier than otherwise expected, which would herald a gradual move towards universal, digital, and innovative higher education, and the future of higher education resources will break down the physical barriers of school walls and transcend geographical limitations, allowing everyone to participate in learning. Kampei Hayashi, associate professor at Shinshu University, Japan, said that the online learning practice in Japanese universities suffers from insufficient information literacy of teachers and students, inadequate hardware facilities, and a major language barrier and this has inspired educators to make timely adjustments and respond flexibly, such as appropriately relaxing copyright restrictions on online resources, focusing on enhancing students’ independent learning abilities, and paying attention to student groups in need of special subsidies.

The Guidance on Flexible Learning during Campus Closures: Ensuring Course Quality of Higher Education in COVID-19 Outbreak was shared during the event [40]. The handbook, based on various cases of higher education from China and overseas, proposed practical suggestions in multiple aspects of higher education to facilitate HEI instructors in conducting flexible instruction to ensure the quality of learning at such a juncture. It begins with a curriculum design for flexible teaching and learning; flexible strategies for blended learning, digital learning resources, and learning tools; diverse flexible teaching activities; and online learning evaluation. It reflects on the current status of the application of educational informatization in higher education, points out the changes in the role of educators in the informatization process, explores the effective integration of formal and informal learning, and examines how to bridge the

achievement gap among students and how to achieve changes in pedagogy through emerging technologies.

5. Vision and Aspiration

MOOCs originated in Canada in 2008 when the 12-week “Connectivism and Connective Knowledge” course was facilitated by Stephen Downes and George Siemens at the University of Manitoba (Inge de et al. [41]). The hype over MOOCs peaked in 2012, declared as the year of the MOOC, when Salman Khan, an investment analyst who began teaching bite-sized lessons to his cousin in New Orleans via the Internet, had turned that activity into a wildly popular educational resource called the Khan Academy. Subsequently, Sebastian Thrun, the founder of Udacity, another MOOC, boldly predicted that within 50 years, the number of universities would collapse to just ten worldwide [42]. Back in 2015, the Chinese government expected MOOCs to bring “revolutionary” change to the education system by reducing inequity in the quality of education between urban and rural schools and by sharing the best teaching resources [43].

As announced at the China MOOC Conference in Beijing on April 9, 2019, China had more than 200 million people taking open online courses, leading the world in both the number and the scale of application of such courses. With more than 12,500 courses, China had built an extensive MOOC network offering a wide range of courses across different disciplines between 2012 and 2018. Since then, more than 1,000 universities and colleges have opened similar courses, not only for their enrolled students but for all people to access and mostly for free. More than 200 such high-quality courses could be found on MOOC platforms in the US, UK, France, South Korea, and Spain [44]. A declaration was issued at the conference pledging to uphold the principles of fairness, inclusiveness, service, innovation, and cooperation in developing China’s MOOCs.

Wu said, “For more than 40 years of reform and opening up, China has been learning a lot from the world in developing its higher education... Now, we want to actively contribute to the world’s higher education through massive online teaching and learning practice.” Dozens of online courses offered by Chinese universities had joined global online education platforms such as <http://edX.org> and <http://coursera.org>, according to the MOE. In addition, as recorded in its annual work plan released in February 2020, the MOE also planned to host a world MOOC conference in Beijing in 2020 and proposed to use the establishment of the World MOOC Alliance to promote the development of online higher education globally.

On June 18, 2020, China’s MOE and seven other ministries and commissions jointly issued “Opinions on the Deepening of International Cooperation and Further Opening up on Education in the New Era,” stating that more efforts will be made to develop courses and improve Chinese language learning programs to provide quality teaching resources to the rest of the world and China will pool its resources to facilitate the realization of the education goals to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” as set out in Sustainable

Development Goal 4 (SDG4) in the United Nation's 2030 Agenda for Sustainable Development [45].

China held the 2nd National MOOC Education Innovation Conference & Joint Session of the HEI Online Open Courses Alliance in Beijing on November 14, 2020. The event focused on the theme of "MOOC's innovative development in the post-COVID-19 era" and released the trial version of "HEIs' Guideline for MOOC Construction and Application," providing useful and practical reference for teachers, administrators, platform operators, and educational department at various levels in terms of the standardization of relevant terminologies; the normalization of its basic components, content requirements, open access, and instruction service; the essential criteria of MOOC-based blended courses; the norms and requirements of MOOC platforms and services; and the evaluation criteria of high-quality MOOCs.

Officially announced during the China MOOC Conference on April 9, 2019, and undisturbed by the global pandemic of COVID-19, the 2020 Global MOOC Conference, the first of its kind since the creation of MOOCs [46] and jointly organized by Tsinghua University and UNESCO Institute for Information Technologies in Education, was held at Tsinghua University, Beijing, and representatives from more than 2,000 international and regional organizations, governments, universities, and online education institutions around the world met both virtually and onsite during December 9–11, 2020, with the theme for the main conference as "Learning Revolution and Higher Education Transformation" and the themes for the 4 sub forums as "Learning Revolution' for MOOC Platforms," "Virtual Simulation: Information Technology and Educational Reform," "Resource Sharing for MOOCs and Global Higher Education Cooperation," and "MOOCs: 'Learning Revolution' for Better University Education," respectively [47]. Mr. Chen Baosheng, China's then Education Minister, announced during the main conference that China had created the biggest pool of MOOCs with the largest scale of application and China had over 34,000 MOOCs, attracting around 540 million online learners, in less than 8 years [48]. A Global MOOC Alliance was established, and the *Beijing Declaration of MOOC Development* was released during the events, rallying pioneers of MOOC, practitioners of online education, and promoters of global education reform from around the world to collaboratively explore the development and use of MOOC and online education, provide quality MOOC and online education solutions for countries and regions in need, and promote the learning revolution and higher education transformation in order to contribute to the fulfillment of SDG 4 [49].

6. Timely Emergence

In response to a surge in school and university closures to curb the spread of COVID-19, UNESCO convened a global video conference with higher education officials to step up the emergency response and share strategies to minimize learning disruption worldwide on March 10, 2020, a time when China had bent the curve while the pandemic situation

in other countries began to worsen (see Figure 2 for pandemic trend globally) and over one-fifth of students worldwide had to stay away from school due to the COVID-19 crisis. Education ministers and other government representatives from 73 countries, including China, participated remotely and shared approaches and optimal practices in emergency response and learning disruption minimization by employing "hi-tech, low-tech and no-tech solutions" to "assure continuity of learning" during school closures and "ensure this crisis promotes innovation and inclusion and does not exacerbate learning inequalities" [50].

One week later, on March 17, 2020, UNESCO launched a coalition to accelerate remote learning solutions as over 850 million children and youth—roughly half of the world's student population—were out of school due to nationwide closures in force in 102 countries and local shutdowns in 11 more countries [52]. This resulted in the number of learners who were prevented from attending educational institutions more than double in only one week, with further increases following. The scale and speed of school and university closures presented an unprecedented challenge for the education sector. Countries all over the world were racing to fill the void with distance learning solutions. However, the uncertain duration of the closures had added further complication to these efforts. Ms. Audrey Azoulay, UNESCO Director-General, remarked that the situation imposed tremendous challenges for countries around the world to provide uninterrupted learning for students at all levels in an equitable manner [52]. However, beyond meeting immediate needs, those efforts created an opportunity to rethink education, scale up distance learning, and reshape education systems to be more resilient, open, and innovative.

China's launch of MOOCs internationally at such a juncture was answering the call of the times, meeting the challenges, and tiding over the difficulties together with the international communities. The initial launch of international MOOC courses on XuetangX Global and iCourse International included more than 100 entries from 59 Chinese universities. China's aim was not to compete with established sources and platforms of online education, but rather to complement and add to existing distant offerings around the world with high-quality course resources. According to Dr. Wu Yan, these courses represent the most innovative and highest quality online courses in China that meet world-class standards.

7. Astronomical Growth

As shared by Wu in his keynote speech, since the onset of the COVID-19 pandemic in China, the MOE has mobilized 37 online courses and technical support platforms by offering over 41,000 MOOCs and virtual simulation experiments for free, with full portfolio solutions and technical support provision. That in turn brought about voluntary participation of more than 110 commercial and university platforms, which together provided a strong guarantee for a smooth operation. The total numbers of MOOCs and other online courses grew by 5,000 and 18,000, respectively, in China in the first quarter of 2020.

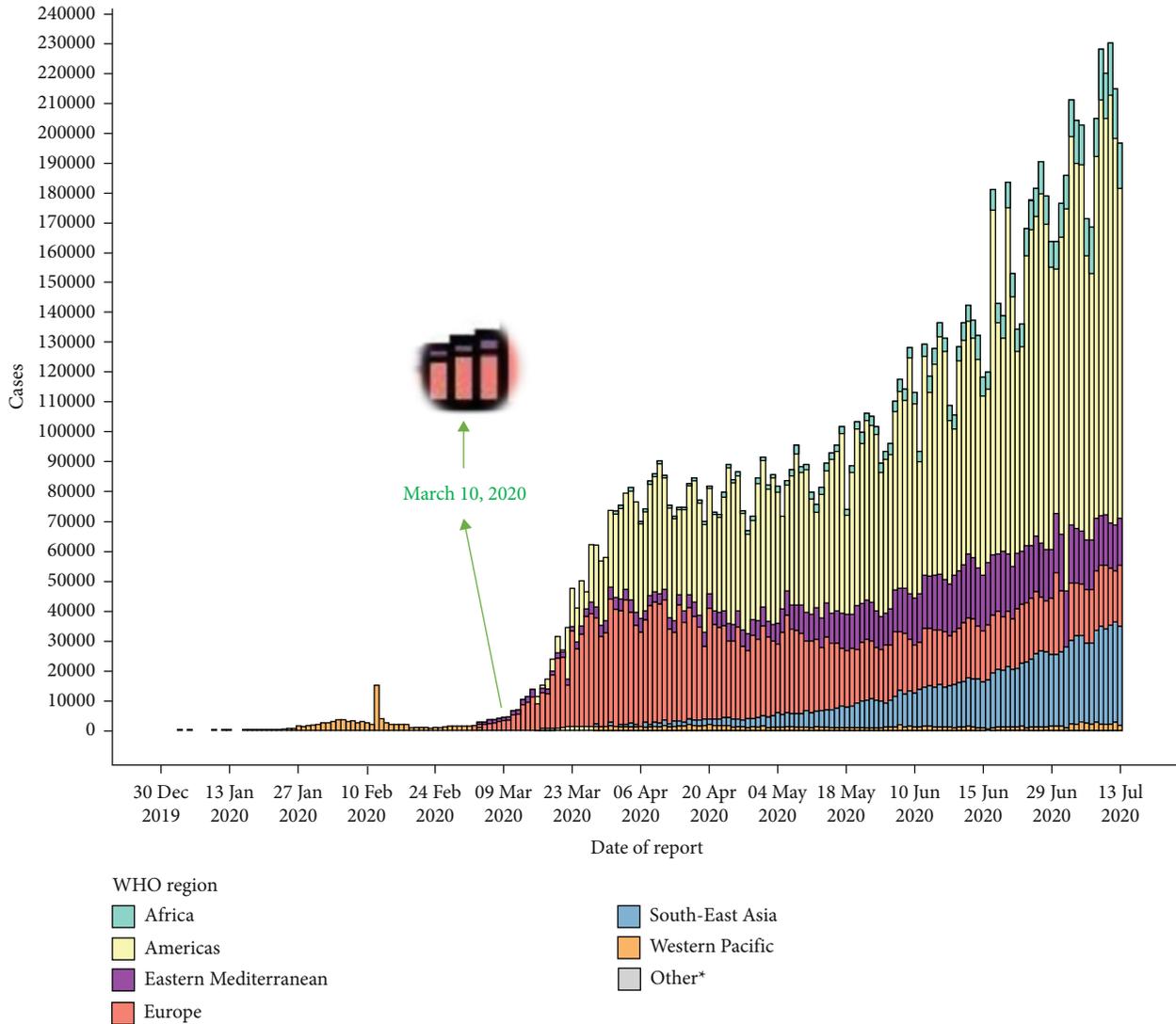


FIGURE 2: Number of confirmed COVID-19 cases from December 30, 2019, to July 14, 2020. China is a country in the Western Pacific, indicated in light orange. Source: WHO COVID-19 Situation Report—176 [51].

A large number of Chinese universities started the spring semester via online courses on February 17, 2020. In the 47-day period through April 3, 2020, an accumulative number of 1.18 billion student-time courses were delivered remotely on the 37 online courses and technical support platforms recommended by China’s Ministry of Education. As shown in Figure 3, after resumption of schooling online in many HEIs on February 17, a Monday, the following two Mondays saw more colleges and universities resume classes remotely, with the numbers of student-time courses peaking statistics in the first quarter of 2020. The tally of students taking online course sessions on those three consecutive Mondays reached 36.56 million, 58.32 million, and 60.74 million, respectively (growing tendency shown with yellow arrows shooting upper right in Figure 3). Those were truly astronomical figures that could never had been imagined before.

Concerted efforts from all quarters ensured that teaching activities in Chinese HEIs proceed as desired, to varying but mostly surprisingly satisfying degrees. Teaching quality

reports had been released by more than 1,400 colleges and universities, as well as 30 content and technical solution providers, offering detailed and in-depth analysis at multiple dimensions ranging from class participation rate, interaction between teachers and students, satisfaction with teaching, teaching effectiveness, ease, and smoothness of sessions, to willingness to continue online education by choice rather than by necessity after the COVID-19 pandemic is over.

A study involving 334 Chinese HEIs, with 13,997 teachers and 256,504 students participating, shows that the massive experiment had been successful overall [53]. Many instructors and students with whom the author conversed had shared that they find online education more superior in many ways compared to the traditional brick-and-mortar mode and will continue to adopt this form by choice even after the pandemic ends. It is not surprising that students, teachers, and college administrators had generally been happy that education carried on anyway despite the public health crisis, but there is growing evidence that even

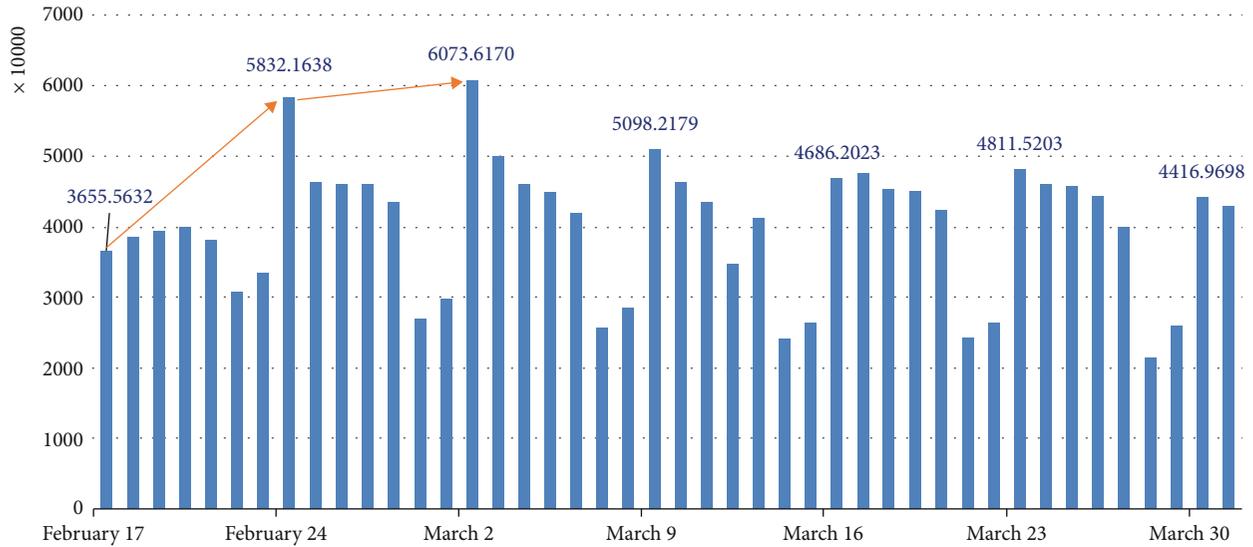


FIGURE 3: Daily active student-time numbers during February 17 and March 31, 2020. Source: Dr. Wu Yan’s keynote speech presentation at the video conference on Course Construction of International Platforms for Online Education by Chinese Universities held in Beijing on April 10, 2020.

the best remotely conducted online education solutions are weak substitutes for classroom interactions and there is much room for improvement if desired goals are to be achieved through distant learning.

It is widely cited that an answer to quality assurance in online courses and, in particular, of MOOCs, as a special type of technology-enhanced learning, is the approach of holistic quality management, a continuous improvement cycle divided into three generic quality dimensions—potential, processes, and results—that entail attention not only to the results but also to the processes and their optimization, as well as continuous formative and summative evaluation and analysis and improvements based on their results. It is also proposed not to measure the traditional drop-out rates but the completion of individual goals and intentions by the MOOC learner [54].

China’s MOE had been summoning relevant departments and agencies to summarize the experiences and achievements of distant education delivery during that period of time and planned to convert “wartime measures” to normal mechanisms and translate provisional teaching reforms into a campaign for overall quality improvement in education, reflecting the spirit of holistic quality management.

8. Star Professors at Fingertips

Since 2017, China’s MOE has continuously launched high-quality national-level MOOCs and national-level virtual simulation experimental projects for the access of all Chinese HEIs and the society at large. The launch of two international platforms for online education at the end of April 2020 was based on a comprehensive consideration of the incremental development in this field, and the application platforms and course resources represent the highest quality English instruction courses that China has to offer.

For instance, Zhong Nanshan, an eminent respiratory specialist, epidemiologist, and academician of the Chinese Academy of Engineering, is a household name in China because of his pivotal role and enormous contributions in fighting the novel coronavirus pandemic as well as the severe acute respiratory syndrome (SARS) back in 2003. Together with his medical team, Dr. Zhong had launched a special online course to disseminate knowledge about fighting COVID-19. In addition to clinical knowledge, the course includes information on major symptoms of COVID-19, how the novel coronavirus is transmitted from person to person, how to prevent infection with the deadly disease, and what role traditional Chinese medicine plays. The course statement suggests that “The course, which focuses on fighting the novel coronavirus pneumonia, is beneficial not only to doctors and students majoring medicine, but also for the general public. It aims to raise awareness of the masses to prevent and control the pandemic” [55].

Zhong was named the inaugural winner of the 2020 Being Edinburgh Award. Niamh Martin-McGarrigle, a member of the Being Edinburgh selection committee, said that “During this time of international crisis, the Being Edinburgh Award allows us to highlight positive news in our global alumni community. Dr. Zhong is an inspiration to students, staff and alumni alike, and embodies important values that the university aims to uphold: drive, passion, and sustained hard work” [56].

Top experts and famous professors offering courses on those platforms also include Prof. Li Jian, a national renowned teacher; Prof. Li Xiaokun, an academician of the China Engineering Academy and an expert in pharmacy; economist Justin Yifu Lin, former World Bank Chief Economist and Senior Vice President; and medical expert Zhang Wenhong, the doctor who became an online celebrity in China for his straight talk about COVID-19 prevention and control efforts. More than 1,000 teachers had been

involved in course construction and teaching services on the iCourse International platform alone for its initial launch. Among them, more than 50 courses were selected from the English version of the national high-quality online open courses and some evolved from refined courses once delivered to international students and graduate students.

During his keynote speech, Dr. Wu noted that “Virus knows no borders, epidemic does not differentiate among races, but education warms hearts far and wide. China’s international university MOOC platforms will convey warmth, strength, and penetrating love to the world, and convey passion for education and teaching to the world. It will gather China’s top universities, best teachers, and the highest rated courses, and provide online education to college students from all over the world. Meanwhile, we will provide the best possible guidance, assistance, and learning services to learners around the world.”

9. Technology the Great Enabler

As an active COVID-19 education response, UNESCO curated on its website a list of distance learning solutions with a wide reach, a strong user base, and evidence of impact to help teachers, schools, administrators, and parents to facilitate student learning and provide social care and interaction during school closures. These solutions include educational applications, platforms, and resources, most of which are provided for free, and many are catering to multiple languages. Based on distance learning needs, they are categorized into nine broad groups, with most of them offering functionalities across multiple categories, including resources to provide psychosocial support, digital learning management systems, systems built for use on basic mobile phones, systems with strong offline functionality, massive open online course platforms, self-directed learning content, mobile reading applications, collaboration platforms that support live video communication, tools for teachers to create digital learning content, and external repositories of distance learning solutions [57].

Four solutions provided by Chinese universities and companies had been included on the UNESCO recommendation list. They are iCourses, listed under “massive open online course platforms” for providing courses to university students; Dingtalk and Lark, listed under “collaboration platforms that support live-video communication” as a “communication platform that supports video conferencing, task and calendar management, attendance tracking, and instant messaging,” and “collaboration suite of interconnected tools, including chat, calendar, creation, and cloud storage”, respectively; and Mosoteach, listed under “self-directed learning content” as an application hosting cloud classes. While these solutions are generally fit for multiple topics and occasions, some courses require more specific technology types and capacities.

For example, the assembly of large components is the key to aircraft manufacturing and its experiments are a necessary part of professional courses. However, given its professional operation, high cost, large space requirements, etc., it is impossible to carry out on-site experiments in col-

leges and universities. According to the assembly process of large aircraft parts and the principle of “highlighting inquiry-based learning, emphasizing systematicness in the knowledge system, and stressing the need of synchronization in advanced assembly technology,” Nanjing University of Aeronautics and Astronautics (NUAA), one of China’s premier learning and research institutions in Aerospace Engineering, has designed and developed an experimental module of the “skin forming process design, automatic drilling, and riveting process design of a panel and wing-body docking of aircraft,” placing ample emphasis on the experimental “inquiry.” Multidimensional teaching methods have been applied to improve the effect of the overall training of students’ ability to apply basic principles, make comprehensive designs, explore, and practice [58].

Virtual reality (VR) technology enables students to explore existing places and things that they could not have access to otherwise [59]. During the China MOOC Conference held in Beijing on April 9, 2019, a live virtual simulation experiment was demonstrated installing aircraft wings to China’s self-developed C919 passenger jet (see Figures 4 and 5). The course titled *Virtual Assembly Experiment of Large Aircraft Components* was presented by NUAA in collaboration with China Unicom, a major provider of broadband communications and information services in China. Students from Nanjing University of Aeronautics and Astronautics (located in Nanjing, Jiangsu province in Eastern China), Northwestern Polytechnical University (located in Xi’an, Shanxi province in Northwestern China), and the Guizhou Institute of Technology (located in Guiyang, Guizhou province in Southwestern China) participated in this session simultaneously.

According to the course description on <http://iLab-X.com> hosted by China’s Higher Education Electronic Audio & Visual Publishing Co. Ltd., both uplink and downlink client-to-server bandwidth requirements are 20 M and the number of concurrent responses is 300 [58]. During the exhibition, China Unicom provided a 5G network connection to facilitate synchronous instruction and participation of instructors and students in ultrahigh-definition 4K over a span of over 4,000 kilometers with a minimum delay of only 38 milliseconds, which are undetectable to the human eye [60]. Students from three widely dispersed locations with more than 1,100 kilometers apart from each other, together with the audience at the conference, could access and join the live course through specialized programs on computers, mobile phones, VR devices, or simply via webpage on computers.

10. Educational Pedagogy Adaption

The MOOC had started a wave of education reforms and would inevitably lead to the government’s management transformation in the field of education [7]. On April 13, 2015, China’s MOE promulgated “Opinions on Strengthening the Application and Management of Open Online Course Construction in Higher Education Institutions.” It stipulates that China’s HEIs should strengthen the training of faculty and technical staff for open online course building applications. Trainings on course construction, curriculum application, vast data analytics, and application shall be

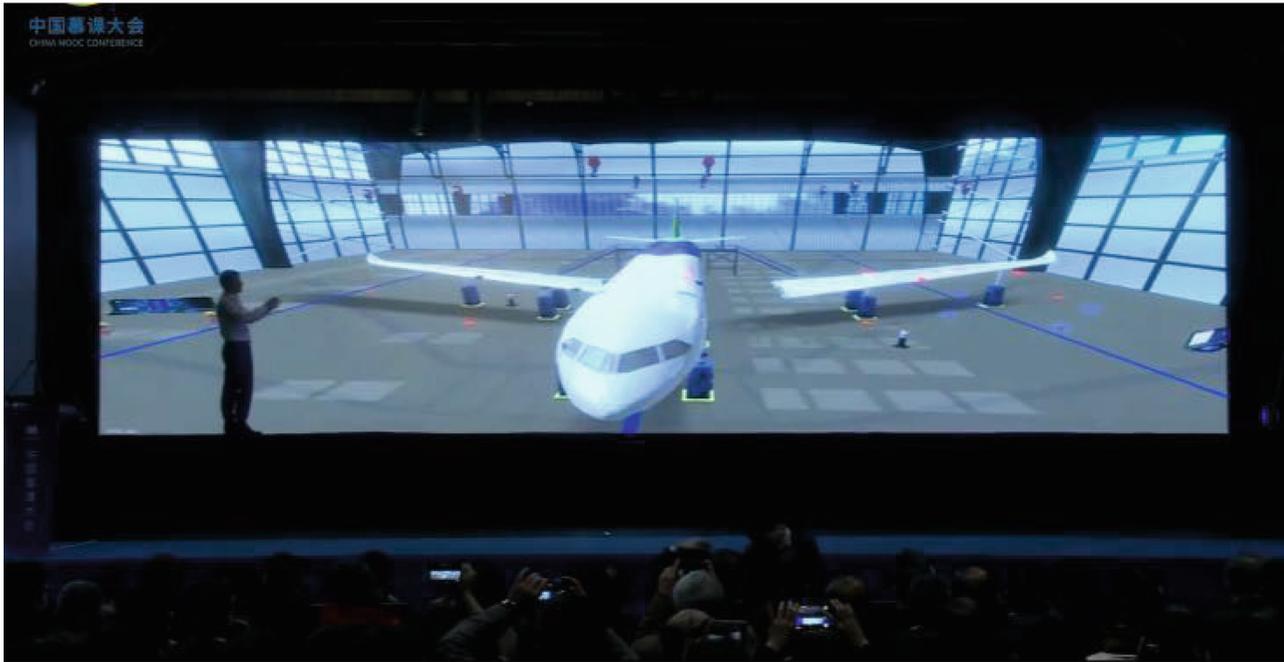


FIGURE 4: Live demonstration of the virtual simulation experiment to install aircraft wings on the passenger jet [60].

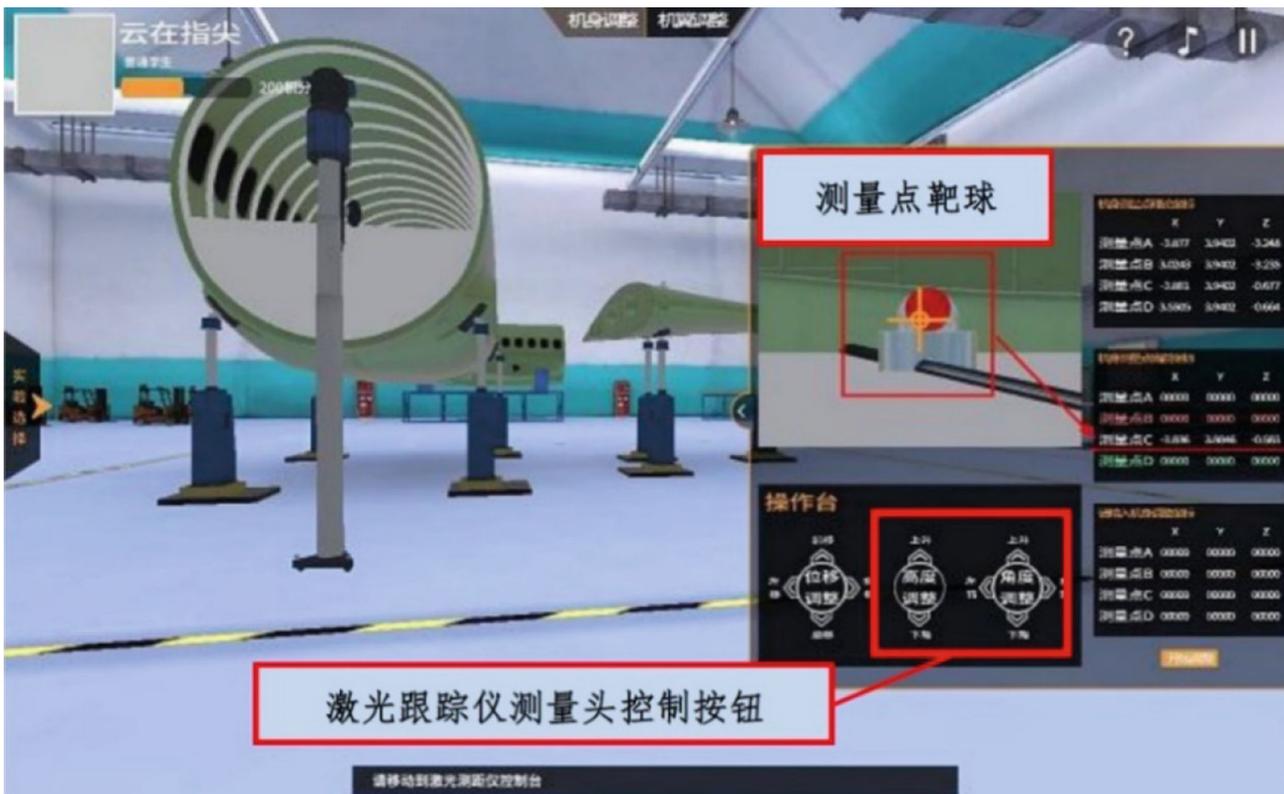


FIGURE 5: Live 5G-enabled VR session of docking aircraft wings to the passenger jet [60].

provided by universities, related institutions, specialist organizations, and online public service platforms for open courses catering to the changing needs of teachers, learners, and technological development. HEIs should effectively assume the primary responsibility for the construction,

application, and management of open online courses and should strive to enhance the awareness, level, and ability of teachers in deep integration of information technology and higher education, as well as positioning open online courses as an important complement to classroom teaching [61].

To accelerate development in composing MOOCs, teacher preparation and development through training and practice are critical in providing quality MOOC learning [43, 62]. The newly introduced trial version of “HEIs’ Guideline for MOOC Construction and Application” has among its goals to guide teachers to become versed in this methodology and form of instruction, use it as a platform for pedagogical innovation, and achieve the goal of improved teaching effectiveness and results.

To meet the needs of the integration of the educational technology and education practices, it is imperative that an interdisciplinary research and teaching team be established, which is helpful to the curriculum and teaching reform on the one hand and is likely to enable a profoundly rapid development in education itself theoretically and practically on the other hand [59]. China’s MOE had established a platform and curriculum development committee to promote the construction and ensure smooth operation of the international MOOC platforms at the same time as establishing an expert advisory group to guide the operation and management of the platforms. The platform and curriculum development committee had been tasked with the formulation of the developmental and operational plan for the platforms, the organization of work related to the construction of the platform, the examination and approval of the curriculum standards and technical specifications, the coordination of government and enterprises in the participation of the construction of the platform, and the organization of advisory services by relevant experts. The expert advisory group was assigned to present opinions and suggestions on platform construction, as well as provide expert guidance and advice on the vetting criteria, selection results, and online instruction and learning and advocate the platforms to HEIs, the public, and the international community. At initial introduction, around fifty high-caliber experts from relevant professional areas had been appointed to seat the above dedicated committee and group to ensure that the designated MOOC platforms would launch with high standards, superior quality, and a smooth user experience.

At the course creation level, respective HEIs take primary responsibility in quality assurance of online courses developed by their own institutions, meanwhile the hosting platform has each set up a specialist team to ensure that candidate courses meet launching standards and relevant technical specifications are followed effectively. As the platforms were launched to serve the international community and English is the lingua franca in the academic circles worldwide, English language teams had been formed at both contributing HEIs and the distribution platforms to provide language support in course preparation and English instruction and to interface friendliness and technical support, respectively. Platform interfaces in other major languages such as Russian, Spanish, French, and Japanese are also available or will be added in due course.

11. Credit Certification

The introduction of MOOC not only presented a convenient way to utilize top notch higher education courses but also

proposes an alternative method to obtain university experience and credit certification [15]. Recognition of learning results gives students additional motivation to take a course. This is equally important in open course settings. Study certification is an integral part of the MOOC platform. Take the iCourse International platform for example, its core functionalities are materialized through four independent yet interconnected systems, namely, the online learning system, course management system, learning certification system, and big data system. The learning certification system records, evaluates, and certifies the learning activities and outcomes of a student through back-stage grade management, course certificate setting, study certificate application, and electronic certificate delivery. As noted on its home page, “we provide the opportunity for all learners to take courses offered by renowned higher education institutions, with a certificate awarded upon successful completion.”

Credits earned at iCourse International can be transferred to the university system if proper procedures are followed. In June 2015, the academic affairs office of Wuchang Institute of Technology (WIT) issued “Notice on the Recognition of Credits Earned at China University MOOC,” stating that the institute had decided to recognize the qualifications earned at China University MOOC (iCourse), based on which iCourse International had been developed, and the credits could be transferred to the academic system of the university from the fall semester of 2015 onward. On the iCourse platform, after taking its platform-based examination upon completing a course, a score of or above 60 out of its hundred-mark system generates a certificate of qualification and a score exceeding 85 earns the student a certificate of excellence. WIT would recognize the grade issued by iCourse and would convert the qualification earned into a pass grade, integrating it into its own academic record system upon finishing a MOOC qualification certification procedure [63].

12. Conclusions

As Friedrich Engels once noted, “there is no great historical evil without a compensating historical progress” [64]. In 2020, the COVID-19 pandemic had accelerated many of the existing challenges and has created the largest disruption of education systems in history, affecting nearly 1.6 billion learners in more than 190 countries on all continents. Closures of schools and other learning spaces have impacted 94 percent of the world’s student population, up to 99 percent in low- and lower middle-income countries [65]. Global learning communities have witnessed a phenomenal use and growth of online education by necessity amid the COVID-19 outbreak despite of accompanying challenges [66]. It is unprecedented in scale, scope, and depth and constitutes the first such collective exploration of online education technologies and methodologies worldwide. This study focused on the practice in China in early 2020 and can by no means represent the overall situation in other countries, especially those with more disadvantaged groups who have no access to broadband Internet access which is crucial to online education involving real-time feedbacks. As online courses have

become more central to university teaching, it will be important to rigorously assess the impact of this change [67] in future studies. However, it is clear that the global challenge caused by this pandemic is turning out to be an opportunity for online education in disguise.

Originally, the worst hit country by COVID-19, China, is now reporting minimal local transmission and is in a position of guarding against imported cases from other countries. With its achievements in large-scale online education experiments since 2020, plus its rich experience and cumulative knowhow over the years, coupled with the long-term education modernization and informationization strategies of its government, China is set to become a major player internationally in the online education arena and will contribute to higher education access and equity globally with the launch of the two global MOOC platforms. With the current epidemic ebbing in China, the zeal on MOOCs and other online education offerings is sustained by practical needs such as international students participating in educational programs offered by Chinese HEIs from their home countries, Chinese students who cannot travel to foreign HEIs taking part in online courses at peer institutions (e.g., partnership universities and Chinese-foreign cooperatively run schools), and further fueled by a multitude of platform-initiated or government-sponsored capacity building schemes on online education or blended learning and MOOC competitions at university, provincial, or national levels.

This massive expedient experiment upends the century-old tradition that students travel to a physical institution to learn, which is bound to change the patterns that teachers teach, students learn, and universities operate, sparking a “learning revolution” [67] and breaking important new ground in the field of higher education. This will probably represent a paradigm shift for online learning and the transformation of higher education forever, bringing a possible response to the “Jobs’ Question,” namely, “Why has IT changed almost every field, but the impact on education is surprisingly small?”, a question raised by Steve Jobs in May 2011 when he met Bill Gates and discussed the problem of education and future schools [68]. As Martin Trow rightly predicted in 2007, it seems likely that in the near future, much of what is done today among people working in physical proximity may be possible to approximate through electronic links among people who are physically separated. And that will be an educational revolution [69].

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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