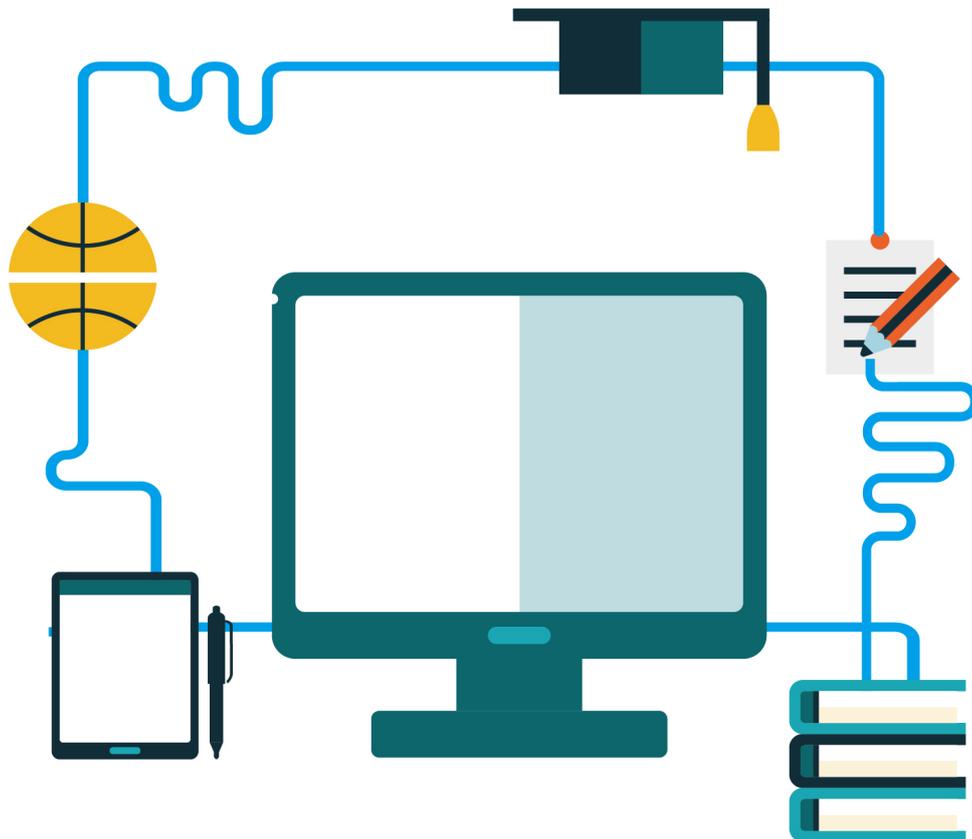


Handbook on Facilitating Flexible Learning During Educational Disruption

The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak

March, 2020. Version 2.0



**Handbook on Facilitating Flexible Learning During Educational Disruption:
The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak**

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The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak

Smart Learning Institute of Beijing Normal University

UNESCO International Research and Training Centre for Rural Education

March 15, 2020

Statement

15/03/2020

As COVID-19 continues spreading in many countries of world, how to keep learning in disruption has become a major challenge to the global education community. As stated by UNESCO Director-General Audrey Azoulay:

“We are entering uncharted territory and working with countries to find hi-tech, low-tech and no-tech solutions to assure the continuity of learning.”

At this critical moment, UNESCO International Research and Training Centre for Rural Education (UNESCO INRULED) and Smart Learning Institute of Beijing Normal University (SLIBNU) are releasing a special publication entitled “Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak” together with our collaboration partners.

During the COVID-19 outbreak, the Chinese Ministry of Education has launched the “Disrupted classes, Undisrupted Learning” initiative, providing flexible online learning to over 270 million students from their homes. Inspired by the united solidarity and innovative experiences of millions of teachers and students, this handbook aims to define the term “flexible learning” with vivid examples and touching stories. It describes several implemented flexible online learning strategies during the COVID-19 outbreak. These strategies are presented based on six dimensions, namely (a) infrastructure, (b) learning tools, (c) learning resources, (d) teaching and learning methods, (e) services for teachers and students, and (f) cooperation between government, enterprises, and schools.

Additionally, this handbook aims to help other educators, researchers and practitioners implement similar case studies in their context. We hope to work together more closely with all partners for the shared mission in this difficult situation. As emphasized by Mrs Stefania Giannini, UNESCO’s Assistant Director-General for Education:

“We need to come together not only to address the immediate educational consequences of this unprecedented crisis, but to build up the longer-term resilience of education systems.”

On behalf of UNESCO INRULED and SLIBNU, I would like to thank our partners from China and abroad. Our special thanks go to the National Commission of the People's Republic of China for UNESCO for their incredible support during the realization of this publication. We also acknowledge with gratitude contributions for this publication from our partner organizations, including UNESCO Institute for Information Technologies in Education (UNESCO IITE), the International Association of Smart Learning Environment (IASLE), the Arab League's Educational, Cultural and Scientific Organization (ALECSO), and Edmodo.



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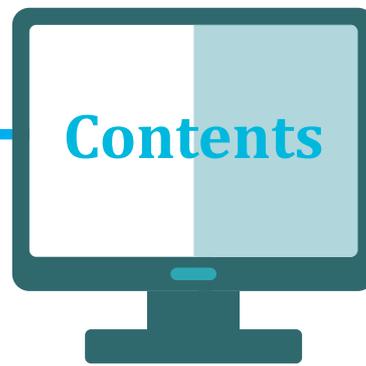
Acknowledgement

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Executive Summary

Large scale outbreaks of pandemic disease, natural disaster, or serious air pollution took place in the global wide, affecting not only human health, but also the education sector. For instance, at the end of 2002, SARS affected several countries around the world. To contain the virus, face-to-face teaching was banned in several regions in China. Similarly, in 2009, the outbreak of H1N1 Flu affected several people around the world, causing school closures in many countries and areas, such as Bulgaria, China, France, Italy, Japan, New Zealand, Serbia, South Africa, Thailand, United Kingdom, and the United States (Cauchemez et al., 2014).

At the end of 2019, while the Coronavirus (COVID-19) is rapidly spreading worldwide, causing the death of over 3000 persons, several countries have initiated several strategies to contain this virus, including school closures. UNESCO stated that, as of 12 March, forty-six countries in five different continents have announced school closures to contain the spread of COVID-19. Specifically, twenty-six countries have completely closed schools nationwide, affecting the learning process of almost 376.9 million children and youth who would normally attend school. A further twenty countries have partially closed schools (localized school closures) to prevent or contain the spread of COVID-19. Particularly, 500 million children and youth are still threatened with not attending their schools if these twenty countries also order nationwide school closures.

International organizations have paid particular attention to the issue of “Education Response in Crises and Emergencies”. UNESCO stated in the Education 2030 Incheon Declaration and Framework for Action that countries should “provide alternative modes of learning and education for children and adolescents who are not in school at both the primary and secondary levels, and put in place equivalency and bridging programmes, recognized and accredited by the state, to ensure flexible learning in both formal and non-formal settings, including in emergency situations”.

Specifically, in China, to contain the COVID-19, the Chinese government has banned most-face-to-face activities, including teaching. The Chinese Ministry of Education has launched an initiative entitled “Disrupted Classes, Undisrupted Learning” to provide flexible online learning to hundreds of millions of students from their homes. Inspired by the united solidarity and innovative experiences of millions of teachers and students, this handbook aims to define the term “flexible learning” with vivid examples and touching stories. It describes several implemented flexible online learning strategies during the COVID-19 outbreak. These strategies are presented based on six dimensions, namely (a) infrastructure, (b) learning tools, (c) learning resources, (d) teaching and learning methods, (e) services for teachers and students, and (f) cooperation between enterprise, government, and schools. Specifically, this handbook can help other educators, researchers and practitioners implement similar case studies in their context. Finally, this handbook shows, based on this practical experience, different collaborations between several sectors (governmental, telecommunication, enterprise, etc.) to provide effective and inclusive education in case of emergencies, such as the COVID-19.

1 Understanding Flexible Learning During Educational Disruption

Lee and McLoughlin (2010) defined flexible learning as a “set of educational approaches and systems concerned with providing learners with increased choice, convenience, and personalization to suit their needs. In particular, flexible learning provides learners with choices about where, when, and how learning occurs, by using a range of technologies to support the teaching and learning process.”

1.1 Flexible learning

The study of flexible learning and teaching has a long history. First, “flexibility” is defined as offering choices in the educational environment, as well as customizing a given course to meet the needs of individual learners. Therefore, providing the possibility of making learning choices to learners is crucial. These learning choices can cover class times, course content, instructional approach, learning resources and location, technology use, the requirements for entry/completion dates, and communication medium (Collis, Vingerhoets, & Moonen, 1997; Goode, Willis, Wolf, & Harris, 2007). With the development of information and communication technologies, new learning modes have appeared that can open more opportunities for flexible learning, such as open learning. Open learning aims to make learners more self-determined and independent, while teachers became more as learning facilitators (Wiki, 2019). Learner-centered philosophy serves as an underpinning theory for this flexibility dominated educational practices (Lewis & Spenser, 1986). In flexible learning environments, barriers that might prevent students from attending a given educational context (e.g., classrooms) are removed. With the further development of technologies, flexible delivery is considered a critical component (Lundin, 1999), which usually empowers learners and instructors to exchange information in a two-way manner. Later, the scope of flexible learning has been further extended beyond the dimension of delivery to cover flexible pedagogy (Gordon, 2014; Ryan & Tilbury, 2013). Gardon (2014) and Ryan and Tilbury (2013) believed that flexibility is not only an attribute of students, but also a feature of educational strategies at the institution level.

Term 1. Flexible pedagogy

In this handbook, we re-conceptualize flexible pedagogy as a learner-centered educational strategy, which provides choices from the main dimensions of study, such as time and location of learning, resources for teaching and learning, instructional approaches, learning activities, support for teachers and learners. In this way, teaching and learning can be flexible rather than fixed. This can help promote easy, engaged and effective learning.

1.2 Characteristics of flexible learning

Flexible learning has several characteristics, as follows:

First, it offers learners rich learning choices from multiple dimensions of study (Goode et al., 2007).

Second, it applies learner-centered constructivism approach which is indicated by a shift from the teacher taking learning responsibilities to the learner taking these responsibilities as well (Lewis & Spencer, 1986; Goode, 2007).

Last, learners are granted a variety of choices and take more responsibilities for their own learning. Therefore, flexible learning requires learners to be more skilled at self-regulation in terms of goal setting, self-monitoring and make adjustments and instructors to promote active learning so that learning in such situations can be engaging and effective (Collis, 1998).

1.3 Dimensions of flexibility

The strategy of flexible learning can be implemented at different levels, such as teaching and learner management, operational management, and institutional management (Casey & Wilson, 2005). Focusing on the flexibility at teaching and learner management level, we identified the following eight key flexibility dimensions.

- **When and where the learning occurs**

It means that the time of participating in a course (Collis et al., 1997), starting and finishing a course (McMeekin, 1998), participating in learning activities (Collis et al., 1997; Collis, 2004; Casey, 2005), the pace of study (Collis, 2004; Casey & Wilson, 2005) can be flexible. Learners can be offered choices based on their needs (e.g., study during evenings or weekends). They can also specify the time they want to interact with others and the time they want to study on their own. The location of learners to carry out learning activities and access learning materials can also be flexible anywhere at any time via mobile devices, such as at campus, home, public transport, airport or even on a plane (Collis et al., 1997; McMeekin, 1998; Gordon, 2014). Due to the outbreak of COVID-19, Beijing Normal University in China cancelled the regular physical class meetings. The alternative ways that the instructors used is to post a list of learning tasks and upload related resources on the learning management system every Monday. Students can then access these resources and study at any time (usually at home during the current week). Finally, the students submit their completed learning homework and assignments before the following week.

- **What and how students will learn**

It allows students to determine the sections and the sequence of content according to their desire, pathways of learning, forms of course orientation, size and scope of the course through modulization of the content (Collis et al., 1997; Collis, 2004; Casey & Wilson, 2005; Gordon, 2014). During the period of COVID-19, the self-inquiry course offered by Guangzhou International Middle School Huangpu ZWIE encouraged students to select the topics based on their personal interests and strength. They can then create products in the formats they prefer, such as a regular letter, posters, brochures, videos, songs or dances to salute the front-line heroes who fight against the novel Coronavirus in Wuhan City, China.¹

¹ <https://lx.huanqiu.com/article/9CaKrnKps6s>

Story1

“Course Supermarket”

Binbei School in Shandong Province opened a “Course Supermarket”, which provides students great flexibility in learning from home and helps them develop self-management skills. The topics of the courses offered by this “supermarket” range from photography, calligraphy, reading, housework, music, fitness and bodybuilding exercises. Examples of the course topics are presented in Figure 1.



Figure 1. Binbei School (Shandong, China) opened a "Course Supermarket" that offers courses with a broad range of topics

Source: https://www.sohu.com/a/375788276_508621

- **How to deliver instruction**

Flexible delivery offers a suitable range of how and where students can access learning materials (Collis et al., 1997; Lundin, 1999; McMeekin, 1998). Students may experience the course in campus-based learning, web-based learning, or in both via different technologies, such as Augmented Reality (AR). Employer-based learning has recently emerged as a new delivery method, which enables students to combine work with study, bringing together higher education providers and employers to produce innovative learning opportunities from a broad view (UK Universities, 2018). A blended way to deliver a course with the theme of English Language for pre-school kids in China provided by New Oriental Education and McGraw Hill allows students to use an Artificial Intelligence-driven mobile application to access the learning resources and study on their own paces during the weekdays¹. The supplementary activities include following and imitating the reading process, automatic grading, and group discussions via social network applications. During the weekend, the lecture is delivered online by the instructors as live virtual classrooms.

- **What strategies could be used for organizing learning activities?**

The learner's choices can be offered using several instructional approaches, such as lectures with tutorials, independent study, discussion, seminar groups, debates, student-led discovery approaches and educational gamification (Gordon, 2014). For instance, the University of British Columbia (2020) has recently used different methods, such as blended learning, Massive Open Online Courses (MOOCs) and experiential learning, to offer more opportunities for learners to control their own learning process and improve their

¹ <http://www.maxen.com.cn/>

learning experiences. For the methods of social organization of learning, flexibility can be enabled by offering learners several ways of studying (individually, in groups, collaboratively, etc.). The instructors at Baiyangdian High School in Xiong'an District delivered live lectures through a software "DingTalk." They also organized group-based student discussions by using the platform ZOOM so that all participants can interact with each other more conveniently. Video-based one-on-one tutoring was used by the instructors at Renmin University Affiliated-Sanya High School so that students can have a better emotional perception while they are addressing the course work with real-time help from the instructors¹.

- What types of learning resources should be provided to students?

For the origin of the resources, in addition to instructor created content, the resource created by learners, libraries, even high-quality resources from the web can also be the potential choices (Collis 2004; Casey, 2005). Regards to the modality of the resources, flexibility can be indicated by using a range of media formats, such as podcasts, narrated screen capture, the full video of lectures and software (Gordon, 2014). Open Educational Resources (OER) can also provide flexibility in the way of using learning resources since they are under an open license. For instance, an educator can use, mix, adapt a given OER to fit his/her learning context.



Free and open learning resources provided to students

The Chinese Ministry of Education coordinated 22 online learning platforms that totally offered 24,000 free and open online courses at the national level¹. Schools and educational corporations at the province level also provided a huge amount of open learning resources so that the quantity and flexibility of resources can be guaranteed during the special period of the virus outbreak. The modality of the resources includes filmed lectures and educational games, as showing in Figure 2. Schools like Wenzhou Experimental Middle School further customized the public resources based on the characteristics of its students to fit their needs².



Figure 2. Parts of resources provided in different modalities³

Notes:

1 <https://news.sina.cn/2020-02-05/detail-iimxxste8997186.d.html?vt=4&pos=3>

2 data source: Participants who attended the webinar on Online Education Needs and Implementation in COVID-19 Situation hosted by CIT, on February 19, 2020.

3 Graphs from <http://jypt.tjty.com.cn/acomonapp/chome/mindex.do> and <https://www.xianshua.net/app/hbszxxxsjxpt/>

1 data source: Participants who attended a webinar on Online Education Needs and Implementation in CO.VID-19 Situation hosted by National Engineering Laboratory for Cyberlearning and Intelligent Technology of China(CIT), on February 19, 2020.

- What technologies are truly useful for learning, teaching and administration?

The use of technologies to enhance teaching and learning (Gordon, 2014) and help instructors and departments to process administrative work within institutions (Casey, 2005) can be flexible. A variety of web 4.0 tools can be used to help learners generate content and interact with peers, such as blogs, wikis, and social networks. Additionally, several technology-based communication mediums, such as emails and instant messages applications, made the instructors and administrative staffs' work much more convenient. To address the challenges that students can't go to campus to study in a regular way during the COVID-19 period, in China, different types of tools and platforms were used in an integrated way to support learning and teaching from home. The major technologies utilized by different schools were summarized and classified into different categories based on their functions in Table 1.

Table 1. The types of technologies used in different schools in China during COVID-19 outbreak

Schools in China	Platform	Communication tools	AI-driven APPs	Survey tools
Wuhan Yucai Experimental Primary School	Wuhaneduyun	WeChat, QQ, DingTalk	Tencent Class	
Wuhan Wuchang District Sandao Street Primary School	Wuhaneduyun		Tencent Class	
Wen Zhou Experimental Middle School	UMU	DingTalk		
Baiyangdian High School at Xiong'an District	Xinkaoyun	DingTalk		
Xiaoxita High School at Yichang Wuyi District	Zhixue	DingTalk		Wenjuanxing
RDFZ Sanya School		WeChat, QQ, DingTalk		
Beijing No. 8 High School		Tencent Meeting	Yuanfudao	
BaGu Primary School in Sichuan Liangshan	Xuexi	WeChat, QQ, DingTalk		
The Asia-Pacific Experimental School of Beijing Normal University	Seewoo Cloud Platform	WeChat, QQ, DingTalk		

- When and how to provide assessment and evaluation?

The assessment and evaluation of learning quality, as well as teaching and academic programs (Collis et al., 1997; Casey, 2005) can be flexible. The flexibility can be indicated by the methods of assessments, such as presentation, research papers, team projects, peer assessments, and standardized tests (e.g., multiple choices). E-portfolio is one method that can offer more flexibility for students to update the evidence of their development and achievement (Gordon, 2014). The timing and delivery channel of assessment can also be flexible, computer based test (e.g. online test, adaptive test) and human managed assessment (paper-based test) are the typical methods. Flexible learning can also be provided by applying learning analytics approaches, which will collect the students' learning traces (within the learning system) to provide real-time assessments, as reports or dashboards.



Real time chatting tools facilitated assessments

The instructors at No.1 Primary School in Puyang, Henan province, required students who study at home to write their answers to the test questions on pieces of paper. Students should then take photos of their completed answer sheets and send them to their instructors via real-time chatting tools, such as WeChat. Instructors' grading and comments were then manually added to the photos of the answer sheets by using the image processing tools like Drawing and then be sent back to students, as shown in Figure 3.

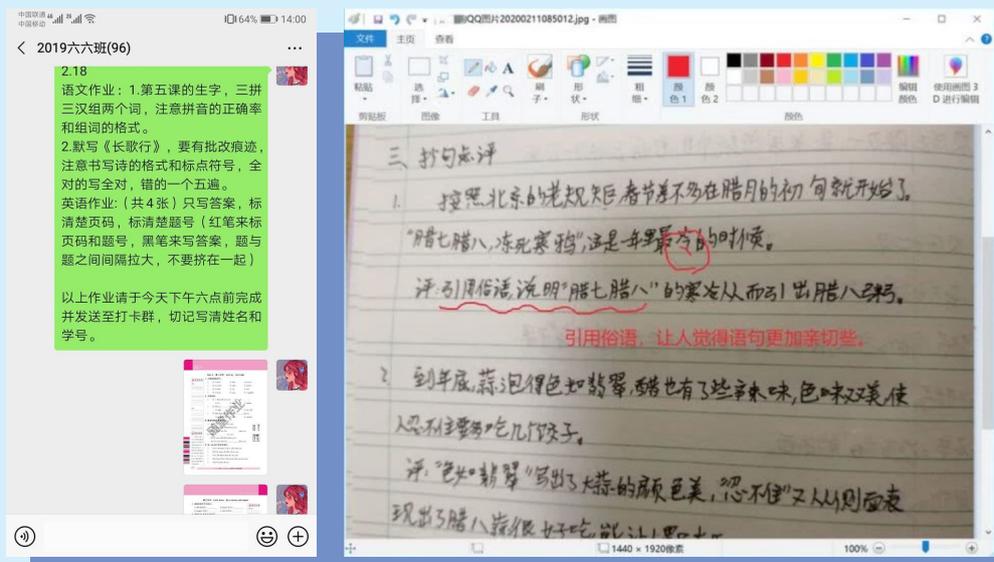


Figure 3. An assessment delivery method by using image processing tools and real-time chatting tools

Source: <https://baijiahao.baidu.com/s?id=1659043617942496101&wfr=spider&for=pc>

- What kind of supports and services should be provided for students and instructors?

The time and place to obtain support and the methods of support can also be flexible (Collis et al., 1997; Casey, 2005; Gordon, 2014). For example, students can get help via help desks, face-to-face or online meetings with tutors, group help sessions and through video-based real-time chatting tools. Allowing learners to specify the language used on learning materials or communication is also an important support, especially for international students. For example, current intelligent learning systems can now provide automatic personalized support to students based on their individual learning characteristics, such as learning performance, personal preferences, etc.



Story 4 The Q & A platform of “Smart Learning Partner”

To address the needs of the students' non-real-time Questions & Answers counseling, Beijing has launched an online Q & A platform. By February 23rd, 2020, there have been 13,705 instructors registered for qualification checking.

All students of grade three in junior high school in Beijing can access the Q & A module of the "Smart Learning Partner" through their computers, mobile phone apps, or the WeChat Subscription. They can upload and publish their questions as text or pictures. Teachers can give students ideas and methods to solve problems through text and pictures. Only one best answer can be adopted for each question.



Figure 4. Online supports for learners and instructors

Source: Advanced Innovation Center for Future Education of Beijing Normal University

2 Applying Online Learning to Provide Flexible Education

At present, according to the development of emergency situation of COVID-19, several countries have adopted various flexible teaching and learning approaches in their education systems, and online education is one of the main approaches. Online learning, as a subset of distance education, has always been concerned with providing access to educational experiences that are at least more flexible in time and in space than campus-based education by utilizing different types of technologies, as discussed in the next section.

2.1 Technology enhanced learning

Technology enhanced learning leverages technology to maximize learning within an environment of high-quality course design that can offer students the options of time, place, and pace, and emphasizes different learning styles. The following five laws play a vital role in applying effective technology enhanced learning (Huang, Chen, Yang, & Loewen, 2013).

- **On intrinsic access to E-learning resources (related to learning resources).**

If learners take the initiative to browse or to “readthrough” all e-learning resources in order to learn more effectively than face-to-face teaching, the resources have to satisfy the following five basic conditions: (a) The contents are of learners’ interests or necessary for them to solve problems; (b) The contents are of moderate difficulty and in an appropriate scale, so that cognitive “overload” will not occur; (c) The structure of the contents is simple and clear, which will reduce the cognitive load of learners; (d) The content is well designed to avoid visual strain; and, (e) The navigation layout is clear with moderate depth so that the learners will not get lost during the navigation on a given learning system.

- **On virtual learning communities (related to learning environments).**

If learners want to communicate in Virtual Learning Environments (VLE) as in the authentic classroom environments, the following three basic conditions are required: (a) Build a trustful learning environment, via providing continuous encouragements, so learners feel a sense of “belonging to the group and environment”; (b) Provide timely feedback to learners, so they can find the answers and acquire a sense of achievement in the VLE; and, (c) Allow learners to gain a sense of emotional identification and release their desire for “competition” or “performance”.

- **On learning management systems (related to the learning system).**

To effectively manage the learning process using Learning Management Systems (LMS), the following four basic conditions should be satisfied: (a) The LMS structure and the “teaching process” are highly coupled; (b) The LMS incorporates automatic services, such as automatic dashboards, which can reduce the teachers and the students’ workload; (c) The generated learning data of both the students and teachers are safe to protect their privacy; and, (d) The LMS should be well-designed in order to provide friendly learning and teaching experiences to both students and teachers respectively.

- **On user’s understanding of the designer’s intention (related to system design).**

Design that does not take into account the user experience might lead to inconvenient learning experiences. In order to overcome this problem, the following three methods can be applied: (a) The use of “metaphor” and “common sense”; (b) Clear and concise documents; and, (c) A universal standard of labels and symbols that is made public and available to teachers and students.

- **On learner's asking for help (related to users).**

In order to make learners more motivated to ask their teachers for help when encountering difficulties, there are three necessary conditions: (a) Appropriate external encouragements (from the teachers, administration, etc.); (b) The intimacy between teachers and students; and, (c) Timely and effective feedback.

2.2 What is online learning

In online learning, learners can interact directly with the learning content that they find in multiple formats (e.g., video, audio, document, etc.). Additionally, they can also choose to have their own learning sequenced, directed, and evaluated with the assistance of a teacher. This interaction can take place within a community of inquiry, using a variety of internet-based synchronous and asynchronous activities (video, audio, computer conferencing, chats, or virtual world interaction). These synchronous and asynchronous online environments will promote the development of social and collaborative skills, as well as personal relationships among participants.

Term 2. Online learning

Online learning is defined as learning experiences in synchronous or asynchronous environments using different devices (e.g., mobile phones, laptops, etc.) with internet access. In these environments, students can be anywhere (independent) to learn and interact with instructors and other students (Singh and Thurman, 2019).

2.3 How to provide online learning

One of the keys to ensure effective online education is active learning. Active learning covers a number of related learning modes, methods, and movements. It represents a shift from traditional, teacher-centered and lecture-based class toward more student-centered class activities that feature group activities, pair discussions, hands-on learning activities, and limited use of traditional lectures. To provide online active learning, the following three learning modes can be applied.

Term 3. Synchronous online learning

Synchronous learning is more structured learning strategy, where the courses are scheduled at specific times and in live virtual classroom settings. In this way, students benefit from real-time interactions, hence get instant messaging and feedback when needed (Littlefield, 2018).

Term 4. Asynchronous online learning

The students in asynchronous learning cannot get instant feedback and message. Additionally, the learning content is not provided in live classes, but rather on different learning management systems or forums (Littlefield, 2018).

Term 5. Open learning

It is the use of teaching methodologies that can help students construct their own learning pathways (self-regulated) and be actively contributing to knowledge building. Specifically, the used teaching materials should be openly licensed and the resources produced during the course should also be released as OER.



Story 5

DingTalk to deliver live-streaming classes

DingTalk is a multi-terminal platform (e.g., PC, Web and mobile devices) for free communication and collaboration created by Alibaba Group for Chinese enterprises. It also supports the mutual transmission of files between mobile phones and computers. Although DingTalk is originally designed for the enterprises, it has been widely used by a large number of primary schools and secondary schools in China to resolve school closures caused by COVID-19. More than 5 million students from more than 10,000 universities and primary schools in 17 provinces attend live-streaming classes via DingTalk.

In response to "Disrupted Classes, Undisrupted Learning", DingTalk further developed a distance education package that can help both teachers and learners. For instance, this package provides health reports on students, online class reports and live interaction. DingTalk also provides real-time class announcements, school notices. Additionally, DingTalk provides free access to online and live classes for schools and colleges across China via computers and mobile devices, supporting

more than one million students to learn at the same time. These online classes offer online teaching, online homework submission and correction, online examination and other learning simulation scenarios. Finally, DingTalk provides free access to online conferencing for all teachers, managers, and principals, ensuring fast and normal coordination between all school members (teachers, directors, etc.).

Figure 5. The main functions provided by DingTalk to support "Disrupted Classes, Undisrupted Learning"
Source: https://www.sohu.com/a/371362451_394951

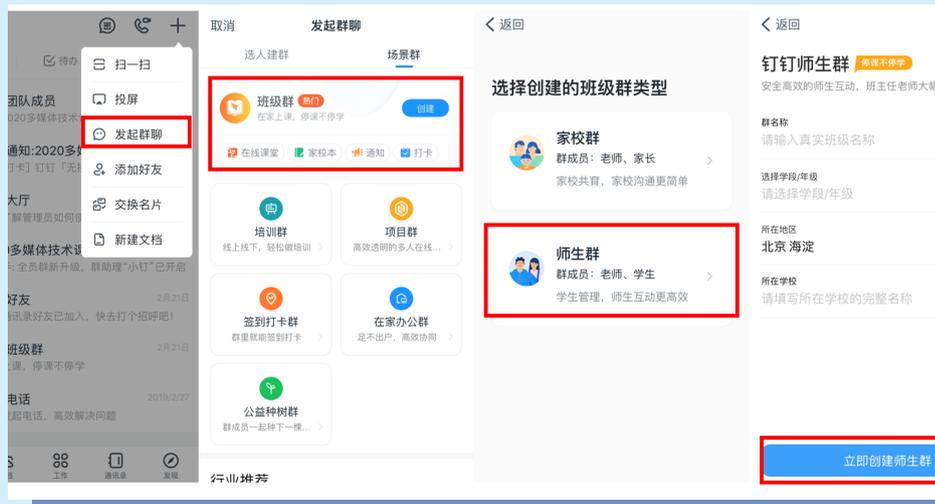


Figure 6. Creating and managing an online class by DingTalk on smartphones
Source: https://www.sohu.com/a/371362451_394951

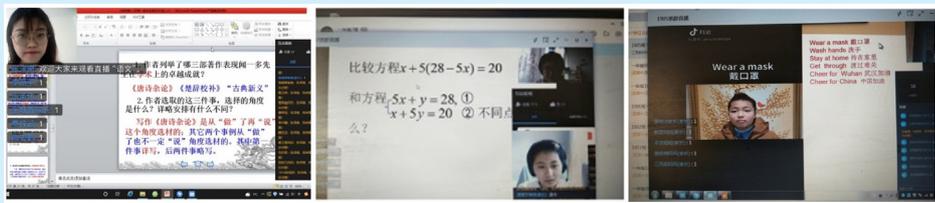


Figure 7. Delivering live-streaming classes of Chinese, Maths and English by DingTalk
Source: <http://www.sjz44z.com/Content-7273.html>

Source of text: https://www.sohu.com/a/371362451_394951

2.4 Core elements for supporting “Disrupted Classes, Undisrupted Learning”

According to the Chinese Ministry of Education (2019), there were in 2018 about 518,800 schools at all levels, with about 16,728,500 full-time teachers and 276 million students in China. As a leading experience worldwide, China is the first country to provide massive online education to hundreds of millions of students nationwide during the epidemic prevention and control period.

From the perspective of online education organization on a huge scale, online education should effectively support “Disrupted Classes, Undisrupted Learning” according to the following seven factors: (a) reliable communication infrastructure, (b) suitable digital learning resources, (c) friendly learning tools, (d) effective learning methods, (e) instructional organizations, (f) effective support services for teachers and learners, and, (g) close cooperation between Governments, Enterprises and Schools (G-E-S cooperation). These seven key factors could be organized into three types of government-led, school-based, and social-service, as shown in Figure 8. The tangrams in the figure are just the “metaphor” of arrangements of these core elements. These types will work in different contexts, i.e., based on the priority of decision-makers from different perspectives. It should be noted that these 7 factors will be in different combinations and communications, depending on the society and culture. For instance, in the “School-based type”, as schools are equipped with basic network infrastructure, the first concern that they will focus on is therefore the use of appropriate learning tools that can be used online or offline to manage or create different learning resources. These seven factors will be discussed in detail in each of the next sections.

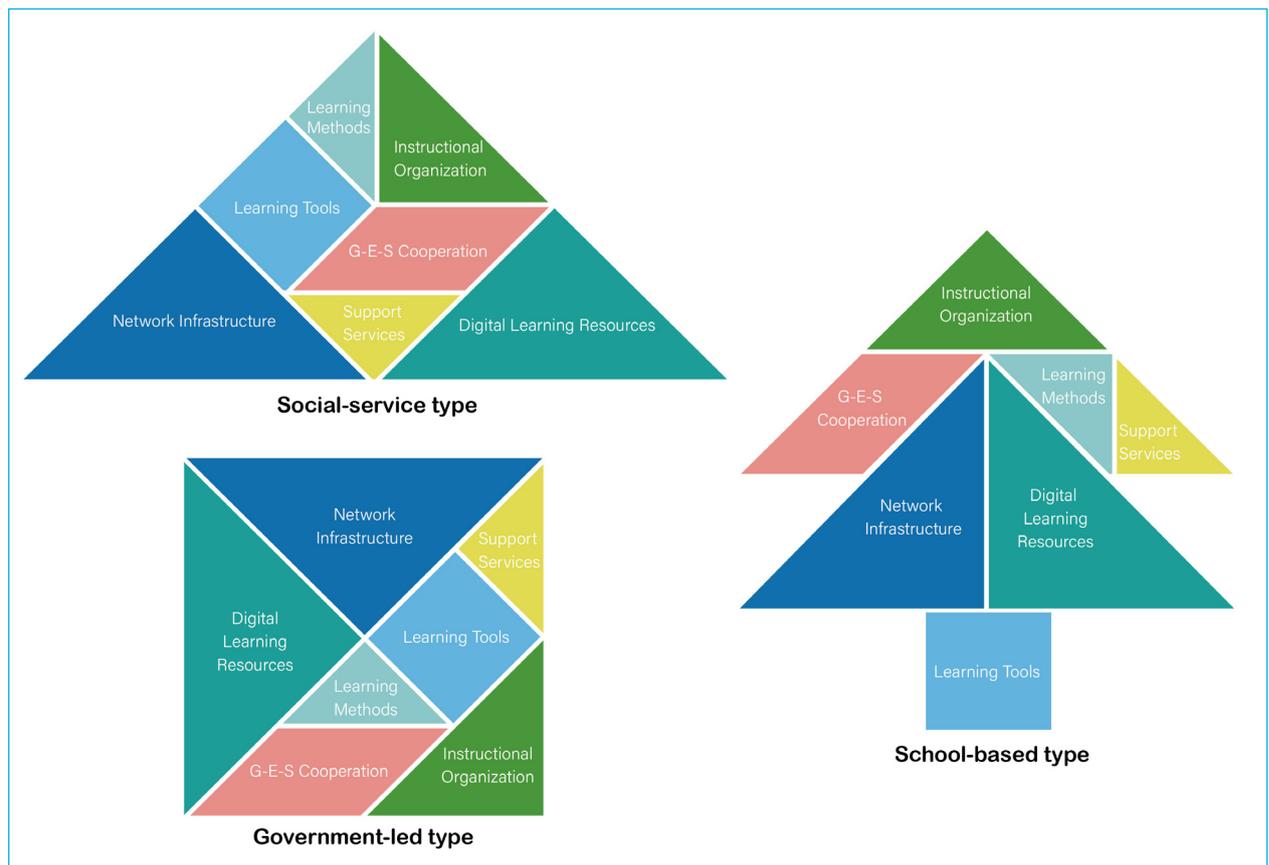


Figure 8. Diagram of flexible learning with cyberspace during educational disruption

Story 6

Providing appropriate learning resources on the National Public Service Platform for Educational Resources

National Public Service Platform for Educational Resources is an initiative of the central government of PRC in providing basic public services for education. The platform creates a network of communication, sharing and application environment for resources providers and users, and serves all levels of education. Large amounts of resources have been provided for teachers and students of schools at all levels, including digital resources that are synchronized with classroom teaching in primary and secondary school (e.g., teaching plans, courseware, teaching videos, course material), problem sets and tests database for the high school entrance examination and the college entrance examination. Additionally, the platform also provides MOOCs for students, teachers and principals of schools at all levels, and resources for vocational education, safety education, moral education, education for physical, health and art.

In order to support the "Disrupted Classes, Undisrupted Learning" during the coronavirus outbreak, the Chinese Ministry of Education quickly launched the National Network Cloud Platform for Primary and Secondary School based on the National Public Service Platform for Educational Resources. To meet the students' learning demands in this special period, appropriate resource modules of 10 topics in time were added to the platform, including epidemic prevention education, moral education, curriculum learning, life and safety education, mental health education, family education, classic reading, trip learning education, film and television education, and electronic books.

On the first day of operation on February 17, 2020, the platform had more than 8 million clicks with millions of users covering 31 provinces of China. Users also from 47 countries and regions logged into this platform. About 85 percent of visitors used mobile devices, such as smart phones and tablets.



Figure 9. National Public Service Platform for Educational Resources
Source: <http://www.eduyun.cn/>

Source of text: http://edu.gmw.cn/2020-02/18/content_33564454.htm

3 Ensuring Reliable Network Infrastructure

Reliable network infrastructure is crucial to support different activities, such as synchronous cyber-teaching using video conferencing, asynchronous cyberlearning by accessing or downloading digital learning resources, and collaboration with peers via social software, etc. Schools should test and evaluate the network bandwidth and increase it if necessary. To ensure a reliable network infrastructure that can support millions of students studying at the same time, the following strategies can be applied.

- Mobilize all major telecom service providers to boost internet connectivity service for online education, especially for the under-served regions.
- Increase the server bandwidth of universities and schools to provide flexible learning and teaching experience for millions of students simultaneously without interruption.
- To ensure accessible learning experiences, several universities used telecourses. Specifically, four channels of China Education Television started open broadcasting of primary and middle school classes across the nation, covering 75 lessons on air to provide learning experiences for those in remote areas without Internet or without cable TV.

Story 7

Reliable communication infrastructure provided by CMCC to ensure “Disrupted Classes, Undisrupted Learning”

China Mobile Communications Group Company Limited (CMCC) is a mobile communication operator based on GSM, TD-SCDMA, TD-TELE and FDD-LTE standard network. Over the years, CMCC has actively promoted the development of national education informatization through taking the lead in jointly releasing the campus broadband "doubling plan" with the Chinese Ministry of Education, and carrying out the campus broadband acceleration and fee reduction.



Figure 10. National Network Cloud Platform for Primary and Secondary School supported by CMCC and other companies
Source: <http://ykt.eduyun.com/>



Figure 11 A student was learning online at the remote village in Jiangxi province supported by CMCC
Source: <http://jx.sina.com.cn/news/zhzx/2020-03-02/detail-iimxstf5822566.shtml>

In order to support the "Disrupted Classes, Undisrupted Learning" during the novel coronavirus outbreak, CMCC assisted four cloud service providers to complete the IDC bandwidth expansion to 2.18T, reserved 12.95T resource for use, opened the SMS capacity of 16,000 pieces/second flow rate, and expand the capacity of 414 mobile cloud hosts. On February 17, 2020, CMCC successfully ensured the smooth launch of the "National Network Cloud Platform for Primary and Secondary School", which served 180 million primary and secondary school students in China to study at home and provided 50 million students with online access at the same time. In addition, CMCC has also actively carried out network security and mobile cloud security of

provincial public platform for education resource service in Guizhou province, Jiangxi province, Beijing city, and Shanxi province.

In Hubei province, CMCC strived to support the launch of "Air Classroom Based on Wuhan Education Cloud" and provided the "Hubei Synchronization School" service, which can provide synchronous curriculum resources on demand service for 6 million primary and middle school students in Hubei province. Supported by "Air Classroom Based on Wuhan Education Cloud", 700000 primary and middle school students in Wuhan city can simultaneously watch live online teaching videos at home. In Hebei province, CMCC, as the exclusive cooperation unit of the provincial department of education, undertook to build and guarantee the launch of an online teaching resource platform of primary and secondary education. The platform can serve 15,000 primary and secondary schools and 12 million teachers and students in Hebei province. In Jiangxi province, CMCC has also covered remote villages to enable children in the village to access the online courses of the new semester, ensuring inclusive learning where "no child should be left behind".



Figure 12. Air Classroom Based on Wuhan Education Cloud supported by CMCC and other companies
Source: <http://www.wuhaneduyun.cn/>



Figure 13. The online teaching resource platform of primary and secondary education in Hebei province supported by CMCC
Source: <http://edu.10086.cn/hbcloud/index>

Source of text: <https://tech.sina.com.cn/roll/2020-02-26/doc-iimxstf4593046.shtml>

4 Utilizing Friendly Learning Tools

Effectively selecting and using learning tools is beneficial to learners in finding and processing information, constructing knowledge, collaborating with peers, expressing understanding and evaluating learning effects in concrete ways.

The convenience of tools should be taken into consideration when choosing learning scenarios. Specifically, tools should be convenient and quick to: (a) help teachers effectively produce and manage resources, release notices and manage students; (b) help students obtain resources, participate in learning activities; (c) help teachers and students interact in real time; and, (d) help teachers, parents and schools understand students' learning performance and make timely school-home interaction. In order to facilitate teachers at all levels to quickly select various learning tools for a smooth online teaching, learning tools are divided into eight categories, as shown in Table 2, according to their different roles in various teaching activities.

Table 2. Classification of learning tools

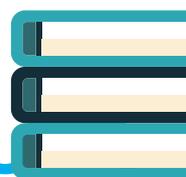
Categories of Tools	Suitable Teaching Scenarios	Representative Tools	Links
Tools for resources producing	PPT recording software	Suitable for PPT-assisted video recording	Power Point and WPS in Windows, Keynote in IOS system (1) PowerPoint: https://products.office.com/zh-cn/powerpoint (2) WPS: https://www.wps.cn (3) Keynote: https://www.apple.com/keynote/
	Screen capture software	Video editing; especially suitable for producing software operation courses	Camtasia Studio, QuickTime, Adobe Premiere (1) Camtasia studio https://www.techsmith.com (2) QuickTime https://support.apple.com/quicktime (3) Adobe Premiere https://www.adobe.com/cn/products/premiere.html
	The software of video production	Producing micro course video quickly	Huawei Course maker App http://www.coursemaker.cn
	The software of original video producing	Suitable for recording handwritten calculation and action skills display	Mobile phones, CamScanner CamScanner https://www.camscanner.com
	The software of Multimedia learning resource producing	Appropriate for developing multimedia courseware	Mystic raft, Sdobe Captivate (1) Mystic raft https://en-vr.101.com (2) Sdobe Captivate https://www.adobe.com/cn/products/captivate.html

Categories of Tools		Suitable Teaching Scenarios	Representative Tools	Links
Tools for synchronous live teaching	All types of live streaming software, including software on interactive teaching, remote office, online-course	Suitable for live teaching courses; different kinds of software can be chosen to satisfy various demands for interaction, network quality or convenience	Teaching interaction: Rain-classroom, Tencent Ketang Chaoxing Learning APP, ClassIn, CCTalk, UMU Social communication: QQ Group, Wechat Group Remote office: Welink, Dingtalk, ZOOM, FEISHU, TED Conversations Online course platform: icourse, edX, Coursera, Udacity	(1) Rain-classroom: https://www.yuketang.cn (2) Tencent Ketang https://ke.qq.com (3) Chaoxing Learning APP http://www.xuexi365.com (4) ClassIn http://www.eeo.cn/cn/index.html (5) CCTalk, https://www.cctalk.com (6) UMU https://www.umu.cn/model/home (7) QQ https://im.qq.com (8) WeChat https://weixin.qq.com (9) Welink https://welink.com (10) Dingtalk https://www.dingtalk.com (11) ZOOM https://zoom.com.cn (12) FEISHU https://www.feishu.cn (14) icourse http://www.icourses.cn/home/ (15) edX https://www.edx.org (16) Coursera https://www.coursera.org (17) Udacity https://cn.udacity.com
Tools for asynchronous teaching	All kinds of online teaching platforms in national level, regional level and university community level, as well as those launched by universities and enterprises	Suitable for the courses in need of asynchronous teaching; suitable network teaching platforms can be chosen according to the requirements of the schools and the courses	Course sharing platform icourse, edX, Coursera, Udacity Reginal MOOC platform CNMOOC Local university MOOC platform UOOC Tsinghua University MOOC platform XuetangX Peking University MOOC platform CHINESE MOOCS Enterprise online course platform: Zhihuishu, ulearning	(1) icourse http://www.icourses.cn/home/ (2) edX https://www.edx.org (3) Coursera https://www.coursera.org (4) Udacity https://cn.udacity.com (5) CNMOOC https://www.cnmooc.org/home/index.mooc (6) UOOC http://www.uooc.net.cn/league/union (7) XuetangX https://next.xuetangx.com (8) CHINESE MOOCS http://www.chinesemooc.org (9) Zhihuishu https://www.zhihuishu.com (10) ulearning https://www.ulearning.cn
Tools for self-regulated learning	Learning apps for all subjects	Suitable for the courses leading students' online self-learning; orientated by problems or tasks and based on all kinds of online interactive learning, inspiring students to utilize learning tools to preview, review or explore on a specific topic	Chinese subject: SANYU, Happy Pinyin App English subject: yangcong345, Sketchpad Physics subject: NOBOOK, wlds100 Chemistry subject: NOBOOK, Potato Chemistry App Biology subject: XINGSE, Potato Biology App History subject: Chinese Cadres Learning App, Your Forbidden City	(1) SANYU http://www.etc.edu.cn/tfish/ (2) Happy Pinyin App http://www.61baobao.com/xuezhishi/kuailiepinyin/ (3) yangcong345 https://yangcong345.com/#/studentPage (4) Sketchpad https://www.jihehuaban.com.cn (5) NOBOOK (physics) https://www.nobook.com/wulistudent.html (6) wlds100 https://www.wlds100.com/view/index.html (7) NOBOOK (chemistry) https://www.nobook.com/huaxuestudent.html

Categories of Tools		Suitable Teaching Scenarios	Representative Tools	Links
Tools for self-regulated learning	Learning apps for all subjects	Suitable for the courses leading students' online self-learning; orientated by problems or tasks and based on all kinds of online interactive learning, inspiring students to utilize learning tools to preview, review or explore on a specific topic		(8) Potato Chemistry App https://www.cr173.com/soft/764883.html (9) XINGSE http://www.xingseapp.com (10) Potato Biology http://www.downcc.com/soft/202055.html (11) Chinese Cadres Learning App https://www.onlinedown.net/soft/136113.htm (12) Your Forbidden City https://www.dpm.org.cn/classify_detail/180890.html
Tools for knowledge construction	Cognitive tools, collaborative editing tools, virtual simulation tools, etc.	Suitable for the courses in need of collaborative learning for the construction of knowledge; from various aspects of the construction of knowledge, tools selection and learning activities design can be conducted by combining course contents	Cognitive tools: mind mapping, GeoGebra Collaborative editing tools: Knowledge forum, wiki, shimo.im, Tencent Document, Google Docs, Trello VR tools: pHET, Sandboxie, KR pano	(1) mind mapping https://www.mindmapping.com (2) GeoGebra https://www.geogebra.org (3) Knowledge forum http://www.knowledgeforum.com (4) wiki http://wiki.com (5) shimo.im https://shimo.im/welcome (6) Tencent Document, https://docs.qq.com/desktop (7) Google Docs https://google-docs.en.softonic.com (8) Trello https://trello.com (9) pHET https://phet.colorado.edu/zh_CN/ (10) Sandboxie https://www.sandboxie.com (11) KR pano http://www.krpano360.com
Tools for learning analytics	Apps, websites, and interactive class software supporting data analysis	Suitable for the development of accurate teaching based on data, such as the self-learning part before the flipped class, and the collaborative learning in computer-supported cooperative learning (CSCL)	Apps: Smart Partner, zhixue, afanti Websites: zhixue, zxxk, FCLASSROOM Interactive class software: Rain-classroom	(1) Smart Partner http://stem.bnu.edu.cn/public/apps/slp/ (2) zhixue https://www.zhixue.com/login.html (3) afanti http://www.afanti100.com (4) zhixue https://www.zhixue.com/login.html (5) zxxk http://www.zxxk.com (6) FCLASSROOM http://www.fclassroom.com (7) Rain-classroom https://www.yuketang.cn
Tools for practice and evaluation	All kinds of tools suitable for higher education and basic education	Suitable for conducting plenty of practice which facilitate learning and mastering of the contents, as well as the evaluation of learning results	Higher education: SO JUMP, wj.qq.com Basic education: yuantiku, knowbox	(1) SO JUMP https://www.wjx.cn (2) wj.qq.com https://wj.qq.com (3) yuantiku http://www.yuantiku.com (4) knowbox http://www.knowbox.cn

Categories of Tools		Suitable Teaching Scenarios	Representative Tools	Links
Tools for resources and class management	Apps for learning and class management, mini programs in Wechat, as well as social software	Suitable for the effective organization of online learning with abundant learning resources, a large number of students and learning tasks.	Learning management systems: Moodle, Learning Cell, Software-as-a-Service, Edmod, Schoology, TalentLMS Class management apps: EasiCare, Mentimeter, Typeform. Social software: QQ Group, Wechat Group, Facebook, WhatsApp, Skype, line.	(1) Moodle https://moodle.org (2) Learning Cell http://www.etc.edu.cn/ko/?view=list (3) Software-as-a-Service (4) Edmodo https://api.edmodo.com (5) Schoology https://www.schoology.com (6) TalentLMS https://www.talentlms.com (7) EasiCare https://care.seewo.com (8) Mentimeter https://www.mentimeter.com (9) Typeform https://www.typeform.com/forms/ (10) QQ https://im.qq.com (11) WeChat https://weixin.qq.com (12) Facebook http://www.facebook.com/ (13) WhatsApp https://www.whatsapp.com/ (14) Skype http://skype.gmw.cn (15) line https://line.en.softonic.com

In terms of utilizing tools to facilitate students' cognitive development and collaborative construction of knowledge, the following aspects are recommended: (a) utilizing various tools in information retrieval, mind mapping, document management, presentation, social tools and other tools to help students access information and compare different views and express their own opinions, and form an organizational and multi-media personal knowledge base; (b) utilizing instant messaging tools, social platforms and learning communities to help students discuss, debate and reach agreements with group members or learning community members, and complete knowledge construction in discussion or online collaborative interaction; (c) utilizing all kinds of tools that provide real-time feedback and evaluation, learning situation analysis. This can help students conduct internal consultation and meaning construction by reflection on learning results and learning process, promote personalized meaning construction, and, ultimately, the development of higher-level thinking.



5 Adopting Suitable Digital Learning Resources

With the development of ICT in education, digital learning resources like Massive Open Online Courses (MOOCs), Small Private Online Courses (SPOCs), online video micro-courses, e-books, simulations, models, graphics, animations, quizzes, games, and e-notes are making learning more accessible, engaging, and contextualized. However, selecting suitable digital learning resources for learners should base on the design of online learning activities.

Term 6. Digital learning resources

The term 'digital learning resource' is used to refer to materials included in the context of a course that support the learner's achievement of the described learning goals. These materials consist of a wide variety of digitally formatted resources including graphics images or photos, audio and video, simulations, animations, prepared or programmed learning modules (Epigeum, 2019).

5.1 Evaluate the suitability of digital learning resources

Ozdemir and Bonk (2017) have pointed out that searching and locating specifically high-quality educational resources, among the thousands that are published, is a difficult task. Therefore, teachers should carefully choose the quality of educational resources to use by referring to well-known national and international repositories, such as the Chinese Ministry of Education (MoE) and Massachusetts Institute of Technology (MIT). Additionally, assessing and selecting good quality digital educational resources is one of the challenging tasks. Specifically, the educational resources can be selected on several criteria, as follows:

- **Licensing:** Educators should choose open license content, as this will allow them to legally reuse and remix these educational resources in their teaching context.
- **Accuracy/quality of content:** several digital resources are published online without knowing the reliability of the content or the publisher. Therefore, educators should refer to reliable digital educational resources and platforms (see the next section).
- **Interactivity:** Educators should choose interactive learning resources which can help increase the learning engagement and motivation of students. For instance, using interactive open textbooks, instead of simple PDF files, would make students more active and interested to learn.

- Ease of adaptability: Educators should choose resources which are easy to adapt in their context, i.e. resources which can be easily mixed or modified to fit a specific learning context. For instance, PPT presentations can be good resources as they can be easily readapted.
- Cultural relevance & sensitivity: Educators should choose educational resources that do not report any offensive information to any given race or culture.
- Suitable learning resources also include the following five criteria : (a) Suitability of content: the learning resources should be highly related to learning objectives and contents, as well as be interesting or necessary to solve problems for students; (b) Suitability of difficulty: the content should be moderate in difficulty and scale, so that students will avoid cognitive overload; (c) Suitability of structure: the structure of learning contents is concise and rational, which will not make students "confused"; (d) Suitability of the media: The media should be presented in an acceptable way, so as not to cause visual fatigue, especially for younger students; and, (e) Suitability of resource organization: different types of learning resources can be effectively organized, such as video, animation, text, electronic teaching materials, virtual experiments, etc., in order to make the layout clear and the content suitable, and students will not be confused.

5.2 The available digital learning resources for different levels of education

Table 3 presents a comprehensive review of available digital learning resources that both teachers and learners can refer to in their context.

Table 3. Classification of Digital Learning Resources

Objects Resources	Basic education	Higher education	Adult education
National public platform for educational resources	National Public Service Platform for Educational Resources; One teacher, one excellent course	Course, FUN, IGNOU, OpenER	Xuexi.cn
Public platforms for educational resources of regions	The educational cloud platforms of provinces and regions, One Stop Learning	University Open Online Courses (UOOC), Zhejiang Institutions of Higher Learning Online Open Course Sharing Platform	The Civil Learning Space in Capital Library of China
School-based resources at all levels	The school-based learning resources of Tsinghua University Primary School, The High School Affiliated to Renmin University of China	XuetangX, CHINESE MOOCS, Blackboard, JMOOC, Ewant	The Open University of China, "SOU Course" FM in Shanghai Open University
All types of resources by online educational enterprises or school-enterprises collaboration	The digital teaching resources and electronic teaching materials of People's Education Press, 101 Education PPT, Connections Academy	Zhihuishu, ulearning, NetEase Online Open Courses, eryl. mooc.chaoxing.com	Udacity, NetEase Cloud Classroom, Zhengbao Cloud Classroom
International high-quality open education resources (OER)	The K12 learning resources in OER COMMONS, Khan Academy	Coursera, edX, Canvas, FutureLearn	ALISON, iversity, Open2Study, openupEd, CodeCademy

Story 8

Appropriate digital learning resources for all education levels provided by Tianjin municipality

Tianjin is a municipality directly under the central government in northern China. It has 16 districts, with a total area of 11966.45 square kilometers, a permanent resident population of 15.60 million, an urban population of 12.97 million, and an urbanization rate of 83.15%. There are about 1.17 million students in primary and secondary schools, and there are more than 100,000 students in junior three and senior three who need to take entrance examination every year.

In order to support the "Disrupted Classes, Undisrupted Learning" during the coronavirus outbreak, the government of Tianjin quickly adjusted the teaching arrangement and launched relevant policies, according to different demands of students in kindergarten, primary and secondary schools, colleges and universities. The Tianjin Municipal Education Commission provided guidance on learning and physical exercise at home during this special period. The guidance on resource entry and selection has been instantly shared to students, teachers, and parents via WeChat.

For the students who need to take the entrance examination, groups of refresher courses were recorded in a short time. Each course was taught by two teachers with senior or above professional titles. These courses broadcasted to the whole city through Tianjin cable television. At the same time, various types of learning resources covering the main subjects of primary and secondary schools were provided to all the teachers and students. These resources were stored on the Tianjin public service platform of education resources for primary and secondary education, the cyber-learning spaces, the personalized learning service system, and the digital library of primary and secondary schools.



Figure 14. Guiding students to choose appropriate resources through WeChat public account
Source: <http://tj.bendibao.com/news/2020130/86600.shtm>



Figure 15. The Tianjin public service platform of education resources for primary and secondary education
Source: <http://tjedu.tjyy.com.cn/api/front/index/first>



Story 9

Free electronic textbooks for primary and secondary schools provided by People's Education Press

People's Education Press (PEP) is a large professional publishing company affiliated to the Chinese Ministry of Education. It is mainly engaged in the research, compilation, editing, publication, and distribution of textbooks for primary and secondary education and other kinds of textbooks for education at all levels. It does not only publish paper medium books, but it also engages in electronic audio-visual and multimedia products publishing and printing, copyright trade, books, and related products logistics services, digital publishing and services.

In order to support the "Disrupted Classes, Undisrupted Learning" during the coronavirus outbreak, PEP has provided open and free access to all digital teaching resources on an APP named "PEP Touch & Read" to primary and secondary school students in China. The digital teaching resources involve texts of three disciplines uniformly compiled by the state and digital teaching materials compiled by PEP, coming with thousands of video and audio micro courses synchronized with the textbooks. In order to support the 6 million teachers and students in Hubei province, PEP provides free digital textbooks and digital application

services for 3 months to the teachers and students of primary and secondary schools in Hubei Province. In addition, PEP provided free digital textbooks for the spring semester of 2020 to teachers and students of primary and secondary schools across compulsory education, senior high school education, secondary vocational education, and special education. The digital textbooks involve nearly 600 varieties of more than 20 disciplines.



Figure 18. The official website of People's Education Press
Source: <http://www.pep.com.cn/>

Figure 19. The staffs of People's Education Press are working overtime to make the resource on the APP named "PEP Touch & Read" free for all users
Source: http://www.pep.com.cn/rjdt/rjdt/202002/t20200204_1949363.shtml



Figure 20. The interface of the APP named "PEP Touch & Read"
Source: <http://image.baidu.com/>



Figure 21. The unified entrance of all digital textbooks for education at all levels
Source: <http://www.dzkbw.com/>

Source of text: http://www.pep.com.cn/rjdt/rjdt/202002/t20200204_1949363.shtml

6 Facilitating Effective Online Teaching and Learning

Unlike traditional classroom learning, online instruction is characterized by having different locations of both teachers and learners, therefore flexible learning should consider effective online teaching and learning instructions using different technologies.

6.1 Instructional organization of learning

A range of teaching and learning strategies can be used in online contexts to make flexible instructions, as highlighted in the following examples of instructional methods (Petrina, 2011).

- **Lecture:** also known as direct instruction. The Direct Instruction teaching strategy mainly focuses on teacher-directed approaches and is the most commonly used teaching method. Here, the content needs to be prepared and organized in advance. Also, the instructor needs to be aware of student requirements for the lessons or sessions. This strategy is effective in imparting knowledge to students in a step-by-step structured way and involves active student participation.
- **Case study:** A detailed analysis is made of some specific, usually compelling event or series of related events so that learners will better understand its nature and what might be done about it. For example, learners in a technology lab might investigate the wear and tear of skate boarding on public works. Another class might look at cases of digital technologies and privacy.
- **Debate:** A form of discussion whereby a few students present and contest varying points of view with regard to an issue. For example, students could take different positions and debate an issue: "Should rights to free speech on the internet be extended to students in schools?"
- **Discussion:** Discussions occur when a group assembles to communicate with one another through speaking and listening about a topic or event of mutual interest. To illustrate, a group of learners convenes to discuss what it has learned about global warming.
- **Student-led discovery:** Students are given responsibility over particular topics and delivery methods. Students can choose how they want to research the material, and then how they will present it to the rest of the class in an engaging way.
- **Experiential learning:** Experiential learning focuses more on activities and requires the students to apply their experience to other contexts. It's more about the process of learning rather than focusing on the content.

Students participate in the activities, reflect and share their experiences, analyse and infer the solutions and formulate plans to apply their learning in new situations. Teachers need to provide the environment for learning and encourage the students to be active. You also need to have back-up plans for activities in case of problems. This model is used in most pre-schools today, since the other models do not work that well with younger kids. This course can show you how to make experiential learning more effective for young kids.

- Academic games or competition: Learners compete with each other one-to-one or team-to-team to determine which individual or group is superior at a given task such as "spelldowns," anagrams, technology trivia, Odyssey of the Mind, or project competition. Commercially available, academic computer games are also very popular.
- Brainstorming: In order to generate creative ideas, learners are asked to withhold judgment or criticism and produce a very large number of ways to do something, such as resolve a problem. For example, learners may be asked to think of as many ideas as possible to eliminating world hunger. Once a large number of ideas have been generated, they are discussed to see their feasibility.
- Drill and practice: A form of independent study whereby, after the teacher explains a task, learners practice it. For example, after students are shown how to use Ohm's Law, they are asked to make calculations of current, resistance and voltage.

6.2 Social organization of learning activities

Several social organizational approaches can be used in online contexts to make flexible learning, as highlighted in the following examples (Promethean, 2017; Petrina, 2011).

- Independent study: Independent study encompasses a range of teaching methods that develop student skills like initiative, self-belief, time management, and self-improvement. Students are encouraged to undertake a planned activity under the supervision of a teacher or guide. It also involves group study or learning with an assigned partner. These methods are designed by the teachers carefully to address the specific requirements of a group. As a teacher, you would need to plan the process of feedback collection, monitor performance and provide the appropriate resources for independent study.
- Cooperative learning: Learners are placed in groups of four to six. Sometimes the groups are as diverse or heterogeneous as possible. In such cases, group members are often rewarded for the group's overall success. Student groups might be given a teacher presentation on the division of fractions. They would then be given worksheets to complete. Team members would first help and then quiz one another. Co-operation involves interdependence. Roles and responsibilities are clearly defined but are open for negotiation. This method of collaboration brings with it a strong sense of accountability.
- Collaborative learning: Students progress personally, while collectively working towards a common goal. Students are accountable to one another and, with appropriate direction, will self-manage this. Learners learn to better work with others having different individual differences(e.g. cultures, styles, etc.).

During the coronavirus period, all teaching activities must be online. This raises the challenge of providing the appropriate online instruction in a flexible way, by considering the characteristics of students and learning

subjects. In order to help teachers combine both the learner characteristics and the content characteristics, we classify the instruction organization types according to the interaction of teachers and students in online environments, as shown in Table 4.

Table 4. Organization forms of online teaching

Time	Types of organization	Technical means	Learning resources	Learning content	Requirements for teachers and students	Expected outcome	Potential risks
Synchronous instruction	Live streaming teaching	Live streaming platforms	Existing teaching courseware/ lecture notes	Face to face teaching contents	Teachers should be capable to use live streaming tools for online teaching. Students should be focused for a long time in front of the screen.	Focused teaching in classroom	Require good network bandwidth, Poor real-time online discussion and communication, poor student experience
	Online real-time interactive teaching	Classroom interaction software	Learning materials and guidance questions should be provided before class	Key and difficult points in teaching	Teachers should be capable of guiding and organizing online interaction. Students should actively communicate with teachers online.	Face-to-face discussion and communication	
Asynchronous instruction	Online self-regulated learning with real-time interactive Q&A	Online learning platform and real-time interactive tools	MOOCs of others or oneself, or self-made courses	Rich learning resources and complete learning activities	Teachers should be capable of producing course resources, such as making videos and designing online learning activities. Students should have strong self-regulated learning abilities.	Improvement of students' self-regulated learning abilities	Students lack the sense of collective belonging, and students with lower self-regulated learning ability are easy to fall behind.
	Online cooperative learning guided by teachers	Online learning space, online collaborative learning platforms and learning analysis tools	Featured websites, databases and learning tools	Individual activities and group activities; individual task and group task	Teachers should be capable of diagnosing problems based on data analysis results and giving guidance in time. Students should collaborate with others and conduct self-regulated learning.	Improvement of students' cooperative learning abilities	There is a huge difference in learning outcomes between different groups, and a few students do not actively participate in it.

Story 10

Self-directed learning encouraged by Guangzhou Nansha No. 1 Middle School

"Self-directed learning" is a prerequisite for students to form good cognitive habits and a key factor of academic success. As early as January 27, 2020, the Chinese Ministry of Education issued a notice on the postponement of the spring semester in 2020 due to the spread of the epidemic, urging schools to use online platforms.

Yang, a senior 3 student at Guangzhou Nansha no.1 Middle School, said it was "important for her to keep up with the pace of study". Every day Yang gets up at 6 am, opens the learning application from 6:20 to 6:50 to practice oral English, read out loud, retell stories, play different roles highlighted in the application, and conduct special exercises by simulating test scenes. From 6:50 to 7:20, she recites the Chinese ancient poems and famous quotes she knows. After breakfast, Yang sat at her desk at 8:00, waiting for the school's live lecture to start. For Yang, online classes not only helped her keep up with the pace of the college entrance examination, but also provided her an opportunity to practice her "self-discipline" Learning.



Figure 22. High school students study independently during epidemic prevention

Source: <https://baijiahao.baidu.com/s?id=1659035542839640688&wfr=spider&for=pc>

Compared with traditional learning methods in schools and classrooms, learning methods in the era of "Internet+" are pluralistic and diverse. They can be either individual learning, or group and community learning; either based on learning tools or resources, or via terminal devices; either self-regulated learning for a specific subject or skill, or collaborative, interdisciplinary learning based on a specific project or problem. During the period of preventing the epidemic, according to the scale of participants and their cognitive levels during the learning process, schools at all levels and kinds can guide students to choose appropriate learning methods based on specific and applicable educational scenarios.

Table 5. Classification of learning methods for different participants

Participants	Learning behavior	Cognitive level	Educational scenario
Individuals	Self-regulated learning based on video-on-demand/ live streaming	Lower-level learning	Fast acquisition of factual contents of all disciplines
	Self-regulated learning based on disciplinary tools	Lower-level learning Higher-level learning	Accurate mastery of factual content of specific discipline and learning of experimental operation skills
	Autonomous and exploratory learning based on learning resources websites	Higher-level learning	Learning of interdisciplinary, open and comprehensive themes
	Self-regulated learning based on terminal devices such as AI, VR, and AR	Lower-level learning Higher-level learning	Learning of experiential content or skills requiring high demand of learning scenarios or experience
Groups	Group discussion based on social media/online forums	Higher-level learning	Learning of controversial topics or open questions, and the acquisition of emotional attitude
	Online group collaboration based on collaborative learning tools	Higher-level learning	Tasks or topics that can be completed in a short period of time
	Inquiry learning based on project/topic	Higher-level learning	Tasks or topics that require a long period of time to complete, covering a wide range of complex operations
Communities	Collaborative construction of knowledge based on learning community	Higher-level learning	Acquisition of complex concepts or cutting-edge knowledge, as well as that of emotional attitude



“Rain-Classroom” to deliver synchronous and asynchronous classes

Rain-classroom is a smart teaching tool jointly developed by Xuetang Online and the office of online education of Tsinghua university, to comprehensively improve the classroom teaching experience, enhancing the interaction between teachers and students, and making online teaching more convenient. Rain-classroom integrates the complex information technology means into PowerPoint and WeChat, establishes the communication bridge between the extracurricular preview and the classroom teaching, and makes the classroom interaction never offline. With the help of Rain-classroom, teachers can publish the pre-class preview courseware with MOOC videos, exercises and audios to students' mobile phones, so that the teachers can easily diagnose the problems of students' learning and give feedback in time. Rain-classroom also provides classroom live broadcast, during which student can answer real-time questions and interact with teachers through “bullet screen”. In addition, Rain-classroom provides teachers and students with complete three-dimensional data support, personalized reports, and automatic task reminders.

On February 17, 2020, Tsinghua University started its online classes on Rain-classroom. In the first week of the new semester, 264,000 teachers and students were attending Rain-classroom, completing 10,635 online lessons involving 3,923 courses, with a total of 395,000 hours. Among these courses, 152 courses were undertaken by 73 foreign teachers from various schools and departments, and delivered in the United States, the United Kingdom, Japan, Canada, France, Australia, and Germany. This is the first time in the history of higher education in the world that a large-scale, real-time, interactive, long-distance and decentralized online teaching system has been implemented.

To make more teachers skilled in using rain classes, the teacher development center of Tsinghua University, together with the Xuetang Online, the academic affairs office and the graduate school, conducted live training on the use of Rain-classroom for teachers in the spring semester of 2020. Yinian Guan, who works in the online teaching and training center of the school, first guided the teachers to experience the basic environment and functions of the Rain-classroom as students, and explained the methods of downloading, installing and using relevant software. The participating teachers conducted real-time interaction with Yinian Guan through "bullet screen" and posts, and got familiar with the teaching environment of the Rain-classroom.

Xinjie Yu, a professor of electrical engineering and who has a rich experience in using Rain-classroom, organized a training about "pre-class, in-class and after-class" arrangement of online teaching. As Yu pointed out, teachers should first change their teaching philosophy before class and "split" their teaching content. The original course should be divided into several 20-30 minute paragraphs, breaking the big story into small stories, breaking the whole course into paragraphs. In order to achieve the ideal teaching effect, Yu suggested that teachers should take full advantage of the interactive advantage of Rain-classroom to intersperse with rich interaction between the three parts to keep attracting students' attention.



Figure 23. A teacher is interacting with his students on Rain-classroom
Source: <https://www.takefoto.cn/viewnews-2064054.html>



Figure 24. Yinian Guan is conducting a live training on the use of Rain-classroom for teachers
Source: http://news.tsinghua.edu.cn/publish/thunews/10303/2020/20200207124404280367426/20200207124404280367426_.html



Figure 25. Xinjie Yu is conducting a live training on the teaching application of Rain-classroom for teachers
Source: http://news.tsinghua.edu.cn/publish/thunews/10303/2020/20200207124404280367426/20200207124404280367426_.html

Source of text: http://news.tsinghua.edu.cn/publish/thunews/10303/2020/20200207124404280367426/20200207124404280367426_.html

7 Providing Supports and Services for Teachers and Students

Effective support services are the key to ensuring the quality of online education. The support services of online education include two types: support services for teachers' online teaching and support services for students' online learning. Both services can be provided in collaboration with the government, schools, enterprises, families, society, etc.

7.1 Technical services for teachers

Efforts should be paid to improving teachers' online teaching ability as both the synchronous and asynchronous online teaching tools are unfamiliar with most of the teachers. It includes online teaching strategies, information technology applications, epidemic prevention cases in schools and local teacher training cases, so as to promote the rapid improvement of teachers' online teaching abilities. The supports for teachers include how to use the synchronous cyberlearning software, how to utilize the learning management system, how to conduct learning activity design etc.

7.2 Learning supports for students

The effectiveness of supportive services for learning is reflected in two aspects: it can promote the students' effective learning and personality development. Effective learning refers to the growth and improvement of students' knowledge, cognition, intelligence, and skills; personality development mainly involves the cultivation of positive attitude towards life, good thinking, basic communication, and cooperative skills, the consciousness of rules, integrity, perseverance, and innovation.



Story 12

Education enterprise “Squirrel AI”: Using AI teachers to create personalized learning system for students.

Squirrel AI is the first AI unicorn company to apply adaptive learning technology in AI in K-12 schools. It has established more than 2,000 learning centers across the country. The Squirrel AI online learning system is different from ordinary live lessons. It not only supports online teaching and learning, but also provides AI service to students' online learning. First, Squirrel AI sets a personalized learning path to locate students' weaknesses in learning accurately to shorten learning time and improve learning efficiency. Secondly, it can visually display students' learning status, monitor learners' learning behaviors in time, provide big data learning analysis, and support learners to view their learning reports real-time. Third, squirrel AI provides different functional views for teachers and principals to monitor and manage their live classes.



Figure 26. the characteristics of platform

After the outbreak of coronavirus in China, Squirrel AI responded quickly and provided 500 million free online learning courses for primary and secondary school students nationwide. On January 26, 2020, Squirrel AI conducted online training for public school teachers, compiled user manuals, organized account registration, and established guiding teams. At present, more than 160 public schools located in Shandong, Hubei, Fujian, and Jiangsu provinces are using squirrel AI for classroom learning, covering the subjects of Chinese, Math, English, Physics, Chemistry. In the course, more than 200,000 students across the country use squirrel AI accounts to study online. It is expected that the demand for squirrel AI student accounts will soon exceed 500,000.



Figure 27. Using Squirrel AI system to facilitate student's smart learning

During the epidemic, students and teachers talked about their feelings after using the squirrel AI classroom. Since the outbreak of COVID-19, students who have to take the entrance examination of senior high school or colleges had too many difficulties and pressures. Xiao Zhang, a third grade student in junior high school, mentioned that he was not good in math, but Squirrel AI helped him improve, since detailed reports on his learning performance and recommended materials are instantly provided. In a face-to-face video interview, Xiao Zhang stated: "I didn't expect to learn like this! In the first class, the assessment

system highlighted my learning weaknesses precisely. This kind of learning experience is so helpful and interactive."

Teacher Wang, a public school teacher, who often uses the squirrel AI system in his class also talked to us about his feelings:

"The squirrel AI system classroom is indeed easier and more effective than regular classrooms! After logging in to the system, I can supervise my course. Although there are many students, I can quickly know the answers of each student through the generated dashboards. After a student finishes the pre-test, the system displays course questions that match his/her ability. After each question is completed, the student can immediately get feedback on each question and the process of solving it. After the class, the system will automatically generate a learning report for each student, and this helps me better monitor my students. "



Figure 28. Using Squirrel AI system to monitor students' learning process

Source: The photo/picture was provided by the cooperation school of Squirrel AI in Zhijiang city, Hubei province. The text was provided by the cooperation school of Squirrel AI in Kuiwen District, Weifang city, Shandong province.



Diversified supports for online teaching and learning

Effective supports and services are important to ensure the quality of online learning. These services can be for both teachers and learners, and based on the collaboration between governments, schools, enterprises, and families.

The national cloud classroom (www.eduyun.cn) provides e-textbooks compiled by the education department. These digital e-textbooks are widely used in various areas and cover all levels of middle schools and high schools. The school can also use the authoring tool embedded in the platform to create a flexible curriculum by using the resources provided on the platform as well. Additionally, the platform supports online lecturing and interactive tutoring functions.

Besides, there might be limitations of internet access in remote areas, therefore the ministry of education requested China Education Television to broadcast courses and resources through TV channels to meet the needs of students studying at home in these areas. The Ministry of Education also coordinated with both the education departments in Beijing, Shanghai, Sichuan, and Zhejiang provinces and schools affiliated to Tsinghua and Renmin University in China to develop high-quality open learning resources during the emergency.

At the same time, the People's Education Press provided the mobile application "PEP Touch & Read", which offers free digital teaching resources. During "Disrupted Classes, Undisrupted Learning," the government required education departments and schools at all levels to cooperate with each other. The Ministry of Education also encouraged a variety of social organizations to proactively offer more diverse learning resources with high quality for the public.



Figure 29. Teacher assigns and checks homework through the network
Source: https://www.sohu.com/a/373272035_114731

Handan Education Bureau has made efforts to support "Disrupted Classes, Undisrupted Learning" from two aspects. One is to help teachers improve their online teaching skills. The other one is to provide various resources to support, guide, and encourage students to carry out independent learning activities at home. Handan city further developed the platform "Classroom on Air" at the city-level. This platform is supplemented by the national primary and secondary school network cloud platform, China Education Television Station, and various excellent education resource platforms. It supports students to study independently at home. In some villages with a limited internet connection, students can watch educational videos offline

via the "Classroom on Air" platform and carry out asynchronous learning by using national and local resources. These resources help maintain the quality of learning, but also help develop the skills of self-regulated learning. To meet the needs of different students in both synchronous and asynchronous learning, filmed presentations were produced by well-known teachers and then broadcasted via "Classroom on Air". To enhance the quality of teaching, Handan Education Bureau also recruited teachers in each subject from all schools in the city to work together on course production for everyone.



Figure 30. Students study at home and some of them are accompanied by parents
The author of photography: Qingfeng Duan, Handan Municipal Education Bureau, Hebei Province



Figure 31. Parents are supervising their children's independent study at home
The author of photography: Hang Lu, BNU PhD. student



Figure 32. A high school student in a village, listens to lectures online on her mobile phone at home
The author of photography: Hang Lu, BNU PhD. student



Figure 33. Online homework correction, real-time guidance of students
The author of photography: Qingfeng Duan, Handan Municipal Education Bureau, Hebei Province



Figure 34. A teacher is recording a lesson for "Classroom on Air"
The author of photography: Qingfeng Duan, Handan Municipal Education Bureau, Hebei Province

Text was written by Hang Lu and Qingfeng Duan



8 Empowering the Collaboration Between Governments, Enterprises, and Schools

Governments, enterprises, and schools (G-E-S) should closely collaborate together to ensure high-quality learning content, diverse learning activities, and effective learning outcomes when students learn online. The G-E-S collaboration should have the following features: flexible instructions; self-regulated learning; on-demand selection and respect for differences; open resources, scientific and technological support. The G-E-S collaboration should be led by the government and organized by schools. The G-E-S collaboration should involve family-school interaction and social participation.

In the face of the current needs of online education during the epidemic and its future development, the government should play multiple roles in policy guidance, overall coordination, and effective supervision, etc. The government should also coordinate enterprises, schools, research institutes, families, the society, etc. to build smooth communication platforms, select suitable learning resources, provide convenient learning tools, encourage diverse learning methods and support flexible teaching methods. Effective support services for online education will be provided through the close cooperation of multiple parties.

Story 14

Collaboration between governments and schools in Wuhan City

Since February 10, 2020, many districts in Wuhan City have implemented the "Disrupted Class, Undisrupted Learning" initiative by using the educational cloud platform of Wuhan city. Each district organized microlearning at the class level via the channel "Classroom on Air". Specifically, all the schools within each district followed the same learning schedule; classes are arranged in the morning, while questions and answers, and assignments are planned in the afternoon. During the implementation phase, district-level governments and schools worked together and solved several challenges. For example, the City Board of Education guided researchers to help the front-line teachers to adapt the 20-30-minute online teaching process and improve their online teaching skills and strategies.



Figure 35. Zhiling Peng, an eighth-grade student from Tongji High School, is taking a class. While listening to the teacher's voice, he also interacted with the teacher in the chat box

Source: <https://baijiahao.baidu.com/s?id=1660457815642562336&wfr=spider&for=pc>

Story 15

Governments & enterprises coordination: Technical services support improved

To support the “Disrupted Classes, Undisrupted Learning” initiative by the Ministry of Education during the COVID-19 outbreak in China, NetDragon, a global leader in building internet communities, announced that its online education platform “One Stop Learning” will provide a new free service plan for live-streaming of courses to over 10 million users.

“One Stop Learning” platform not only updates the latest information on COVID-19 and measures for public health, but also provides services including teachers’ class preparation and teaching, online assignments and exams, live-communication between schools and parents, academic research, and operational management that allow users to effectively accomplish their daily work.



Figure 36. Online courses on “One Stop Learning” platform



Figure 37. A pupil is studying on “One Stop Learning” platform

On February 01, the Fuzhou Bureau of Education further published the “Guidelines on proper management of education for primary, secondary, and vocational schools amidst postponement of school semesters”. The guidelines state that “One Stop Learning” is chosen as the official platform in support of Fuzhou’s “Continuous Learning amid School Suspension” mandate. The platform will then facilitate online learning of over one million teachers and students as well as several million parents.

Meanwhile, “One Stop Learning” platform has also aided the Department of Education of Hubei Province to support the national initiative entitled “Disrupted classes, Undisrupted learning”. In collaboration with Hubei Province, NetDragon established the “Hubei Education Cloud Platform”. After the construction and testing of the platform were completed (in three days), live trials were conducted on January 30, in three cities, including Macheng, Xiantao and Yangxin, and over 10 thousand live courses were carried out since then. The company has cooperated so far with Hubei, Fujian, Guangdong, Hunan, Shandong, and other provinces to provide online educational services including live teaching and online courses.

Source: The text and images were provided by ELENITY.

Conclusions and Recommendations

School closures in many countries worldwide during the spread of COVID-19 made more than 376.9 million learners being excluded from the learning process. Alternative approaches, such as online learning, were then used to maintain undisrupted learning. However, several challenges were reported during the application of online learning in the global wide, according to the literature and international experts. For example, (a) Internet connection can be unreliable if there are thousands of learners learning simultaneously; (b) Some instructors can find it difficult to find online resources that are the most suitable in their teaching contexts because thousands of resources are published online; (c) Several instructors and learners do not have the appropriate digital skills to teach and learn online. This can make the online teaching/learning experience inconvenient for them; (d) Several learners lack crucial learning competencies, such as adaptation, independent study, self-regulation and motivation, which are key factors for successful online learning; and, (e) Several instructors simply use direct instructions without considering important features of online learning, such as interactivity, social presence, and cognitive presence, resulting in un motivating learning experiences.

Based on the Chinese practices to maintain sxzd undisrupted learning during COVID-19, the following experiences are identified to facilitate flexible online learning.

Top-level departments of the government, such as ministries and commissions, collaborated with each other and then coordinated with regional government agents, colleges, schools, and enterprises to ensure a reliable network infrastructure. Particularly, specific communication networks (internet servers, etc.) that can handle millions of users were quickly deployed during this COVID-19 situation. This helped support millions of live classrooms, as well as watching, downloading, and uploading interactive media resources. The government also coordinated national platforms with enterprises of cyberlearning to provide educational resources and tools in the national wide via multiple channels so that instructors and learners can use them based on their specific needs. Furthermore, the government, in collaboration with several schools, provided training on how to use the online learning repositories and select the appropriate learning resources accordingly.

Experts, schools, and governments at different levels also provided learning supports as professional training and immediate assistance for instructors, learners, and parents to guide them on how to use digital tools and platforms for an effective online learning experience. The supports and services varied according to the features of particular education contexts (levels, regions, schools, subjects, etc.). For instance, several suggested platforms, tools, and methods were customized based on the provided learning scenarios by instructors and according to the age of learners.

The government, in collaboration with special education specialists, adapted several learning materials to the needs of learners with disabilities (e.g., mental retardation) to cater their specific learning needs during the COVID-19 situation. Additionally, instructors further provided appropriate online support for learners with

special needs, such as one-on-one tutoring and real-time communication with parents, in order to provide an inclusive online learning experience for them.

Based on the above practices and experiences, this handbook identified the following seven core elements of effective online education in emergencies.

- (1) Ensuring reliable network infrastructure, which can handle millions of users simultaneously, is crucial to support smooth online learning experience without interruption when: (a) providing synchronous online teaching using video conferencing; (b) using (watching, downloading, uploading) interactive learning resources (videos, games, etc.); and, (c) collaborating with peers via social platforms.
- (2) Using friendly learning tools is beneficial to learners in finding and processing information, constructing knowledge, collaborating with peers, expressing understanding, and evaluating learning effects in concrete ways. It is also vital that instructors avoid overloading learners and parents by asking them to use too many applications or platforms. In this context, schools should coordinate between all the instructors to use consistent learning tools or platforms.
- (3) Providing interactive suitable digital learning resources, such as online video microlecture, e-books, simulations, animations, quizzes, and games. The criteria for selecting digital learning resources should include licensing, accuracy, interactivity, ease of adaptability, cultural relevance & sensitivity, and also the suitability of content, difficulty, structure, media, and organization.
- (4) Guiding learners to apply effective learning methods can be used individually or in groups. Specifically, the online instructional practice should involve using online communities, via social networks, to ensure regular human interactions and to address potential online challenges, such as learners' perceived loneliness or helplessness.
- (5) Promoting effective methods to organize instruction by adopting a range of teaching strategies, such as case studies, open debates and discussions, learners-led discovery, experiential learning, etc.
- (6) Providing instant support services for teachers and learners on learning about urgent school and governmental policies, using effective learning technologies, tools, and resources and collaborating between the government, schools, enterprises, families, society, etc.
- (7) Empowering the partnership between governments, enterprises, and schools. Specifically, the governments should also coordinate enterprises, schools, research institutes, and families to build smooth communication platforms to exchange urgent notices and to keep everyone safe.

From this Chinese experience, some limitations are also noted that should be considered in the future. For instance, to provide accessible learning experiences, all universities should rely on tele-courses to provide learning experiences for those in remote areas without internet or without cable TV. Additionally, more affordable devices should be developed as well to provide offline digital learning resources for learners, especially in those remote areas. Moreover, researchers and practitioners should consider different accessibility guidelines (e.g., WCAG 2.0) while developing their digital learning resources platforms, tools and devices. This helps provide an effective approach to accessibility, functional diversity and e-inclusion in educational settings. Finally, more inclusive authoring tools (that work with different functional diversities) should be developed so that educators can use them to create accessible digital learning resources.

References

- Casey, J., & Wilson, P. (2005). A practical guide to providing flexible learning in further and higher education. Retrieved from <http://qmwww.enhancementthemes.ac.uk/docs/publications/a-practical-guide-to-providing-flexible-learning-in-further-and-higher-education.pdf>
- Cauchemez, S., Van Kerkhove, M. D., Archer, B. N., Cetron, M., Cowling, B. J., Grove, P., Hunt, D., Kojouharova, M., Kon, P., et al. (2014). School closures during the 2009 influenza pandemic: national and local experiences. *BMC infectious diseases*, 14, 207. <https://doi.org/10.1186/1471-2334-14-207>
- Collis, B., Moonen, J. and Vingerhoets, J. (1997), Flexibility as a Key Construct in European Training: Experiences from the TeleScopia Project. *British Journal of Educational Technology*, 28: 199-217. doi:10.1111/1467-8535.00026
- Collis, B. (1998). New didactics for university instruction: Why and how? *Computers & Education*, 31, 373–393. [https://doi.org/10.1016/S0360-1315\(98\)00040-2](https://doi.org/10.1016/S0360-1315(98)00040-2)
- Collis, B and Moonen, J (2004) *Flexible Learning in a Digital World* (2nd edition), London: Routledge and Falmer
- Epigeum. (2019). What do we mean by 'digital learning resources'? Retrieved from https://flexiblelearning.auckland.ac.nz/learning_technologies_online/6/1/html/course_files/1_1.html
- Goode, S., Willis, R., Wolf, J., & Harris, A. (2007). Enhancing IS Education with Flexible Teaching and Learning. *Journal of Information Systems Education*, 18(3), 297–302.
- Gordon, N. A. (2014). Flexible Pedagogies: technology-enhanced learning. In *The Higher Education Academy*. <https://doi.org/10.13140/2.1.2052.5760>
- Huang, R., Chen, G., Yang, J., & Loewen, J. (2013). The New Shape of Learning: Adapting to Social Changes in the Information Society. In R. Huang & J. M. Spector (Eds.), *Reshaping Learning SE - 1* (pp. 3–42). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-32301-0_1
- Huang, R., Zhang, M., Shen, Y., Tian, Y., & Zeng H. (2020) Research on the Core Elements of Running a Huge Scale of Cyber-learning: A case study of “Disrupted Class, Undisrupted Learning” supported effectively by online education[J]. *e-Education Research*,41(3).pp:10-19
- Huang, R. (2020) Catching Key Factors, Effectively Promoting Online Learning[N]. *China Education Daily*,2020-03-07(003).
- Lee, M. J. W., & McLoughlin, C. (2010). Beyond distance and time constraints: Applying social networking tools and Web 2.0 approaches to distance learning. In G. Veletsianos (Ed.), *Emerging technologies in distance education*(pp. 61–87). Edmonton, AB: Athabasca University Press.

- 
- Lewis, R. and Spencer, D. (1986) What is Open Learning?, Open Learning Guide 4, London Council for Education Technology, pp. 9 - 10
- Littlefield, J.(January 14, 2018).The Difference Between Synchronous and Asynchronous Distance Learning. Retrieved from <https://www.thoughtco.com/synchronous-distance-learning-asynchronous-distance-learning-1097959>
- Lundin, R. (1999) Flexible Teaching and Learning: Perspectives and Practices, UniServe Science News Volume 13.
- McMeekin, A. (1998) Flexible Learning and Teaching and IT, Keynote address to the 1998 Monash University Flexible Learning and Technology Conference, 1 October 1998.
- Ministry of Education of the People's Republic of China. (2019). Statistical Communiqué on National Educational Development in 2018. Retrieved from http://www.moe.gov.cn/jyb_sjzl/sjzl_fztjgb/201907/t20190724_392041.html
- Ozdemir, O., Bonk, C. J.(2017). Turkish Teachers' Awareness and Perceptions of Open Educational Resources. *Journal of Learning for Development*, v4 n3 p307-321
- Petrina, S. (2011). Instructional Methods and Learning Styles. In *Advanced Teaching Methods for the Technology Classroom* (pp. 91–122). <https://doi.org/10.4018/978-1-59904-337-1.ch004>
- Promethean(2017). Collaborative learning vs. cooperative learning: what's the difference? Retrieved from <https://resourced.prometheanworld.com/collaborative-cooperative-learning/>
- Ryan, A., & Tilbury, D. (2013). Flexible Pedagogies: new pedagogical ideas. Retrieved from http://www.heacademy.ac.uk/resources/detail/flexible-learning/flexiblepedagogies/new_ped_ideas/report?utm_medium=email&utm_source=The+Higher+Education+Academy&utm_campaign=4074096_140506&utm_content=New-pedagogical-ideas-report
- Singh, V., & Thurman, A. (2019). How Many Ways Can We Define Online Learning? A Systematic Literature Review of Definitions of Online Learning (1988-2018). *American Journal of Distance Education* 33.4: 289-306. <https://doi.org/10.1080/08923647.2019.1663082>.
- UK Universities. (2018). Flexible learning: The Current State of Play in UK Higher Education. London, UK.
- University of British Columbia.(2020). Flexible Learning. Retrieved from <http://flexible.learning.ubc.ca/>
- Wiki.(2019). Open learning. Retrieved from https://en.wikipedia.org/wiki/Open_learning

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Fabio Nascimbeni, Assistant Professor, Universidad Internacional de La Rioja (UNIR), Spain,

Jonathan Michael Spector, Professor, University of North Texas, U.S.

Jianhua Zhao, Professor, Southern University of Science and Technology, Senior Expert, International Centre for Higher Education Innovation (ICHEI) under the auspices of UNESCO



Smart Learning Institute of Beijing Normal University (SLIBNU)

Beijing Normal University (BNU) grew out of the Education Department of Imperial University of Peking established in 1902, which initiated teacher training in China's higher education. After the development for over a century, BNU has become a comprehensive and research-intensive university with its main characteristics of basic disciplines in sciences and humanities, teacher education and educational science. Smart Learning Institute (SLI) is jointly established by Beijing Normal University and a global educational technology company NetDragon Websoft. SLI is a comprehensive experimental platform involving scientific research, technology development, and innovative instruction. SLI focuses on detecting learning patterns powered by ICT, creating smart learning environments and platforms for life-long and life-wide learning, as well as supporting diversified, personalized and differential learning needs for digital learners.



UNESCO International Research and Training Centre for Rural Education (UNESCO INRULED)

UNESCO International Research and Training Centre for Rural Education (UNESCO INRULED) was jointly founded by the Chinese government and UNESCO and located at BNU in 2008. The vision of UNESCO INRULED is to promote social-economic development in rural areas by bringing about positive changes in the thinking and behavior and rural people, who make the majority of the population in developing countries and to achieve the goals of Education for All. UNESCO INRULED has published over 40 publications, including research projects, training modules, magazines as well as newsletters. UNESCO INRULED also has established a wide network of cooperation with UN agencies, development agencies, non-governmental organizations, foundations and closed links with UNESCO institutions and centers.



UNESCO Institute for Information Technologies in Education (UNESCO IITE)

UNESCO Institute for Information Technologies in Education (IITE) was established as an integral part of UNESCO by the General Conference of UNESCO at its 29th session (November 1997) and is located in Moscow, Russian Federation. IITE is the only UNESCO category 1 Institute that holds a global mandate for ICT in education. In line with the new Education 2030 Agenda, IITE has developed its strategic priority areas to meet new demands and tasks ahead. The mission of IITE in the new era is promoting the innovative use of ICT and serving as facilitator and enabler for achieving Sustainable Development Goal 4 (SDG 4) through ICT-enabled solutions and best practices.



International association of smart learning environment (IASLE)

The International Association of Smart Learning Environments (IASLE) is a cutting-edge professional forum for researchers, academics, practitioners, and industry professionals interested and/or engaged in the reform of the ways of teaching and learning through advancing current learning environments towards smart learning environments. It provides opportunities for discussions and constructive dialogue among various stakeholders on the limitations of existing learning environments, need for reform, innovative uses of emerging pedagogical approaches and technologies, and sharing and promotion of best practices, leading to the evolution, design and implementation of smart learning environments.



Arab League's Educational, Cultural and Scientific Organization (ALECSO)

Arab League's Educational, Cultural and Scientific Organization (ALECSO) was founded in 1975. Its Documentation and Information Department provides information on all aspects of education including adult education, culture and science in and on Arab countries. Expansion of the documentation services through use of Internet is being planned in order to deepen international contacts and co-operation. The Department of Documentation and Information maintains cooperation and coordination with the Arab countries in the domain of information processing and exchange, in order to guarantee easy flow and high efficiency. This aim also includes the Arabization of information tools consistent with the Arab national ambitions that stress the upgrading of economic and social plans in the Arab region; thus reaching an optimum enrichment of development.



Edmodo

Edmodo is an educational technology company offering a communication, collaboration, and coaching platform to K-12 schools and teachers. The Edmodo network enables teachers to share content, distribute quizzes, assignments, and manage communication with students, colleagues, and parents. Edmodo is very teacher-centric in their design and philosophy: students and parents can only join Edmodo if invited to do so by a teacher. Teachers and students spend large amounts of time on the platform, both in and out of the classroom. Edmodo is free to use, but it also offers premium services.



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