

EdTechHub Report

What can be learnt from China's recent experiences with Covid-19 and school closures that can inform other countries' education technology-enabled responses?

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Section 1: Executive Summary

Scope of study

- This report reviews what can be learnt from China's recent experiences with Covid-19 and school closures that can inform other countries' education technology-enabled responses.
- It is informed by a recent EdTech Hub review's conclusion that 'China's experience [during Covid-19] will be particularly valuable'.¹ The review addresses two areas that the review identified for further exploration: first, 'the government's strategy for subsequently filling gaps in content, equity of provision or improving quality.' Second, 'whether these refinements have been managed at a national or local level'.²
- It is also informed by the other EdTech hub reviews, in particular the review on remote teaching that included a focus on China.
- The report's remit included Hong Kong and Taiwan. It also gathered information from as many as possible of China's 28 provinces.
- The scope of this review is limited to school-age learners.
- Evidence regarding policies on school re-opening, and the role of schools and teachers in controlling further outbreaks is being covered in a separate Ed-Tech hub review.
- The research for this was entirely desk-based: the rapid nature of the report meant that interviews were not feasible.

Evidence issues

- A comprehensive search of academic evidence – in both English and Chinese –, has revealed almost no relevant peer-reviewed articles. Whilst this is understandable for Covid-19, given the short timescale and the ongoing nature of the situation, the dearth of literature on educational responses to SARs/H1N1 means it is impossible to analyse how China's current response has been informed by evidence from previous responses to disease outbreaks.
- Our evidence sources therefore largely consist of government documents, guidance, blogs and news articles. Overall, this data is more descriptive than analytical, lacks evaluative evidence, includes very little critique of policies or practices. It is almost impossible to find sources for many of the assertions made in blogs and articles.
- The review has used official provincial, administrative region and municipal websites to identify local and provincial responses to the pandemic. The information available about regional responses varied, and it has not been possible to identify within this review whether the recommended guidance was enacted or not. Providing examples of guidance within one province does also not necessarily indicate it was absent in another, as it may be due to limited information available online.

¹ Joynes, C. Gibbs, E. & Sims, K (2020) Country-level response to providing education continuity under COVID-19: What's working? What isn't? [Online] Accessed at: <https://edtechhub.org/wp-content/uploads/2020/05/whats-working-whats-not.pdf> p.7

² Ibid. p. 9

Summary of findings

China's response to Covid-19 built on the distinctive foundations of its existing education political economy, in particular: high levels of pupil performance with low achievement gaps (as measured by PISA); highly centralised school system decision-making, governance and development processes (although this may be gradually evolving); a political culture that is generally less encouraging of debate about education practices; and a professional culture in which teachers are open to change and finding new ways to solve problems.

China appears to have a high level of 'education technology maturity' in terms of coverage, investment, usage and attitudes. It has made significant progress in improving access, major Chinese technology companies are rapidly increasing their focus on education, and China is the world's largest investor in machine-based personalised learning. The prioritisation of education technology already appears to have impacted on school policies, professional skills and attitudes. According to 2018 PISA data, over 90% of Chinese students are enrolled in schools that have an effective online learning support platform, significantly higher than the OECD average. In the four major Chinese cities, over 90% of school principals agreed or strongly agreed that teachers have the necessary time, technical and pedagogical skills to integrate digital devices into their instruction. However, despite this positive enabling environment, national restrictions prevent the availability of much of the content that many other teachers around the world use to support teaching and learning.

From its work with EdTech hub, K4D, governments around the world and its own large-scale programmes in Sub-Saharan Africa, Education Development Trust has created a draft diagnostic framework that includes key components of effective Covid-19 policy response. Although this framework remains subject to change as new evidence emerges, this review has adapted six key components of the framework to categorise China's responses.

1. Clear role accountabilities across different levels of the system

- Whilst China's centralised system was able to take swift action, provincial-level education authorities used their knowledge to tailor policy and guidance to local needs.
- National guidance, reinforced by local messaging, encouraged a holistic, balanced home learning environment, prioritising family wellbeing over 'home-schooling'.

2. Evidence-based policy decisions and communications

- The Chinese Ministry of Education responded rapidly and communicated messages clearly through its "Disrupted Classes, Undisrupted Learning" initiative.
- The government's most fundamental evidence-informed decision was to guide against excessive 'screen time', both to support pupil wellbeing and to prevent network congestion.

3. Rapid evolution of coalitions and partnerships

- National and provincial governments initiated a number of rapid multi-sector partnerships to support significant growth in online access, learning and teaching opportunities.

4. Technology-enabled learning and teaching

- China's overall approach was significantly informed by the concept of 'teacher presence', synthesising appropriate blends of synchronous and asynchronous learning opportunities.
- Provinces, municipalities and schools adopted different technological solutions based on local need and capacity.
- Digital resources that provided rapid feedback and assessment mechanisms were core to many of the online learning approaches.
- There was limited evidence of province-level professional development programmes that helped teachers to improve their online teaching pedagogies.

5. Explicit focus on the most vulnerable, including psycho-social needs

- China's overall approach and province-level activity during closure has been designed to promote equal, universal access to online learning, rather than target disadvantaged pupils.
- Psychosocial support is often built into universal curriculum-based teaching and learning, as well as being addressed specifically, but targeted support for vulnerable pupils or groups does not appear to have been prioritised during school closure.

6. Adaptive, evidence-informed leadership to continually improve quality and reach

- There is no current evidence on how China systematically tracked the impact of its approach during school closure, and what adaptations – if any – were made during this time period.
- The recent release of a large-scale national online survey and official responses to this survey show a willingness to reflect on and adapt approaches in preparation for future school closures. As an official statement suggested:

“This large-scale online education practice has exposed outstanding problems such as insufficient network capabilities, insufficient high-quality digital education resources, insufficient teacher capacity in use of information technology, and insufficient online teacher-student interaction and emotional communication. These problems will need to be solved for future work.”

Preparing for and enacting the transition back to school

Transition from online learning to classrooms has followed national health and safety guidelines, with the specifics of implementation determined at or below provincial level, with planning for transition occurring in some provinces from the moment that school closures started. China is still early in its transition from remote learning to classrooms and will continue to be a source of interest and learning based on how these transitions are carried out in practice.

Section 2: Key themes

Background

*The closure of schools in China began in Wuhan Province on 23 January. On 21 February, all schools across China closed. By 16 March, some less affected cities began to open, and by early May schools in nearly all provinces started to open, including in Wuhan itself. Across the country, priority for re-opening was given to high school students in their final years.*³

China's school system

China's response to Covid-19 built on the distinctive foundations of its existing education political economy – its performance, policies, practices, culture and school workforce.

Whilst this review cannot summarise all aspects of China's school system or debates around effectiveness, below are a few key features that might inform how policymakers can learn lessons from China's experience with Covid-19, and avoid the 'isomorphic mimicry' of simplistic and often unsuccessful policy transfer.⁴

- China's school system is one of the largest in the world. In 2018, over 276 million students were supported by nearly 17 million full-time teachers in over 518,000 schools.⁵
- The performance of its pupils, as measured by 2018 PISA test results in reading, mathematics and science, in its four most populous provinces (180 million students in Beijing, Shanghai, Jiangsu and Zhejiang,) is by some distance the best in the world. The 10% most disadvantaged pupils largely outperform the average results across the other 78 OECD countries, and overall levels of achievement gaps are low.
- China's school system decision-making, governance and development processes are highly centralised, and its political culture is generally less encouraging of debate and disagreement about education policies and practices than in most other OECD countries. However, the latest TALIS survey shows that teachers in China were second only to Vietnam in believing that most teachers are open to change and to finding new ways to solve problems, revealing an appetite and agency for teacher-led innovation.⁶
- The Chinese government's 2016-20 five year plan aimed for changes in governance and decision-making so that the education system could 'operate on the principle of separation

³ GEM Report (2020) *How are countries addressing the Covid-19 challenges in education? A snapshot of policy measures*. [Online] Accessed at: <http://www.iiep.unesco.org/en/reopening-schools-how-get-education-back-track-after-covid-19-13424>

⁴ The term 'isomorphic mimicry' was created by Lant Pritchett to describe how so-called weaker states often build policies, processes and institutions that copy those in stronger states, but without their core underlying functionalities. Pritchett, L. (2013) *The Rebirth of Education: Schooling Ain't Learning* Brookings Institution Press

⁵ Huang, R.H., Liu, D.J., Tlili, A., Yang, J.F., Wang, H.H., et al. (2020). Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak. Beijing: Smart Learning Institute of Beijing Normal University

⁶ OECD (2019), *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners*. [Online] Accessed at: <https://doi.org/10.1787/1d0bc92a-en>.

between the management, running, and assessment of schools, expand the decision-making powers of schools, improve inspection of and oversight over education, and strengthen social oversight over education'.⁷ Whilst the review did not find the details of how this shift has been implemented, this overall direction of travel may have influenced the shape of provincial variations in China's educational response to Covid-19.

China appears to have a high level of 'education technology maturity' in terms of coverage, investment, usage and attitudes.

China has for several decades made significant progress in closing the infrastructure and access elements of its digital divide. The 2018-20 Implementation Plan for Promoting Online Poverty Alleviation was close to achieving its target of 98% broadband coverage in the poorest villages by 2020. This ran alongside strategies to promote distance learning.⁸

China has also been making significant investments in education technology, often through an expansion of existing technology firms, such as Tencent Holdings and NetDragon.⁹ As the world's largest investor in 'machine-based personalized learning—support for individual and adaptive learning that facilitates, responds to and channels learners' own interests... China has uniquely positioned itself to address this challenge in relation to its own education system and those of other countries'.¹⁰ The country has also witnessed large-scale growth in online English resources and instruction, and online tutoring, receptive to a growing middle class and the increase in private schools.¹¹

The prioritisation of education technology already appears to have impacted on school policies, professional skills and attitudes. According to 2018 PISA data, over 90% of Chinese students are enrolled in schools that have an effective online learning support platform, significantly higher than the OECD average.¹² In the four largest Chinese cities, over 90% of school principals (with a minimal gap between advantaged and disadvantaged schools) agreed or strongly agreed that teachers have the necessary time, technical and pedagogical skills to integrate digital devices into their instruction. Macau and Hong Kong also had higher rates than the OECD average of 65% on this indicator, and the results were similar for whether teachers have sufficient time for lesson-planning using digital devices.¹³

⁷ Central Committee of the Communist Party of China (2015)

⁸ CCTV News. (2020). How to help poor students get the online courses. [Online] Accessed at: https://toutiao.china.com/shsy/gundong4/13000238/20200304/37868320_2.html

Central Committee of the Communist Party of China (2015) 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (2016–2020) p164

⁹ Gaible, E. (2018) *Education materials markets: Country analyses*. (White paper.) World Bank

¹⁰ *ibid* p3

¹¹ *ibid*

¹² Schleicher, A. (2020) Education disrupted – education rebuilt: Some insights from PISA on the availability and use of digital tools for learning, OECD Education and Skills Today. [Online]. Accessed at: <https://oecdeditoday.com/coronavirus-educationdigital-tools-for-learning/>

¹³ Reimers, F. & Schleicher A. (2020) A framework to guide an education response to the COVID-19 Pandemic of 2020 OECD. [Online]. Accessed at: https://read.oecd-ilibrary.org/view/?ref=126_126988-t63lxosohs&title=A-framework-to-guide-an-education-response-to-the-Covid-19-Pandemic-of-2020

In the four largest provinces of China, over 90% of children from less advantaged schools had access to a quiet place to study, and just below 90% had access to a computer for schoolwork.¹⁴ Students in Macau and Hong Kong were slightly below the OECD average of 60%.

However, despite this positive enabling environment, national restrictions prevent the availability of much of the content that many other teachers around the world use to support teaching and learning. This may partly explain the relatively low utilisation of online platforms to share and download teacher-generated content, in comparison, for instance, to teachers in England the US.¹⁵

As part of a broader mission to modernise its education system, China's national plan for 2016-20 had prioritised the following educational technology-related objectives:¹⁶

- Move faster in implementing the project to ensure that broadband internet is accessible to each school, quality digital educational resources are accessible to each classroom, and an online learning space is accessible to each student, and to put in place platforms for educational resources and management;
- Continue support for IT infrastructure construction in rural primary and secondary schools;
- Establish a national quality learning resource platform through government service procurement;
- Develop modern remote and online learning with a focus on vocational education and applied higher education.

The following themes have been categorised into six components, adapted from Ed Dev Trust's draft diagnostic framework to support educational responses to Covid-19.

1. Clear role accountabilities across different levels of the system, including for parents and families

Whilst this review can affirm the recent EdTech hub review's assertion that 'centralised systems [such as China's] are better able to take swift action', a deeper analysis of regional and school responses reveals a significant amount of interpretation of national guidance, as well as locally-led innovation and partnerships.

Throughout this review, examples from different provinces, administrative regions, municipalities and more localised responses will be offered to demonstrate how centralised policies have been adapted at local levels. Although there is little evidence that can help determine which responses have been the most effective, the examples provided offer insights into a level of local agency over educational responses to Covid-19.

¹⁴ *ibid*

¹⁵ Zhang, W. et al (2020)

¹⁶ Central Committee of the Communist Party of China (2015)

The Chinese Ministry of Education has encouraged provincial level education authorities to use their knowledge to tailor policy to local needs.

The national government has created policies and guidance on home-based learning during school closures, with the responsibility for implementation and design resting at local levels. Each province, municipality, and in many cases, local districts are responsible for developing rollout plans and making decisions about school closures and schools reopening. In Zhejiang, for example, weak schools have been encouraged to connect with stronger schools to support online learning during school closures. The province made it clear that teachers had the freedom to use a variety of resources and teaching approaches.¹⁷ Information is not yet available on usage or impact. The specifics of Zhejiang's response were not identified in guidelines from other provinces or municipalities.

Official guidance relating to Covid-19 appears to be built on a clear existing understanding of roles, rather than did offering specific clarity on closure-related roles and responsibilities.

One gap in the literature and official documentation/guidelines relates to roles and responsibilities of different actors in the education sector at provincial and localised levels. For example, it is unclear which responsibilities or decisions sit with local education officials, headteachers, teachers or parents. One explanation for this lack of information might be that China has a structured system with a clear chain of command and embedded responsibilities. Another explanation, however, may be that due the speed in which decisions had to be made, there was simply not enough time to provide guidance on roles and responsibilities in the Covid-19 response. It is not possible within the scope of this review to determine the reason behind this lack of information on roles and responsibilities, but it may be explained by the pre-existing clarity of these roles and the expectation that the existing delineation of responsibilities would continue as normal.

National guidance, reinforced by local messaging, encouraged a holistic, balanced home learning environment, prioritising family wellbeing over 'home-schooling'.

The official guidance on home learning included guidance on Covid-related health and more general wellbeing, as well as on principles of active learning and how to encourage a balance between formal learning and other activities. This was built around the 'SCIENCE' model: **S**cheduling learning and playing in balance, **C**hoosing learning resources on demand, **I**nspiring the study from playing, **E**ngaging in learning by self-monitoring, **N**ourishing learning ability with e-assessment, **C**arrying out

¹⁷ The People's Government of Zhejiang Province (2020). Teaching guidelines issued in Zhejiang to fully implement online education for primary and middle schools during school closure. [Online]. Accessed at: http://www.zj.gov.cn/art/2020/2/6/art_1654331_41948673.html. See also World Bank (2020a) *Response to COVID-19: Preparing for School Re-Opening The Case of China East Asia and Pacific Education Briefing Note*. [Online]. Accessed at: <http://documents.worldbank.org/curated/en/743891587996521873/pdf/Response-to-COVID-19-Preparing-for-School-Re-Opening-The-Case-of-China.pdf>

reflection on learning methods, and **Exercising daily and moderately**'.¹⁸ It included detailed advice around online learning. However, no data is available on usage. Overall, given the detail and level of sophistication of the guidance, it is likely that more educated parents would have benefited most from this guidance. Simpler local or school-created guidance may also have been available, but was not found in this review's search.

Additional resources have been uploaded to e-resource sites in Hong Kong to support teachers in facilitating student home learning. Hong Kong Education City, launched in 2000, is a website owned by the Hong Kong Autonomous Region Government.¹⁹ The website has resources for parents, students and teachers that are free to use, with many of the resources recently adapted for the pandemic. Resources include home learning calendars for different grades that include self-learning exercises, webinars for teachers on how to continue to teach and support students through remote learning, and a series of learning and support resources for parents. Although information about changes in use are not available at this time, HKEdCity has been in operation for a long time and is a well-known, trusted local brand for home-based learning. It is likely, although not certain, that the prior existence of such support increases its effectiveness during school closures.

Some provinces and municipalities have also encouraged participation in household chores as part of their daily learning schedule. In Tianjin municipality, a series of homework guides were issued to households with a list of activities for children of different age groups to engage with. Younger primary school children were given 15 items of work to do at home, including tying their shoelaces, folding clothes, taking the initiative to organise personal items, and cleaning the table and floor after meals.²⁰

2. Evidence-based policy decisions and communications

The Chinese Ministry of Education responded rapidly and communicated messages clearly through its “Disrupted Classes, Undisrupted Learning” initiative, which offered flexible online learning to over 270 million students.

This initiative harnessed both international evidence on remote teaching and knowledge of China's context to provide an evidence-based approach. The recent Ed Tech Hub review summarised ‘Disrupted Classes, Undisrupted Learning’ as follows:

In its early response to school closures, the Chinese Ministry of Education focused on establishing the delivery of remote learning via online mechanisms.²¹ Its approach to implementation was based on three integrated priorities: i) ensuring the right teaching and

¹⁸ Smart Learning Institute of Beijing Normal University, UNESCO Institute for Information Technology in Education (IITE) (2020) Guidance on active learning at home during the COVID-19 outbreak. [Online]. Accessed it: <https://iite.unesco.org/wp-content/uploads/2020/04/Guidance-on-Active-Learning-at-Home-in-COVID-19-Outbreak.pdf>

¹⁹ HKEdCity (2020) Hong Kong Education City. [Online]. Accessed at: <https://www.hkedcity.net/home/>

²⁰ Tianjin Municipal People's Government. (2020a). Moral education. [Online]. Accessed at: http://www.tj.gov.cn/xw/bum/202003/t20200325_3671410.html

²¹ Huang et al (2020).

learning content was available; ii) ensuring that this content could be accessed by users for free; and iii) ensuring that appropriate delivery infrastructure and bandwidth was in place to guarantee large numbers of students could access this content. The Chinese government worked cross-governmentally and with internet providers and support companies to ensure that the selected online education platforms had their systems upgraded to handle the increased traffic.²²

The Chinese authorities sought to refine this basic delivery model over time. Further strategic interventions have been identified based on a multifaceted approach intended to ensure successful online teaching through the provision of seven inter-related elements. Widely recognised as key enablers in remote online schooling, these include: i) a reliable ICT-based communications infrastructure; ii) coordinated access to suitable digital learning resources; iii) user-friendly digital learning tools; iv) pedagogic and instructional design based on effective learning methods; v) coordination of online delivery by instructional organisations; vi) provision of effective support services for teachers and learners; and vii) close cooperation between governments, enterprises and schools.²³

Building on an existing National Public Service Platform for Educational Resources, the government launched a National Network Cloud Platform for Primary and Secondary School, including some resources and modules designed for the crisis, including epidemic prevention education and mental health education.²⁴

Although it has been argued that the national response ‘did not follow a normal policymaking process’, it is unclear how policymaking processes, as well as implementation processes, differed from the norm.²⁵ Following a rapid two-week decision-making, planning and partnership-building period, clear communication was achieved partly through large scale tele-conferences involving national and provincial officials and school principals.²⁶

The government’s most fundamental evidence-informed decision, taken at national level but reinforced and adapted locally, was to guide against excessive ‘screen time’, both to support pupil physical and emotional wellbeing, and to prevent network congestion.

This decision was evident in two policies. First, based on evidence around child development and online access, television broadcast resources were prioritised for primary level pupils, and cloud-based internet solutions for those at secondary level.²⁷ Second, official guidelines limited screen-

²² UNESCO (2020a) How is China ensuring learning when classes are disrupted by coronavirus? 19th February 2020 [Online]. Accessed at: <https://en.unesco.org/news/how-china-ensuring-learning-when-classes-aredisrupted-coronavirus>

²³ Huang et al (2020)

²⁴ Huang et al (2020)

²⁵ Zhang, W. et al(2020)

²⁶ McAleavy, T. and Gorgen, K. (2020). What does the research suggest on best practice pedagogy for remote teaching? [Online] Accessed at: <https://edtechhub.org/wp-content/uploads/2020/04/research-best-practice-pedagogy-remote-teaching.pdf>

²⁷ Di, S. (2020) South China Morning Post With schools remaining closed during coronavirus outbreak, China launches national remote learning platforms. [online] Accessed at: <https://www.scmp.com/tech/policy/article/3050940/schools-remaining-closed-during-coronavirus-outbreak-china-launches>

based teaching and the length of lessons. Whilst there is no evidence as yet on whether these guidelines were followed by schools or families, these key national messages were reinforced in documents at the provincial level. Indeed, many provinces, such as Shanghai, included specific guidance:

*The online teaching of primary school students is 20 minutes, which is 15 minutes shorter than traditional classroom teaching. On average, 5-6 classes are scheduled every day, so that each student needs to watch for no more than 2 hours a day. The interval between the two classes is at least 20 minutes. Eye exercises and gymnastic exercises will be arranged for students to strengthen their physical training, protect their eyesight and strengthen their body.*²⁸

The Shanghai Educational Committee's regulations also specified that live online teaching for children aged under six was forbidden.²⁹

Shenzhen's guidelines suggested longer amounts of time for each online lesson, with a maximum of 40-minute lessons for high school students, and a maximum of two hours of 'homework'.³⁰ Generally, across districts, content became more prescriptive with age, partly informed by the demands of national examinations. Whereas other provinces opted for a mixture of online and TV-based learning, Sichuan opted for an entirely TV-based approach. The provincial government stated that this was to protect the health and safety of students by ensuring they were not spending prolonged periods of time on devices such as phones, laptops and tablets.³¹ Hubei province made it clear that expectations on students were to be lowered during school closures, stating education administrations should "appropriately reduce content" and "slow down progress".³²

3. Rapid evolution of coalitions and partnerships

National and provincial governments initiated a number of rapid, innovative, and seemingly robust partnerships involving the private sector, schools and NGOs to support significant growth in online access, learning and teaching opportunities.

Cooperation between government, enterprises, and schools was one of six key priorities in the MoE strategy, enabled by substantial institutional capacity and fast-moving bureaucratic powers. Whilst

²⁸ The Paper (Pengpai news) (2020) "Shanghai requires each lesson on Internet should limit to 20 minutes". Press release. [Online]. 18 February 2020 [Online]. Accessed at <http://edu.sina.com.cn/zxx/2020-02-18/doc-iimxxstf2403211.shtml>

²⁹ Li, L. (2020) *China ECE Policy Response to COVID-19*. [online] Accessed at:

<https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/china-ece-policy-response-to-covid.pdf>

³⁰ Sohu News. (2020a). "February 17 officially start online education. How will primary and secondary school network class be conducted in Shenzhen? The official response by the Ministry of education". Press release. [Online]. Accessed at: https://www.sohu.com/a/372754296_811773

³¹ The People's Government of Sichuan Province (2020). Press release: Sichuan Launches TV-based Online Teaching for Primary and Secondary Schools. [Online]. Accessed at: <https://www.sc.gov.cn/10462/10758/10760/10765/2020/3/11/ce382f80d3b8444fa37c51397d69a5e5.shtml>

³² Hubei Provincial Department of Education (2020). Guiding opinions of the provincial Department of Education on the Network Teaching of Primary and Secondary Schools in the province during the epidemic prevention and control period. [Online] Accessed at: http://jyt.hubei.gov.cn/fbjd/tzgg/202001/t20200130_2016444.shtml

the evidence base behind the decision-making on commissioning and procurement of technological equipment/internet services is not clear, the speed of these partnerships ensured that broadband and data coverage and resources grew in response to need.

State ownership or part-ownership of industries enabled thousands of resources that had previously had an associated cost to become freely available. This included all online education connectivity. The People's Education Press made all of its digital resources available for free within days of school closure.³³ The Open University of China followed suit with online courses and resources. Although aimed at higher education students, teachers and school-age students were also encouraged to use these resources.³⁴ This activity resulted in 22 Ministry-coordinated online learning platforms, offering 24,000 free online courses designed for undergraduates and vocational colleges, but used by schools.³⁵

Provinces also played a role in securing partnerships. Fuzhou and Hubei Provinces selected Net Dragon's *One Stop Learning* as their official learning platform. The platform, which includes resources for learners, teachers and parents, and opportunities for online interaction, was also used in Fujian, Guangdong, Hunan and Shandong. Hunan Province's "teaching assistant flow package" provided mobile phone packages for every student from a disadvantaged family, as well as every teacher. Technical support was provided through a rapidly-levered partnership between the provincial government and China telecom, China Mobile Communications Group and China United Network Communications.³⁶ This review did not find evidence of partnerships with entities outside of the technology sector. This may be because the key focus of the Chinese national and regional authorities appears to have been on ensuring access to online learning for as many students as possible, with other partnerships (if any) receiving less publicity.

Beyond its boundaries, a new 'South to South' collaboration between the UNESCO Institute for Information Technology in Education, UNESCO International Research and Training Center for Rural Education (INRULED) and the Smart Learning Institute of Beijing Normal University has published handbooks for flexible learning and guidance on active learning.³⁷ The impact and sustainability of this partnership is as yet unclear.

4. Technology-enabled learning and teaching

³³ Ministry of Education. The People's Republic of China (2020a). MOE opens online learning platform to facilitate home study. [Online]. Accessed at: http://en.moe.gov.cn/news/press_releases/202002/t20200201_417275.html

³⁴ Ministry of Education. The People's Republic of China (2020b). Open University of China provides free services to support MOE's "Home Study" Initiative. [Online]. Accessed at: http://en.moe.gov.cn/news/press_releases/202002/t20200201_417276.html

³⁵ Huang et al (2020)

³⁶ Chinanews.com (2020) "Hunan province provides 20G free traffic package to help poor students with online teaching." Press release. 25 February 2020 [Online] Accessed at: <http://news.eastday.com/eastday/13news/auto/news/society/20200225/u7ai9117525.html>

³⁷ Yao, H. Shehzad, H. & Xiaotong, D. (2020) *South-South cooperation in the COVID-19 education response: Practices from China* Blog. [Online]. Accessed at: <https://www.globalpartnership.org/blog/south-south-cooperation-covid-19-education-response-practices-china>

China's overall approach was significantly informed by the concept of 'teacher presence', synthesising appropriate blends of synchronous and asynchronous learning opportunities.

The project team behind 'Disrupted Classes, Undisrupted Learning' categorised four possible pedagogical techniques (see below). Whilst avoiding prescription, the team identified advantages and disadvantages in particular contexts, and above all encouraged a blend of approaches (see Annex 1).³⁸ The techniques are:

- Live-streaming teaching (lecture format)
- Online real-time interactive teaching
- Online self-regulated learning with real-time interactive Q&A
- Online cooperative learning guided by teachers.

The team identified three priorities for remote learning that encouraged pupil engagement by ensuring that all activities had some aspect of 'teacher presence':

- Building a sense of belonging to a community
- Providing timely feedback to learners
- Encouraging learners to relax and not be preoccupied with competitive achievement.

Most of the case studies of Chinese technology-enabled learning practices demonstrate this blended approach – for instance, between the use of Dingtalk for live lectures and the use of Zoom for group interaction, and other software for one-to-one follow-up that requires 'emotional perception'.³⁹ Dingtalk was used by over five million students in seventeen provinces.⁴⁰ However, a survey of 62,446 primary and secondary school students revealed that less than 30% of teachers were broadcasting lessons live to students.⁴¹ The same study also revealed that approximately 50% of parents stayed with their children whilst they studied online at home. Teachers in some provinces have also been offered training in the use of online teaching platforms and tools. For example, in Xiangtan City, Hunan Province, three courses on teaching practices online were developed.⁴² Teachers were reportedly positive about the training, with 17,000 teachers participating.

Provinces, municipalities and schools have adopted different technological solutions based on local need.

Lanzhou City in Gansu Province adopted an approach that blends technology with other types of home learning. They have not put in place requirements for children to participate in online learning, but have stated that "Each school can take initiatives to arrange students to study at home (review,

³⁸ Huang et al (2020)

³⁹ Ibid

⁴⁰ Ibid

⁴¹ China Youth Daily. (2020) "The big data portrait of online education of primary and secondary schools under the epidemic situation." press release. Author from Central China Normal University. [Online]. Accessed at: http://www.xinhuanet.com/politics/2020-04/13/c_1125846623.htm

⁴² The Chinese Education Information Website. (2020) "Hunan: strengthening Teacher Training to help online teaching". Press release. [Online]. Accessed at: http://www.ict.edu.cn/jiaoshis/n20200316_66379.shtml

preview, read, and interest development etc.) according to the student body and mind characteristic...”.⁴³ In the Municipality of Beijing, a province-wide Q&A platform was launched for pupils from Grade 3 upwards, involving over 13,000 registered instructors.⁴⁴

Hong Kong also opted for a blended approach, and provided resources that can be used for both online and offline learning. Their official guidelines state:

*“Real-time online teaching is merely one of the e-learning strategies. There are other ways of e-learning. Teachers may provide students with learning materials, exercises and texts for extracurricular reading, collect assignments and offer feedback by using the learning management systems that they are familiar with, as well as emails and the school website”.*⁴⁵

At the school level, there are examples of teachers using more innovative, enquiry-based or project-based learning opportunities⁴⁶. In a primary school in Hexi District, the school principal delivered an online lesson about the current heroes, and how learning can take place outside the classroom. The lesson started with the statement: “Dear children, society is the best classroom. What is happening right now is a vivid and profound textbook”.⁴⁷ Some private schools, including international schools such as Guangzhou International Middle School,⁴⁸ have used the opportunity of high levels of at-home technology usage and parental support to innovate.⁴⁹ However, one challenge to this approach in particular has been that ‘[many] learners lack crucial learning competencies, such as adaptation, independent study, self-regulation and motivation, which are key factors for successful online learning’.⁵⁰

Digital resources that provided rapid feedback and assessment mechanisms, through teachers, specially trained assessors or AI, were core to many online learning approaches.

Chinese teachers were encouraged to use a variety of assessment techniques, from simply emailing photographs of handwritten exercises, to online adaptive assessment, based on ‘fitness for purpose’ criteria.⁵¹ E-portfolios were also encouraged by the MoE, although take-up is not yet known.

⁴³ Lanzhou Daily. (2020) “The disrupted classes, undisrupted learning in Lanzhou City, Chengguan District primary and Secondary schools” Press release. [Online]. Accessed at: <http://gs.people.com.cn/n2/2020/0224/c191680-33822764.html>

⁴⁴ Huang et al (2020)

⁴⁵ The Government of Hong Kong Special Administrative Region (2020) *Suspending classes without suspending learning – e-learning*. [Online]. Accessed at: <https://www.edb.gov.hk/en/about-edb/press/cleartheair/20200402.html>

⁴⁶ Huang et al (2020)

⁴⁷ Tianjin Municipal People’s Government. (2020b). Schools at all levels in our city organise colourful online ideological and political education activities. [Online]. Accessed at: http://www.tj.gov.cn/xw/bum/202003/t20200320_3671173.html

⁴⁸ Huang et al (2020)

⁴⁹ Matcher, E. (2020) ‘What happened when Hong Kong’s schools went virtual to combat the spread of coronavirus’ *Smithsonian magazine*. [Online] Accessed at: <https://www.smithsonianmag.com/innovation/what-can-americans-learn-from-hong-kongs-unplanned-experiment-online-learning-during-coronavirus-180974331/>

⁵⁰ Huang, et al (2020) p39

⁵¹ Rural Education Watch (2020) ‘No. 1 Elementary School in Gaodang Town: We are advancing’. [Online]. Accessed at: <https://baijiahao.baidu.com/s?id=1659043617942496101&wfr=spider&for=pc>

The approach to providing feedback to and communicating with students throughout the process of online learning differed between provinces. It is unknown whether all provinces and municipalities encouraged or provided guidance to schools and teachers on how teachers and students were to interact during school closures, but a few examples have been identified.

Hubei's provincial education department encouraged the use of an "Everyone Connect" platform for teachers to interact with students.⁵² In addition to teachers delivering feedback to students about their work, teachers were also encouraged to help students understand how to interact with learning materials from home. In areas with low levels of technology availability, teachers were encouraged to telephone students or find alternate ways to engage wherever possible. In the Municipality of Beijing, some formal examinations and assessments continued, with through parents and teachers serving as online invigilators to students.⁵³ In Shanghai, lessons were broadcast on television and online. 1000 teachers produced classes for broadcast on TV and internet platforms, enabling the most effective teachers to offer instructional teaching to many more pupils through online access. Approximately 1,000 classes were recorded, with each taking six-to-eight hours to create. After watching classes online, students who owned iPads or similar devices would use these to answer questions from teachers.⁵⁴

Whilst the rapid pace of developments around school closures rendered innovation around assessment very difficult, existing initiatives were expanded on. For example, Squirrel AI, an existing AI-based learning platform, rapidly rolled out online training and support for schools across four provinces and 160 public schools in five subjects. Usage was expected to increase from 200,000 to over 500,000.⁵⁵

Beyond the creation of national resources and some software-related support from technology companies, there was limited evidence of province-level professional development programmes that helped teachers to improve their online teaching pedagogies.

At national level, the Department of Teacher Education collaborated with key teacher training institutions to provide a resource pack to support online teaching strategies and technology applications.⁵⁶ The Teachers' Online Teaching Ability Enhancement Training Resource Packs involved a number of national and regional universities and teacher training providers, museums and businesses. This is another example of a rapid partnership between a diverse range of organisations.

The handbook on flexible learning mentioned Handan Education Bureau's support for teachers to improve online teaching skills, and Wuhan City's Board of Education commissioned researchers to work with teachers to turn standard lessons into shorter online lessons, using a variety of online teaching skills.⁵⁷ However, the review found no other examples of local approaches to teacher

⁵² Hubei Provincial Department of Education (2020)

⁵³ UNESCO Institute for Lifelong Learning (2020) UNESCO learning cities responding to COVID-19. [Online]. Accessed at: <https://uil.unesco.org/lifelong-learning/learning-cities/unesco-learning-cities-responding-covid-19>

⁵⁴ Shanghai Municipal People's Government. (2020). City's 1.4m students carry on, online. [Online]. Accessed at: <http://www.shanghai.gov.cn/shanghai/n46669/n48081/u22ai128159.html>

⁵⁵ Huang et al (2020)

⁵⁶ Zhang, W., Wang, Y. Yang, L. and Wang, C. (2020) 'Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 outbreak' in *Journal of Risk and Financial Management* Vol. 13, Issue 3.

⁵⁷ Huang et al (2020)

training and development during the closure period. This may be due to a lack of publicly available information on teacher training. One national challenge has been identified that ‘many teachers simply use direct instructions without considering important features of online learning, such as interactivity, social presence, and cognitive presence, resulting in unmotivating learning experiences.’⁵⁸ It may be that provinces and teacher training institutions, in reconfiguring their offers in response to Covid-19 and preparedness for future pandemics, take distinctive approaches to meeting this challenge.

5. Explicit focus on the most vulnerable - including the learning and psycho-social needs of disadvantaged students

China’s overall approach during closure has been designed to promote equal, universal access to online learning, rather than target disadvantaged pupils.

China’s approach has largely focussed on increasing access to remote learning, seeking to reach as many students as possible through televised and online lessons. There is limited information available on how children in households with no or limited technology have been reached during school closures. A key initial priority at both national and provincial level has been to work with major telecom providers to improve coverage of internet services. This was largely targeted towards rural areas, in addition to areas with low bandwidth. Internet service providers and other platforms have been required to expand provision wherever possible at no cost to the regions with the most vulnerable populations.⁵⁹ Despite some claims that online learning has reduced inequalities (for instance, by enabling all students to be taught by the best teachers through TV broadcasts), there is no evidence as yet to support this.⁶⁰

At the provincial level, action to try to alleviate the impact on the most vulnerable has also largely focused on access issues.

As noted above, the majority of responses have focussed on improving access to online learning for all. Sichuan province issued guidance that banned schools from charging students for online education resources.⁶¹ In Guangdong province, over 9,000 students were provided with tablets, and local internet service providers have been actively encouraged to work with local villages to supply internet where it is currently unavailable.⁶² However, newspapers continued to report on network and infrastructure difficulties in rural areas.⁶³ In mountainous areas in Sichuan, Yunnan, Guizhou and

⁵⁸ Huang et al (2020) p39

⁵⁹ Zhang et al (2020); GEM (2020); UNESCO (2020a)

⁶⁰ Miller, F. (2020). Educational equality in China: how online learning during coronavirus has changed the status quo. SUP China. 20th February 2020. [Online]. Accessed at: <https://supchina.com/2020/02/20/china-online-learning-during-coronavirus-has-changed-status-quo/>

⁶¹ China Internet News Center. (2020). “Sichuan: local schools are not allowed to charge students for online education resources.” [Online] Accessed at: http://news.china.com.cn/2020-03/04/content_75770768.htm

⁶² Zhang et al (2020)

⁶³ National Business Daily. (2020) “Network teaching under the epidemic situation: moving forward in the groping. It is difficult to build ‘classroom on air’ in some rural areas”. Press release. [Online]. Accessed at: <http://www.nbd.com.cn/articles/2020-02-20/1409914.html> and Xinhua daily telegraph news. (2020). “More than 2,000 people in one county are unable to take online

Hubei provinces, network coverage continued to be problematic. One newspaper reported how pupils in Gansu Province were 'riding a camel to find a signal'.⁶⁴

In addition to promoting access, some provinces have also focussed on supporting the learning of specific groups of vulnerable students. For example, as part of the transition back to school, many provinces, including Sichuan and Hainan, supported schools to assist disadvantaged students and others who appeared to have fallen behind peers through individualised plans⁶⁵. It is unclear whether these plans included an education technology element, although many of these students will have fallen behind through poor at-home technology options. The deputy director general of Changsha education bureau, Hunan Province, indicated in an interview that his focus was on pupils with special educational needs, including 'left-behind children and children of migrant workers, as well as students whose origin is not in Changsha'.⁶⁶ Remedial solutions would include more recorded content for students to watch on demand, and more personalised communication and counselling. There is no evidence to date on whether these policies were enacted, and whether they had positive outcomes.

It was claimed that 'the government, in collaboration with special education specialists, adapted several learning materials to the needs of learners with disabilities [...] 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.'⁶⁷ However, this review could find no further information about implementation, usage or impact.

One article reports that across China, services supporting children with special needs were scaled back.⁶⁸

Psycho-social support has been built into universal curriculum-based teaching and learning in some provinces and municipalities, as well as being addressed specifically, but targeted support for vulnerable pupils or groups does not appear to have been prioritised during school closure.

A key aim of the 'suspending classes without stopping learning' strategy was to support a broader sense of learning, including wellbeing and personal growth.⁶⁹ On a national level, schools have been encouraged to provide counselling services for students. A national 24-hour hotline was also set up

classes, xinhua daily telegraph said. "don't let poor students fall behind." Press release. [Online]. Accessed at: https://www.thepaper.cn/newsDetail_forward_6278798

⁶⁴ Sina technology. (2020) "Online class: it is too difficult for students in mountainous areas: riding a camel to find a signal." Press release. [Online]. Accessed at: <https://tech.sina.cn/2020-03-23/detail-iimxxsth1101543.d.html?from=wap>

⁶⁵ World Bank (2020a)

⁶⁶ Sanxiang metropolis daily (2020) "Network teaching 'new class', Changsha has done this". [Online]. Accessed at: <https://baijiahao.baidu.com/s?id=1660669790523522659&wfr=spider&for=pc>

⁶⁷ Huang et al (2020) p39

⁶⁸ South China Morning Post (2020). 'For Hong Kong students with special needs, coronavirus pandemic is harming more than just education – it can make their symptoms worse' [Online]. Accessed at: <https://www.scmp.com/news/hong-kong/education/article/3075217/students-special-needs-hong-kong-coronavirus-pandemic>

⁶⁹ Zhang et al (2020)

to support students with their mental health and wellbeing during the pandemic.⁷⁰ In late January, the Ministry of Education also released a notice mandating all education authorities to create expert teams to provide mental health support to individuals affected by Covid-19.⁷¹

In districts, provinces and special administrative regions, different approaches have been adopted to integrate psychosocial support into the curriculum. In Chaoyang district in the Municipality of Beijing, anecdotal sources have reported that the only mandatory online learning for elementary school students relates to mental health, with additional encouragement for at-home physical education.⁷² Other provinces have opted for more integrated approaches. In the Special Administrative Region of Hong Kong, the Hong Kong Education City Website has many curriculum resources available to teachers, students and parents, covering both psychosocial support and academic learning. Guangdong province released official guidelines for working with students during the pandemic, attributing “great importance to the impact of the epidemic on students’ mental health”.⁷³

This suggests that some localised approaches have placed a greater emphasis on the mental and physical health and wellbeing of students during the pandemic than on academic outcomes, particularly for children of primary school age.

6. Adaptive, evidence-informed leadership to continually improve quality and reach

There is no current evidence on how China, at national and provincial level, systematically tracked the quality and reach of its approach during school closure, and what adaptations – if any – were made during this time period.

Although a number of sources state that a national monitoring and evaluation team has been put in place to understand how effective online learning methods will be to inform policy in future, further information on this is not yet available.

Some provinces and municipalities highlighted the importance of receiving feedback from teachers, parents and students in responding to the pandemic, and also put in place stronger measures for the delivery of online learning in future. Lu Jing, the Director of the Shanghai Municipality Education Commission, said as this was ‘a first’ for the city, feedback would be collected from teachers, parents and students to gradually improve how remote learning takes place.⁷⁴ This learning would also be applied to future crises where schools may need to be closed. However, whether or not this was achieved, and how, is as yet unknown.

⁷⁰ GEM Report (2020)

⁷¹ Ministry of Education. The People’s Republic of China. (2020c). MOE requests psychological support be provided to relieve novel coronavirus-related stress. [Online] Accessed at: http://en.moe.gov.cn/news/press_releases/202001/t20200130_417071.html

⁷² Ning and Corcoran (2020). How China’s schools are getting through COVID-19. Edsurge. [Online] Accessed at: <https://www.edsurge.com/news/2020-04-20-how-china-s-schools-are-getting-through-covid-19>

⁷³ The People’s Government of Guangdong Province. (2020b). Press Release: no statutory holidays for all grades in primary and secondary schools! 2020 spring primary and secondary education teaching to continue. [Online] Accessed at: http://edu.gd.gov.cn/zxzx/xwfb/content/post_2989623.html

⁷⁴ Shanghai Municipal People’s Government (2020)

The recent release of a large-scale national online survey, and official responses to this survey, show a willingness to reflect on and adapt approaches in preparation for future school closures.

Early in May, The China National Institute of Education Sciences released the preliminary results of a survey of 180,000 teachers and 1.8 million parents. Newspaper articles on the results revealed gaps:

- Between levels of teacher support for at-home online learning during school closures (80%) and levels of teacher satisfaction with what they had provided (37.5%)
- Between the technology skills of younger and older teachers
- Between the opportunities provided in urban and rural schools, especially low-performing rural schools, where teachers used fewer resources and were less interactive in lessons, and where parents were less satisfied with the education provided during closures.
- Between teachers' skills in private and public schools.⁷⁵

Teachers surveyed wanted support in the following areas:⁷⁶

- Training on skills and technologies that promote interactions (70.2%)
- Technical support to allow teachers to spend more time on teaching versus navigating the technology itself (60.9%)
- Ensuring availability of relevant teaching and learning content (57.5%)
- Systematic training on how to conduct online education (53.4%).⁷⁷

Whilst raw data is not yet available, the gap between the demand for training to improve interactions and training for online education seems significant and may inform adaptations both to training and to suggested online approaches, including for online learning when schools are open.

Both teachers and parents expressed a strong overall preference for asynchronous teaching, such as "pre-recorded video recording and broadcasting". Again, this may inform future government strategies for remote teaching.

Recent announcements from the Ministry of Education have demonstrated a willingness to communicate openly about the limitations in its approach, and to address these limitations in future adaptations. Lu Yugang, Department of Basic Education of the Ministry of Education, in an official statement, said:

*"This large-scale online education practice has exposed outstanding problems such as insufficient network capabilities, insufficient high-quality digital education resources, insufficient teacher capacity in use of information technology, and insufficient online teacher-student interaction and emotional communication. These problems will need to be solved for future work."*⁷⁸

⁷⁵ World Bank (2020a)

⁷⁶ World Bank (2020b) referencing Guangming Daily, April 21, 2020, "Disrupted Class, Undisrupted Learning – Lessons from China. [Online]. Accessed at: https://news.gmw.cn/2020-04/21/content_33755332.htm

⁷⁷ World Bank (2020a)

⁷⁸ Ministry of Education, The People's Republic of China (2020d) How China address digital divide in implementation of large-scale online education for all. [Online]. Accessed at: http://www.moe.gov.cn/fbh/live/2020/51987/mtbd/202005/t20200515_454593.html

Preparing for and enacting the transition back to school

Policies and guidelines regarding remote learning at provincial level include reference to continuity in learning from online to the classroom, and guidance on how schools and teachers are to manage the transition. This suggests forward-planning from education authorities and early consideration of how learning content in online lessons will be transferable to classroom settings during transition periods.

Transition from online learning to classrooms has followed national health and safety guidelines, with the specifics of implementation determined at or below provincial level.

Consideration of transitions from online learning to classroom learning has been encouraged from the start in some provinces. The transition from remote to classroom schooling is largely mandated by the Chinese Ministry of Education, though more specific guidelines have been produced at local level to respond to specific contextual needs. The table below provides a high-level overview of the national guidelines and policies that apply across China, in addition to examples identified in provinces, municipalities and special administrative regions.

	Health and safety	Academic	Phased return	Mental health
National level	Thermal camera temperature checks or equivalent. Not allowed to go to school if symptoms appear on the day before.		Schools to return based on the local situation with the spread of Covid-19.	Expert teams to support mental health due to Covid-19-related stress.
Local level, in selected provinces, municipalities and/or special administrative regions	Disinfect schools daily.	Learning needs to be assessed by teachers on return. Assumption that younger children will not have progressed since they were last in school.	Senior high school students set to take examinations return first. Other students to continue remote learning.	Counsellors working with students upon return. Guidance for teachers on how the pandemic may have impacted student mental health.

Guangdong province has released guidelines that encourage a smooth transition from online learning to the classroom, with three key features. First, there is an emphasis on psychosocial support for students returning to classes, and the need for a school counsellor to work with students upon their return. Second, there is a stipulation that online learning should continue to be offered to students who are unable to return to school due to “special circumstances”, including one-to-one

counselling, where required. Third, the provincial government released guidelines on how teachers can assess student learning when they transition back to in-person schooling.

“Schools should thoroughly understand the students’ home learning situation, make a diagnosis and evaluation of the quality of online learning, accurately analyse the academic situation, distinguish between different school periods, different grades, different classes, and different disciplines, adjust the teaching plan in a targeted manner, and effectively link between online education and back-to-school learning...All localities can flexibly arrange online education content according to the age characteristics of students, strengthen various forms of contact and communication between teachers and students, and strictly implement “zero-point” teaching after students return to school to ensure fair education.”⁷⁹

The focus on psychological support to students has also been a prominent feature in other provinces. The Education Bureau of Yuexiu District organised online mental health education and training for primary and secondary school students ahead of schools reopening, to help them prepare.⁸⁰

China is still in the early stages of its transition from remote learning back to classrooms. China will continue to be a source of interest and learning based on how these transitions are carried out in practice. Questions remain about how the country will approach lost curriculum content, whether students will still be expected to sit examinations, and how much additional time schools will be expected to continue operating into holiday periods, if at all. It is too early for such learning to take place.

⁷⁹ The People’s Government of Guangdong Province. (2020a). Press Release: How to ensure the effectiveness of online education, what to do if there is no equipment. [Online]. Accessed at: <https://mp.weixin.qq.com/s/aCA7oZ0jjQnWlsTelgTifA>

⁸⁰ Sohu news. (2020b) “Disrupted school, undisrupted learning: no psychological panic – Dongshan Experimental Primary School to carry out mental health education and training activities”. Press release. [Online]. Accessed at: https://www.sohu.com/a/391314871_756455

Annex One

Recommended online teaching techniques in China⁸¹

Time	Types of organisation	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 content	Teachers should be capable to use live streaming tools for online teaching. Students should be focussed 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 questions and guidance materials should be provided before class	Key and difficult points in teaching	Teachers should be capable of guiding and organising 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 tasks and group tasks	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

⁸¹ Huang et al. (2020). pg. 28

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