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Abstract

The COVID-19 pandemic has exerted unprecedented and profound impacts on education around the world, which has brought near-universal closing of schools at all levels by July 2020. As the first country hit by the virus on a large scale, China launched online course programs to cope with this learning crisis from February to July in 2020. Using data of 710 primary and high school students from the China Rural Revitalization Strategy Thinktank Survey, we examined students' participation in, parents' concern about, and students' satisfaction with online courses in rural China. We found that 76 percent of sample students had participated in online courses by early February, with an average duration of online learning at 4.68 hours on the most recent weekday. Results from the Logit model show that the higher the grades, the more likely that parents are concerned about students' study during the pandemic. Besides, parents from the richest quintile households are 19 percentage points less likely to be concerned about their kids' study than those from the poorest quintile households. Moreover, compared with students taking online courses provided by unofficial resources, the odds of students' perception that online courses are worse than face-to-face courses would be 34 (24) percentage points lower when schools (local education bureaus) provide the online courses. Furthermore, students with siblings are more likely to perceive that online courses are worse than face-to-face courses (18 percentage points higher) than their peers from single-child households.

Keywords: COVID-19, students, online learning, rural China

JEL codes: I200, I210, I280, I290

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1. Introduction

The COVID-19 has caused the largest disruption in world education history. By mid-April 2020, 94 percent of learners worldwide had been affected by the pandemic, representing 1.58 billion students, ranging from preschool to university in 200 countries (United Nations, 2020). By July 2020, over one billion learners had still been out of school (UNICEF, 2020).

To mitigate the impact of COVID-19 on education, many countries have taken measures to support access to remote learning via online learning, radio, television, or texting. UNICEF (2020) reported that policy measures to ensure continued learning had reached 69 percent of schoolchildren globally by July 2020. Among the various forms of remote learning, online learning turns out to be the most common one, accounting for more than 60 percent of countries around the world (United Nations, 2020). For example, in Russia, an online learning platform was available for all students, teachers, and parents around the country (World Bank, 2020a).

China was one of the first countries to embark on an online learning program during the pandemic. On February 12 in 2020, the Ministry of Education (2020) issued the guidance requiring "Ensuring learning undisrupted when classes are disrupted". Since then, nearly 200 million primary and high school students in China started their new semester online, arguably the largest online learning practice in human history (World Bank, 2020a). Under this guidance, the Ministry of Education integrated high-quality tutorial materials and launched the National Public Service Platform for Educational Resources. In the meantime, to improve the quality of internet access, the Ministry of Industry and Information Technology upgraded the bandwidth of the online platform, and telecom service providers boosted internet connectivity service. All schools and students around the country were suggested to conduct online learning by choosing services that fit their local conditions the best, including online platforms, live-streaming, digitalized TVs, and mobile Apps. In addition, it was also suggested to arrange the learning schedules properly with reasonable duration to avoid adding

unnecessary burdens on students (Ministry of Education of the People's Republic of China, 2020a).

Despite its wide adoption, there still exists concern about implementing online learning in rural areas considering their limited access to quality hardware or software (Kapasia et al., 2020). Although all major telecom service providers have taken great effort to enhance the internet connectivity in rural China immediately after the guidance was issued, some students in remote and less developed areas still have limited or unstable access to the Internet. Besides, some students are not well equipped to take online courses yet. Even if both the hardware and internet service are available, the quality of online courses may be a concern as online courses tend to lack interactions with teachers (Yukselturk, 2010), lack supervision, and need more self-control of students (Logan et al., 2002). Some studies found that parents' involvement plays an important role in the effectiveness of online courses (Black, 2013; Curtis, 2013; Borup et al., 2015). This might be even more salient for rural China given the high prevalence of left-behind children or the busy schedule of the parents (Chang et al., 2011). Considering that rural students accounted for more than 60 percent of students enrolled in primary and high schools in 2019, reaching 108 million (Ministry of Education, 2020b), and there were still 6.43 million left-behind children in rural areas in 2020 (Ministry of Civil Affairs, 2020), it is worth paying attention to such a large group of students taking online courses.

A close examination of the literature reveals at least two potential gaps. Firstly, as far as we know, few studies focused on online learning during the COVID-19 pandemic. Most of them are in the absence of a pandemic, such as studies of Driscoll et al. (2012), Figlio et al. (2013), Borup et al. (2015), Alpert et al. (2016) in America, and Banerje et al. (2007) in India. Secondly, the few empirical studies that discussed online learning during the COVID-19 pandemic still have problems with the representativeness of the sample. For example, the results of Kapasia et al. (2020) were based on a survey that was completed by students voluntarily filling in an online questionnaire, which exists the problem of self-selection (Bethlehem, 2010). Luo and Si (2020) only drew on data from only one school in central China, which is hard to represent all the students in China.

In this paper, we seek to fill the potential gaps in knowledge by drawing on data from a nationally representative survey conducted during the pandemic by one-on-one

telephone interviews. With this unique dataset, we aim to analyze the participation in online courses, and how are the parents' and students' perceptions under COVID-19 in rural China. To meet this goal, we pursued three specific objectives. Firstly, we described the participation in, parents' concern about, and students' satisfaction with online courses for primary and high school students. Secondly, we examined the correlates of parents' concern about their children's study during the pandemic. Finally, we also examined the correlates of students' satisfaction with online learning during the pandemic.

Our analyses yield three important findings. Firstly, 76 percent of sample students have taken online courses by the time of our survey, with an average duration of online learning at 4.68 hours on the most recent weekday. Secondly, results from the Logit model show that the higher the grades, the more likely that parents are concerned about students' study during the pandemic. In addition, parents from the richest quintile households are 19 percentage points less likely to be concerned about their kids' study than those from the poorest quintile households. Thirdly, compared with students taking online courses provided by unofficial resources, the odds of students' perception that online courses are worse than face-to-face courses would be 34 (24) percentage points lower when schools (local education bureaus) provided the online courses. Furthermore, students with siblings are more likely to perceive that online courses are worse than face-to-face courses (18 percentage points higher) than their peers from single-child households.

Our study contributes to the literature in three ways. Firstly, our survey was conducted by one-on-one telephone interview, which can avoid the self-selection in "voluntary" online surveys. Moreover, it is a timely survey, which was conducted at the height of the epidemic when online courses just began, avoiding recall error. In addition, the dataset is nationally representative, creating a profile of online learning during the COVID-19 pandemic among primary and high school students in rural China.

In the rest of this paper, we begin with literature review. Then we introduce our data and sampling procedure. Furthermore, we present our descriptive analysis, followed by empirical strategy and multivariate analysis. The final section concludes the paper and discusses the policy implication.

2. Literature review

Participation in online learning has long gained the attention of scholars. Without direct teacher supervision, online learning is a student-centered approach that requires self-discipline and active participation (Logan et al., 2002). Existing studies indicate that the participation rate of online learning is largely related to the proportion of class discussion (Liang and Kim, 2004), and improving the enthusiasm of class discussion has a positive impact on increasing the participation rate of online courses (Jiang and Ting, 2000). Yukselturk (2010) divided students' participation in discussion into three categories: active participation, medium active participation, and inactive participation. He found that students' academic performance and gender mattered in how well students participated in class discussions. Students with better academic performance were more active in class discussions, which led to a higher participation rate in online learning. And among the students who actively participated, the ratio of female students was higher.

In addition to participation, studies have also talked about students' satisfaction with online learning. Allen et al. (2002) compared students' satisfaction with online learning and traditional face-to-face learning in higher education through meta-analysis. They found no difference in students' satisfaction with online learning and traditional face-to-face learning. The findings of Driscoll et al. (2012) in North Carolina also confirmed that there was no significant difference in students' satisfaction with online learning and face-to-face learning. However, Bernard et al. (2004) found that when online classes adopted real-time methods such as live broadcast, the teaching time lost its flexibility and students were more satisfied with face-to-face classes.

The wide discussion about the impact of online learning on students' academic performance remains controversial. Through a meta-analysis of 51 published studies, the US Department of Education concluded that students got better grades through online learning compared to face-to-face learning (Means et al., 2009). However, only a few of the 51 studies included in the analysis were based on Randomized Controlled Trial, which threatened the conclusion. Then both Figlio et al. (2013) and Alpert et al. (2016) conducted Randomized Controlled Trials to compare the impact of online learning with face-to-face learning on the academic performance of students enrolled in principles of microeconomics in university. In contrast to the U.S. Department of Education's conclusion, the findings of Randomized Controlled Trials indicated that

students randomly assigned to face-to-face classes performed better on both midterm and final exams than students in online classes. At the same time, Figlio et al. (2013) found that Hispanic, male, and students with low academic performance had significantly worse performance after participating in online learning compared to face-to-face learning. Similarly, Alpert et al. (2016) found that the negative impact of online learning on academic performance was mainly concentrated among students who had poor academic performance before participating in the Randomized Controlled Trial. Poor self-control and difficulties in language resulting in a poor understanding of the teaching material may partly explain the heterogeneity of the effects.

Similar to face-to-face learning, parental involvement also has a positive impact on students' engagement and academic performance in online learning. Online learning has a higher rate of absenteeism compared to traditional learning (Molnar et al., 2015). Existing studies on online learning for primary and high school students have found that increasing parental participation has a significant effect on reducing absenteeism (Borup et al., 2015; Borup et al., 2013). Parental involvement mainly includes supervision, encouragement, and guidance (Curtis, 2013). Liu et al. (2010) pointed out that parental involvement had a positive effect on the development of children's perseverance, self-control, and time management. Notably, Black (2013) found that when parents lacked sufficient knowledge to guide their children in the difficulties they encountered in online courses, excessive parental involvement would lead to poorer academic performance.

All these studies above were in the absence of a pandemic, after the outbreak of the COVID-19, some studies focused on online learning during a pandemic. International organizations are the first to release research reports on the shock to education and policy implications. World Bank (2020b) pointed out that the COVID-19 may be the largest simultaneous shock to all education systems in our lifetimes, and researchers simulated the potential impacts on schooling and learning outcomes. To cope with the crisis, it is necessary to use remote learning and new techniques to prevent learning loss. World Bank (2020a) introduced how countries are using different methods (including online learning, radio, television, texting) to support access to remote learning during the COVID-19 pandemic. Besides, World Bank (2020b) and United Nations (2020) also put forward other recommendations, for example, education systems should actively prevent students from dropping out through communication

and targeted financial support. Family engagement can also be an important channel for providing guidance and resources to support students' learning at home during school closures. Bao (2020) mainly introduced the case of online learning in Peking University, and came up with six specific teaching strategies and five high-impact principles through summarizing the online teaching experience of teachers in PKU.

A few empirical studies focused on the participation of online learning during COVID-19 and its impact on academic performance. Kapasia et.al (2020) assessed the learning status of undergraduate and graduate in India during the COVID-19 pandemic. Through online questionnaires, they found that approximately 70% of learners were engaged in online learning during the lockdown period, and most of them used Android phones to participate in courses. Students had been facing problems related to depression and anxiety, poor Internet connectivity, and unfavorable learning environment at home. During the pandemic, students from remote and marginalized areas faced greater challenges for study. However, there might exist the problem of self-selection in the process of filling in online questionnaires, which would lead to bias in the reflection of the real situation. Luo and Si (2020) took the sample of the 9th and 12th-grade students of a high school in central China as the research object, and found that the academic performance of students from poor families and rural families slipped after the outbreak of COVID-19. In this way, they came up with a conclusion that the universal implementation of online learning at the present stage widened the gap between students of different family conditions, and the promotion of educational digitalization needed both efficiency and fairness. However, the analysis and conclusion are based on the sample in only one high school in central China, which lacks external validity.

In general, few studies have examined online learning in rural China during the COVID-19 pandemic based on large-scale data at the micro-level. Previous studies on online learning are mostly in the absence of any pandemic, only a few studies examined online learning during the COVID-19 pandemic. Among them, the reports of international organizations mainly analyzed the shock to education and put forward policy implications from the macro level, lacking empirical analysis at the micro-level. A few empirical studies exist the problem of self-selection and small sample, which is hard to arrive at accurate conclusions and draw policy implications from their empirical results.

3. Data and sampling

We draw on data from the China Rural Revitalization Strategy Thinktank Survey (CRRSTS). CRRSTS is a longitudinal study of households in rural China, which was administered by the China Center for Agricultural Policy at Peking University and their local collaborators. CRRSTS began in 2000 with a survey of 1,199 rural households at 60 villages in 6 provinces: Hubei, Hebei, Liaoning, Shaanxi, Sichuan, and Zhejiang. The survey was expanded to Guangdong province in 2016 (Wang and Huang, 2018; Wang et al., 2019) and followed by Jiangxi province in 2018 (Huang et al., 2019). The sample provinces were randomly selected from each of China's major agri-ecological zones respectively. When each sample province entered the CRRSTS for the first time, the sample households were selected by a standardized multi-stage stratified random sampling process that the survey teams implemented uniformly across provinces. Within each sample province, sample counties were randomly selected based on their per capita gross value of industrial outputs (Rozelle, 1990, 1996). Following the same sampling procedure as the county selection, sample townships and villages were selected randomly. Within each sample village, sample households were randomly selected from a roster of households that reside in the village at the time of the survey. For a detailed description of the sampling procedure of this survey as well as its follow-up waves since 2000, please refer to de Brauw et al. (2002), Brandt et al. (2004), Wang and Huang (2018), Wang et al. (2019) and Huang et al. (2019).

In this paper, we focus on the data from 2020 wave of CRRSTS. The 2019 wave before the COVID-19 outbreak was conducted by trained enumerators in December 2020 2019 through one-on-one, face-to-face interviews, respectively. But the 2020 wave, also conducted by trained enumerators on February 12, 2020, had to take a one-on-one telephone interview manner as the entire country had been put under strict containment at that time (Tian et al., 2020; Wu and McGoogan, 2020).

The recent two waves of CRRSTS share at least three features that allow us to analyze the participation in online courses, and how are the parents' and students' perceptions under COVID-19 in rural China. First, as described above, the standardized multi-stage randomized sampling procedure makes our sample representative of China. In the 2020 wave, we ended up surveying a total of 1,733 rural households at 233

villages of 112 townships in 48 counties in 8 provinces in China. For the purpose of this study, we focus on those households who have primary or high school students and those for whom we are able to make children-parents linkage with data from the 2019 wave. Following these inclusion criteria, our final sample contains 710 students from 493 households. Ideally, each province would contribute an average of about 12% of households to the entire sample. While seven sample provinces each contribute 6% to 12% of households to the entire sample, Jiangxi contributes 37% (Table 1). As the sample size in Jiangxi is much bigger than that of other sample provinces, in the analysis we presented below, we weight each sample household by the inverse of the product of eight times the number of sample households in the sample province under discussion. For example, the number of sample households in Liaoning province is 290, the weight attached to each sample household in Liaoning province would be 0.04% (1/ (8*290)). The second feature of the CRRSTS panel data is that different waves were focused on the same households in the same villages in the same provinces, and the protocols during each of the waves were kept as similar as possible.[1] In this way, we can obtain the information of students' family background from 2019 wave and merge the data from 2020 wave with 2019 wave.

Finally, and most importantly, the survey collected rich information. For the purpose of this study, we mainly draw on online learning module. In this module, we collected information about whether a student got a notice from school about online learning, whether he or she took online courses as well as the duration, who is the provider of the online courses, whether the student is satisfied with online courses, and whether parents are concerned about their children's learning during the pandemic. Besides, we also collected information on student and household characteristics, such as student's gender and grade, household income, access to the internet, number of children.

4. Descriptive analysis

To gain a better understanding of online learning during COVID-19 in rural China, we conducted both descriptive statistics and multivariate analyses.

[1] As it happens in almost all longitudinal studies, some sample households were not available in certain followup waves. Whenever this happens, we randomly selected a similar household from the same village to replace the missing household.

We described the participation status of online learning in two steps. We first checked whether students participated in online courses. Conditional on participation, we then examined the duration of taking online courses. Our data show that 76% of sample students had taken online courses by the time of the survey on February 12, varying in different groups (Table 2, row 1). The percentage of having taken online courses increased from 73 percent in primary school to 82 percent in senior high school. Among those who participated in online course, they spent 4.68 hours taking online courses on the most recent weekday (Row 2, Column 1). For students of different grades, the overall time of taking online courses was a little long, with sixteen percent of them spent more than 6 hours (Row 2, Column 1). Meanwhile, the average hours on online courses increased with the grade: 4.11 hours in lower primary school (39% over 4 hours), 4.12 hours in upper primary school (42% over 4 hours), 4.94 hours in junior high school (40% over 5 hours), and 5.86 hours in senior high school (33% over 6 hours) (Columns 2-5).

Descriptive statistics show the participation in online courses and the characteristics of students and households (Table 3). Since the variables "Accumulative hours of taking online courses on the most recent weekday", "Provider of the online courses" and "Think online courses worse than face-to-face courses" are all conditional on participation, the observations of these variables were less. At that time, seventy-three percent of the parents expressed concern about children's study (Row 1). The providers of online courses were mainly schools and local education bureaus, accounting for 68% and 18% respectively (Row 3b). Besides, the majority of students tended to be negative in their evaluation of the quality of online courses, with seventy-one percent of students thinking online courses less effective than face-to-face courses (Row 3c).

Cross-analysis provides evidence that students' grade matters in parents' concerns about their kids' study during the pandemic (Table 4). Specifically, as students move from lower primary school to high school, the proportion of parents expressing concern about their kids' study is increasing (Row 3, Column 1). When we examine the relationship between household income and parents' concern, we find differences between different household quintiles when ranked in terms of household income per capita. Comparing with other quintiles, the parents of the richest quintile households express the lowest percentage of concern (Row 8, Column 1). However, the difference

in household quintiles when ranked in terms of household income per capita failed the significance test.

Conditional on taking online courses, results from the cross-analysis also show different correlating factors in accumulative hours of taking (Table 4). When examining the relationship between providers of online courses with accumulative hours of taking, there seems to be some pattern to the data. Specifically, accumulative hours of taking on the most recent weekday are the longest (4.88 hours) if the school provides the courses, while accumulative hours are the shortest (3.58 hours) when students find the online courses by other unofficial sources (Row 1, Column 2). Boys' online hours are significantly longer, and if students have a smartphone at home, the online hours will also be significantly longer (Row 2 and 7, Column 2). Apart from these variables, we find that compared with their peers from other quintiles, students from the poorest quintile when ranked in household income per capita spent the least time on online courses (Row 8, Column 2).

Similarly, conditional on participation, results from the cross-analysis also indicate that providers of online courses are correlated with the satisfaction of online courses (Table 4). Specifically, students who take online courses provided by the school are the least likely to perceive that online courses are worse than face-to-face courses. By contrast, if the online courses are from other unofficial sources, for example, found by themselves, the possibility of thinking online courses worse is the highest among different providers of online courses (Row 1, Column 3). Besides, when we look at the results from the cross-tabulation, there may be some apparent relationship between other explanatory variables but not come out significantly.

5. **Multivariate analysis and results**

To further examine the correlates of parents' concern about and students' satisfaction with online courses during the pandemic, we conduct multivariate regression analysis. Because of the nature of the binary dependent variables, Logit model are used. We also include a set of provincial dummy variables to control for factors at the province and above level that might affect parents' concern about and students' satisfaction with online learning. Meanwhile, we also run LPM models as a

robustness check. All the standard errors are clustered at the county level. The empirical model is specified as follows:

$$Y_i = \alpha + s_i'\beta + h_i'\gamma + v_s + \epsilon_i \quad (1)$$

where Y_i denotes whether student i's parents are concerned about his/her study during the pandemic. s_i represents a vector of student characteristics, including gender and grade. h_i indicates a vector of household characteristics, including parents' education, whether the household has only one student at the primary or high school level, possession of equipment for online courses, as well as household income status. v_s specifies fixed effect at the province level, and ϵ_i denotes error term.

As to the correlates of students' satisfaction with online courses as compared to face-to-face courses, the empirical specification remains the same as Model (1) except that we further control for the providers of online courses (p_i).

$$Z_i = \alpha + p_i'\delta + s_i'\beta + h_i'\gamma + v_s + \epsilon_i \quad (2)$$

where Z_i denotes whether students think online courses worse than face-to-face courses, s_i, h_i, v_s and ϵ_i are the same as in Model (1).

Results of the marginal effect from Logit regressions provide evidence about the correlates of parents' concern about their kids' study during the pandemic (Table 5). We can find supporting evidence for the grade hypothesis from cross-tabulation, which means that parents of higher grade students are more likely to express concern about their kids' study. Specifically, compared with parents of lower primary school students, ceteris paribus, parents of upper primary school students are 11 percentage points more likely to express concern about their kids' study, with parents of junior high school students 12 percentage points more likely and senior high school 14 percentage points more likely (Row 2, Column 2). In addition, quintile of household income per capita also comes out significantly in the correlates of parents' concern. As households move from the poorest quintile when ranked in household income per capita to the richest quintile, holding everything else constant, the odds of parents expressing concern will decrease by 19 percentage points (Row 7, Column 2).

Similarly, results of the marginal effect from Logit regressions demonstrate that a couple of factors are significantly correlated with students' satisfaction with online courses (Table 6). Firstly, the provider of online courses matters. Specifically,

comparing with “other sources of online courses”, ceteris paribus, the possibility of thinking online courses worse than face-to-face courses will decrease by 34 percentage points if the school provides the online courses, or decrease by 24 percentage points if the local education bureau provides the courses (Row 1, Column 2). Besides, students with siblings are more likely to think online courses worse than face-to-face courses. Specifically, comparing with students from single-child households, holding everything else constant, the odds of perceiving online courses worse will increase by 18 percentage points when students have siblings (Row 5, Column 2).

The above results reveal that students from low-income households may face more difficulties in learning online courses. Parents from the richest quintile households are less likely to express concern about students’ study during the pandemic, which is consistent with our intuition. A possible explanation is that study is not the only way out for students from the richest quintile households. For students from low-income, however, education is an important way to change their lives.

It is also worth paying more attention to the satisfaction of students who have siblings with online courses. The likelihood that thinking online courses worse than face-to-face courses will significantly increase if there are two or more students at home. This may be due to the interference caused by multiple students taking online courses at the same time.

The relationship between the provider and satisfaction of online courses supports the hypothesis from the cross-tabulation that the source of online courses is a contributing factor for students’ satisfaction. From the results that the possibility of thinking online courses worse is significantly less if the school or local education bureau provides online courses, we can see that official sources help reduce the dissatisfaction with online courses. If students seek online course resources by themselves, however, it is difficult to ensure the quality and progress of online courses.

To assess the robustness of our findings, we also conducted regressions without weight. As we introduced, the results described above weighted each sample student by the inverse of the product of eight times the number of sample students in the sample province under discussion. When we re-estimated the results without any weights, the

results remain substantially the same, except that household income comes out insignificantly in the correlates of parents' concern about their kids' study.[2]

6. Conclusions and policy implications

Although there are several exceptions, the results of multivariate analysis are basically consistent with descriptive statistics. The results show that, compared to those lower primary school students, parents of upper primary and high school students are more likely to be concerned about students' study during the pandemic. Besides, parents from the richest quintile households are 19% less likely to be concerned about their kids' study than those from the poorest quintile households. Moreover, compared with students taking online courses provided by other unofficial resources, the odds of students' perception that online courses are worse than face-to-face courses would decrease by 34 (24) percentage points when schools (local education bureaus) provide the courses. Furthermore, compared with students from single-child families, students with siblings are more likely to perceive that online courses are worse than face-to-face courses (18 percentage points higher).

Our research findings bear important policy implications in informing the design of policies and interventions to help students adapt to this new study mode better. First, we should pay close attention to the difficulties of online learning faced by students from low-income households and households with two or more students. It is suggested to coordinate with relevant local departments, organize schools and village committees to investigate the situation of them, and provide accurate assistance. For students who lack equipment or cell phone data for online learning, appropriate financial assistance, fee waiver of equipment, or data delivery package should be provided. Teachers need to pay more attention to the daily learning status of these students and solve their problems encountered in online courses timely.

Second, if online courses are needesd in rural areas in the future, it is necessary to standardize the source of online courses and provide students with high-quality resources. Considering the impact of online course sources on students' satisfaction with online courses, education departments should select high-quality online course

[2] Results for the robustness checks are available upon request to the corresponding author of the paper.

resources for students, and verify the effect of online teaching timely. It is suggested that for junior high school students and below, unified online course sources can be established according to districts and counties, with a unified curriculum schedule provided as guidance. And for those schools, grades, or subjects that are temporarily unable or unfit to open an online course via live or recorded broadcasting, it is also appropriate to provide unified and standardized online courses. Under the circumstances, teachers should take the responsibility of remoting guidance and supervision after online courses and providing students with feedback through WeChat or other forms after class.

Third, education departments at all levels should pose significance on making a scientific schedule of online courses to strike a proper balance between study and rest. We find that the time students spent on online courses are increasing with grade, and many of them spend much time online. Therefore, students should pay attention to physical exercise and ensure the balance of study and rest. What education departments should do is setting and implementing a different upper limit of online courses time for students of different grades, and rationally arranging the distribution of total online learning time among subjects.

We acknowledge at least two limitations of the study. The first drawback is that we lack information on students' academic performance, which can measure the effectiveness of online learning. Besides, the paper only analyzes the correlates of parents' concern and students' satisfaction, which means that cause-effect relationships should not be inferred from our findings.

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Table 1. Number of Sample Households and Students

Province	**Number of households**	**% of households**	**Number of students**	**% of students**
	(1)	(2)	(3)	(4)
(1) Sichuan	48	10	55	8
(2) Guangdong	59	12	111	16
(3) Jiangxi	182	37	290	41
(4) Hebei	35	7	44	6
(5) Zhejiang	39	8	50	7
(6) Hubei	57	12	76	11
(7) Liaoning	30	6	36	5
(8) Shaanxi	43	9	48	7
All sample	493	128	710	100

Source: Authors' survey.

Table 2. Descriptive analysis of online learning by grade

	All sample	**Lower primary school**	**Upper primary school**	**Junior high school**	**Senior high school**
	(1)	(2)	(3)	(4)	(5)
(1) Took online courses (%)	76	69	76	77	82
(2) Accumulative hours of online learning on the most recent weekday (h)	4.68	4.11	4.12	4.94	5.86
0⩽hours⩽4 (%)	50	61	58	44	30
4<hours⩽5 (%)	16	17	19	16	10
5<hours⩽6 (%)	18	13	14	22	27
6<hours⩽12 (%)	16	9	9	18	33
All sample	100	100	100	100	100

Source: Authors' survey.

Table 3. Summary statistics of key variables

Variable	Obs	Mean	SD.	Min	Max
	(1)	(2)	(3)	(4)	(5)
A. Participation in on-line courses					
(1) Parents are concerned about the education of the student (1=yes, 0=no)	710	0.73	0.44	0	1
(2) Took online courses (1=yes, 0=no)	710	0.76	0.43	0	1
(3) Conditional on participation					
(3a) Accumulative hours of taking on the most recent weekday	537	4.68	2.15	0	12
(3b) Provider of the on-line courses					
The school (1=yes, 0=no)	537	0.68	0.47	0	1
Local education bureau (1=yes, 0=no)	537	0.18	0.38	0	1
China Education TV (1=yes, 0=no)	537	0.08	0.29	0	1
Other sources (1=yes, 0=no)	537	0.06	0.16	0	1
(3c) Think on-line courses worse than face-to-face courses (1=yes, 0=no)	537	0.71	0.45	0	1
B. Student characteristics					
(4) Female (1=yes, 0=no)	710	0.46	0.50	0	1
(5) Student grade					
(5a) Lower primary school (1=yes, 0=no)	710	0.27	0.44	0	1
(5b) Upper primary school (1=yes, 0=no)	710	0.29	0.45	0	1
(5c) Junior high school (1=yes, 0=no)	710	0.28	0.45	0	1
(5d) Senior high school (1=yes, 0=no)	710	0.16	0.37	0	1
C. Household characteristics					
(6) Mother or father got at least senior high school education (1=yes, 0=no)	710	0.26	0.44	0	1
(7) Have only one student at the primary or high school level (1=yes, 0=no)	710	0.40	0.49	0	1
(8) Have computer/laptop (1=yes, 0=no)	710	0.37	0.48	0	1
(9) Have smartphone (1=yes, 0=no)	710	0.88	0.32	0	1
(10) Household income per capita quintile					
(10a) Poorest quintile (1=yes, 0=no)	710	0.20	0.40	0	1
(10b) Second quintile (1=yes, 0=no)	710	0.19	0.39	0	1
(10c) Third quintile (1=yes, 0=no)	710	0.18	0.39	0	1
(10d) Fourth quintile (1=yes, 0=no)	710	0.23	0.42	0	1
(10e) Richest quintile (1=yes, 0=no)	710	0.20	0.40	0	1

Source: Authors' survey.

Table 4. Cross-tabulations

Groups	Parents are concerned about the study of the student	Conditional on taking online courses	
		Accumulative hours of taking on the most recent weekday	Think on-line courses worse than face-to-face courses
	(1)	(2)	(3)
(1)Provider of online sources			
School	\	4.88	0.68
Local education bureau	\	4.42	0.79
China Education TV	\	4.38	0.72
Other sources	\	3.58	0.81
P-value	\	0.000***	0.089*
(2)Student gender			
Male	0.75	4.83	0.71
Female	0.71	4.50	0.71
P-value	0.318	0.078*	0.931
(3)Student grade			
Lower primary school	0.68	4.11	0.72
Upper primary school	0.74	4.12	0.71
Junior high school	0.78	4.94	0.71
Senior high school	0.75	5.86	0.71
P-value	0.074*	0.000***	0.996
(4)Mother or father's education			
At least senior high school	0.71	4.68	0.73
Otherwise	0.74	4.68	0.71
P-value	0.422	0.98	0.517
(5)Number of students			
Only student	0.71	4.77	0.71
Multiple students	0.75	4.62	0.72
P-value	0.38	0.44	0.817
(6)Access to computer			
Have computer/laptop	0.72	4.87	0.75
Otherwise	0.74	4.56	0.69
P-value	0.445	0.11	0.113
(7)Access to smartphone			
Have smartphone	0.74	4.77	0.72
Otherwise	0.7	3.86	0.63
P-value	0.429	0.004***	0.155
(8)Household income per capita quintile			
First quintile	0.72	4.17	0.74
Second quintile	0.75	5.12	0.71
Third quintile	0.73	4.82	0.75
Fourth quintile	0.79	4.51	0.68
Fifth quintile	0.67	4.77	0.71
P-value	0.266	0.026**	0.795

Note: 1. *** p<0.01, ** p<0.05, * p<0.1; 2. For binary variables, t test was carried out as the significance of difference test. With two or more groups of variables, analysis of variance was used. But if variables are not satisfied with the hypothesis of homogeneity of variances, we use the method of regression and testing coefficient jointly to show the significance of the difference. Source: Authors' survey.

Table 5. Regression results-the correlates of parents' concern about the study of students

Variables	Logit	Logit	LPM
	(1)	(2)	(3)
A. Student characteristics			
(1) Female	-0.04	0.00	0.01
	(0.04)	(0.05)	(0.04)
(2) Student grade			
(2a) Upper primary school	0.08	0.11*	0.10
	(0.06)	(0.06)	(0.06)
(2b) Junior high school	0.10*	0.12**	0.11**
	(0.05)	(0.05)	(0.05)
(2c) Senior high school	0.08	0.14*	0.13
	(0.08)	(0.09)	(0.09)
B. Family characteristics			
(3) Mother or father got at least senior high school education	-0.00	0.02	0.03
	(0.05)	(0.06)	(0.06)
(4) Have only one student at the primary or high school level	-0.01	0.04	0.03
	(0.06)	(0.07)	(0.07)
(5) Have computer/laptop	-0.05	-0.03	-0.02
	(0.06)	(0.07)	(0.07)
(6) Have smartphone	0.11	0.15	0.13
	(0.09)	(0.10)	(0.10)
(7) Household income per capita quintiles			
(7a) Second quintile	-0.02	-0.06	-0.05
	(0.07)	(0.06)	(0.05)
(7b) Third quintile	0.00	-0.05	-0.04
	(0.08)	(0.08)	(0.08)
(7c) Fourth quintile	0.08	0.08	0.06
	(0.08)	(0.07)	(0.06)
(7d) Fifth quintile	-0.12	-0.19***	-0.18**
	(0.08)	(0.06)	(0.07)
FE	No	Yes	Yes
Observations	710	710	710

Note: 1. Robust standard errors in parentheses, and clustered at the county level
2. The coefficients are marginal effects.
3. ***Significant at 1% level; **significant at 5% level; *significant at 10% level.

Source: Authors' survey.

Table 6. Regression results-the correlates of thinking online course worse than face-to-face course

Variables	**Logit**	**Logit**	**LPM**
	(1)	(2)	(3)
A. Provider of the online courses			
(1a) School	-0.15	-0.34***	-0.27**
	(0.10)	(0.10)	(0.12)
(1b) Local education bureau	-0.09	-0.24***	-0.17
	(0.10)	(0.09)	(0.12)
(1c) China Education TV	-0.09	-0.21	-0.12
	(0.14)	(0.16)	(0.14)
B. Student characteristics			
(2) Female	-0.03	-0.01	-0.02
	(0.04)	(0.05)	(0.05)
(3) Student grade			
(3a) Upper primary school	-0.08	-0.01	-0.01
	(0.07)	(0.09)	(0.08)
(3b) Junior high school	-0.03	-0.07	-0.05
	(0.06)	(0.08)	(0.07)
(3c) Senior high school	-0.00	-0.01	-0.01
	(0.10)	(0.13)	(0.12)
C. Family characteristics			
(4) Mother or father got at least senior high school education	0.01	0.02	0.02
	(0.06)	(0.07)	(0.07)
(5) Have only one student at the primary or high school level	-0.09	-0.18**	-0.14*
	(0.06)	(0.08)	(0.07)
(6) Have computer/laptop	-0.03	0.04	0.02
	(0.06)	(0.07)	(0.06)
(7) Have smartphone	0.08	0.05	0.06
	(0.06)	(0.05)	(0.06)
(8) Household income per capita quintiles			
(8a) Second quintile	-0.03	-0.03	-0.03
	(0.08)	(0.08)	(0.09)
(8b) Third quintile	0.05	-0.02	-0.02
	(0.10)	(0.10)	(0.10)
(8c) Fourth quintile	0.11	0.04	0.05
	(0.09)	(0.09)	(0.09)
(8d) Richest quintile	0.08	0.02	0.03
	(0.09)	(0.10)	(0.10)
FE	No	Yes	Yes
Observations	537	537	537

Note: 1. Robust standard errors in parentheses, and clustered at the county level; 2. The coefficients are marginal effects; 3. ***Significant at 1% level, **significant at 5% level, *significant at 10% level. Source: Authors' survey.