

The Effectiveness of Online Learning During COVID-19 for Students in Three Public Universities in Cambodia

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Abstract: *This paper aims to identify the determinants of online effective learning in three public universities in Cambodia during the COVID-19 pandemic using our joint survey data of about 1500 samples collected from National University of Battambang, Royal University of Phnom Penh and Royal University of Fine Art. From our survey data we found that a vast majority of students in both rural areas and urban areas used smart phones for online study. However, about half used computers. Microsoft team, Telegram and ZOOM were the main platforms for online learning during COVID-19. The internet service was still poor, and the quality of the internet service was not much different between rural and urban areas. Using a simple logistic regression model, we found that older students are more likely to choose online/hybrid learning than younger students, students from families whose income were reduced during COVID-19 are less likely to choose online/hybrid learning in the next semester, the more severe the economic effect of COVID-19 are, students are more likely to choose online/hybrid learning, students who use home Wi-Fi are more likely to choose online/hybrid learning than students who use mobile Wi-Fi, teacher's skills for online learning is also important for students to choose online/hybrid learning, students who are more active in sports are more likely to choose online/hybrid learning in the next semester. The findings suggest that online learning is appropriate for senior students while face-to-face learning shall be provided to freshman students.*

Keywords: *online learning, COVID-19, anxiety, depression, sport activities, effectiveness*

I. INTRODUCTION

Any online learning environment is considered to be a framework that “uses the Internet to deliver some form of instruction to learners separated by time, distance, or both” (Dempsey & Van Eck, 2002, p. 283). Online learning is also defined as a teaching and learning process between teachers and students that involves various digital mediums, such as 'WhatsApp', 'Zoom', and 'Google Classroom'. Any assignments or activities, provided by the teacher online, are considered part of online learning (Basar et al., 2021). Online learning (often referred to as e-learning) refers to the use of digital materials to support learning. It does not necessarily take place at a distance. It can be used in physical classrooms to complement more traditional teaching methods, in which case it is called blended learning (Organization for Economic Co-operation and Development, 2020). Online learning can be part of remote learning. Remote learning refers to synchronous or asynchronous instruction provided in a place outside the classroom. Synchronous learning means that students are connected to learning experiences where a teachers' immediate feedback is possible. Asynchronous or self-directed learning means that students can learn at their own pace and chosen time. Remote learning takes an array of forms ranging from paper-based take-home packages to online platforms. Remote learning is also possible through a variety of different channels, such as mobile phones, television, radio, and tutors (Munoz-Najar et al., 2021). Hybrid learning combines in-person learning with remote learning. It is sometimes also referred to as blended learning. Distance learning refers to learning that is done away from a classroom or the workplace. Traditionally, this involved offline correspondence courses

wherein the student corresponded with the school via post. Today, it involves mainly online education, with an instructor that gives lessons and assigns work digitally (Organisation for Economic Co-operation and Development, 2020, p. p.5).

Like other countries, Cambodia also closed schools either fully or partially for extended periods between February 2020 and February 2022. COVID-19 pandemic caused full or partial school closure across Cambodia between February 2020 and February 2022 with a total of 532 days (fully closed for 280 days and partially closed for 253 days), making Cambodia stand out as the country experiencing the third highest number of school closure days in East Asia and Pacific (EAP) during these two years (Bhatta et al., 2022). Online and remote learning was introduced to schools to reduce learning loss. The first case of COVID-19 was confirmed in Cambodia in a Chinese man on January 27, 2020 (<https://www.who.int/cambodia/news/detail/28-01-2020-ministry-of-health-responds-to-first-positive-case-of-new-coronavirus>). In February, Cambodia welcomed MS Westerdam cruise ship with more than 2,200 tourists and crew members on board to dock in Sihanoukville after it was turned away by five countries, including Japan, the Philippines, Taiwan, Thailand, and Guam. The tourists were also allowed to travel to visit Angkor Wat, the most famous tourist destination in Cambodia. The COVID-19 outbreak in Cambodia seemed to be serious in mid-March and it remained quiet again between April and June. On 16 March 2020, educational facilities were closed nationwide, travel restrictions and self-quarantine of migrant workers were issued. Karaoke bars (KTVs) and nightclubs were closed on 17 March. In addition, the government banned religious and other large gatherings including postponing Khmer New Year (12-16 April 2020) and cancelling the water festival which was supposed to be held in late October. The Khmer New Year was officially rescheduled for 17-21 August. In early October, some schools and universities were allowed to reopen by the Ministry of Education and Sports provided they could adhere to appropriate health safety standards. On 7 July, the Phnom Penh Municipal Administration announced KTVs and clubs could reopen, provided they convert their venues into restaurants and receive a city hall permit to operate. The majority of COVID-19 cases in Cambodia were acquired abroad and male. A joint Situation Report #10 issued by the World Health Organization (WHO) and Ministry of Health (MoH) on 7 September 2020 indicated that as of 6 September 2020, 274 confirmed cases of COVID-19 were reported from Cambodia, of which 272 cases had recovered and 236 cases were acquired overseas, representing 11 nationalities in addition to Cambodian, with the rest locally acquired (<http://cdcmoh.gov.kh/resource-documents/who-moh-situation-report>). The majority of infected persons were male. The Ministry of Health of Cambodia indicated that the cumulative cases of COVID-19 in Cambodia on 09 October 2020 reached 283, of whom 57 were female and 226 male. According to Le Bureau de Prospective Economique, Cambodia was ranked third in the World and first in Asia for controlling and countering the adverse effects of COVID-19.

At primary school level, learning loss during COVID-19 pandemic can be attributed to lack of access to the internet and computers at home of students and teachers and low usage of essential platforms for online learning. A study by UNICEF (2022), which used data from the 2016 and 2021 grade six national learning assessments (NLA) carried out by the Education Quality Assurance Department (EQAD) of the Ministry of Education Youth and Sports (MoEYS), showed an evidence of substantial learning loss for grade 6 students, as average achievement levels in 2021 were 0.30-0.75 standard deviations lower than the 2016 averages. The study found that the percentage of students who failed to demonstrate basic proficiency increased from 34% to 45% in the Khmer language and from 49% to 74% in Mathematics despite that face-to-face instruction was replaced with remote teaching and learning activities. The study found that E-learning platforms that grade 6 students used were: YouTube page (22.2%); the MoEYS Facebook page (20.3%); and the MoEYS Podcast

(19.3%). For teachers, the patterns were again very similar, although in more usage. In addition to low usage of E-learning platforms, relatively few students and teachers report having internet connections at home, but most report having access in some way (via phone, café, etc.). Home computers are also fairly rare among students (about 6% on average), but more common in teacher homes.

The challenges for effective online learning at upper secondary school level are also like those of primary school level. At upper secondary education level, Thy et al. (2023) found that teachers and students, during their eLearning, faced the challenge of interactions stemming from their difficulties in handling their teaching and learning using technology and online platforms such as Telegram, Zoom, Microsoft Team, Google Meet. In addition, digital devices and disruptions to teaching and learning due to poor internet connections, electricity cut-offs, and/or noisy environments were quite distracting during online instruction.

This paper aims to examine (1) the socio-economic effects of COVID-19 on university students in Cambodia, (2) the applications of ICT tools for online learning, and to (3) identify the determinants of online effective learning, as self-reported by students from three public universities in Cambodia during the COVID-19 pandemic using our joint survey data of about 1500 samples collected from National University of Battambang, Royal University of Phnom Penh and Royal University of Fine Art. Our main research hypothesis is that COVID-19 pandemic and education lockdown caused anxiety and depression, reduction in extracurricular activities, among the public university students, economic difficulties, which affected the effectiveness of online learning. Our research contributes to the previous literature about the determinants of online learning effectiveness by adding to the existing models (Basar et al., 2021; Soong et al., 2001) new factors, such as anxiety, depression, recreation activities, economic conditions during the COVID-19 pandemic.

II. RELATED LITERATURE

At higher education level, a few studies examined the effectiveness of online learning. Chet et al. (2022), using surveyed data of 1,002 undergraduate students at Royal University of Phnom Penh, a large public university, found that 81.4% of the students did not wish to pursue online learning post-pandemic because 62.5% of them revealed that their academic performance was affected during online learning. Only 18.6% of the students wished to continue online learning. It was also found that factors that influence the decision to continue to study online in the future included gender, the effect of online learning, permanent address, and home WIFI connection; and the leading causes of willingness to continue online education included time and money-saving, the current availability of Sustainability, various practical and flexible platforms for educational purposes, and the creation of an independent learning environment. Heng et al. (2023), using an online surveyed data of 1025 samples from universities throughout Cambodia, revealed key challenges for online learning were the expense of purchasing Internet data, connectivity issues, disruptive environments for learning, reduced learning interactions, and psychological issues, among other challenges. Limited ICT skills among students was one of the challenges in online learning (Chealy & Serey, 2020). Sol (2021) suggests that in the post-COVID-19 era, Cambodian higher education institutions should invest more in improving their digital infrastructure and learning resources, digitalize their delivery approach, provide regular professional development and training for faculty members, and promote collaboration and partnerships with diverse stakeholders.

Whether face-to-face learning is more effective than online learning or vice versa is ambiguous. Some previous studies demonstrated that online learning caused learning loss compared to face-to-face learning in classrooms. Pei & Wu (2019) provided evidence that

online learning worked but it was less effective than offline methods. Spending too much time on screen can cause depression, which is claimed by the World Health Organization (2011) as the leading cause of disease burden worldwide by the year 2030. Moderate or severe depression level was associated with higher time spent on TV watching and use of computers (more than 6 hours per day in total) (Madhav et al., 2017). However, it seems that online learning activities are well suited for graduate level education as student satisfaction with an online course is higher; GPA and other measures of student achievement are the same or better because computer networking provided a more authentic learning environment in the sense that students can easily communicate with other educational professionals outside the class group if they desire (Kearsley et al., 1995). Nguyen (2015) also showed that online learning is generally at least as effective as the traditional face-to-face format, especially for the postsecondary education arena.

Munoz-Najar et al. (2021) proposed five principles for effective remote/online learning: (1) Ensure remote learning technology is fit-for-purpose: availability of technology is a necessary but not sufficient condition for effective remote learning. Meaningful internet connectivity must be ensured, which means that students, teachers, and parents can use the Internet every day via an appropriate device with enough data and connection speed to enable learning; (2) Use technology to enhance teacher effectiveness: teachers can motivate students to find positive value in the learning process, provide incentives to perform, give targeted feedback in the areas where students experience difficulties, and provide socio-emotional support; (3) Establish meaningful two-way interactions: for remote learning to be successful it needs to allow for meaningful two-way interaction between students and their teachers by using the most appropriate technology for the local context; (4) Engage parents and students as partners in the teaching and learning process: in addition to supports provided by teachers, parents can help supports to improve social contact which may be reduced by remote or hybrid learning, (5) Rally all actors to cooperate for learning: collaborate and liaise with local and international partners.

III. METHODOLOGY

1. Methods and Data

This research aims to identify the determinants of online effective learning. A structured questionnaire was developed and used to interview undergraduate students in three public universities, namely, National University of Battambang, Royal University of Phnom Penh and Royal University of Fine Art in Cambodia to collect primary data. The questionnaire was designed through discussion among selected professors and enumerators from those three universities various times through online platforms such as Microsoft team, ZOOM and Google classroom. The questionnaire that was deployed was in Khmer language and divided into five parts- (1) general information, (2) psychological situation, (3) economic situation, (4) learning outcome, and (5) social/extracurricular activities.

Questionnaires in Khmer language in Google form were sent to students to fill out on a voluntary basis with support from volunteer students. The volunteer students were trained about how to fill the questionnaires before they sent the questionnaire to their friends. Students were asked to send the questionnaire to their friends who study in the three public universities. STATA 15 was used for analysing data after we prepared and cleaned data in Excel which was extracted from responses in Google form. The questionnaire was sent to undergraduate students in RUPP, NUBB, and RUFA to complete with instructions from our enumerators who received training before the survey started.

The data were collected between 9th and 23rd of July 2022 for RUPP, between 10th of July 2022 and 1st of August 2022 for NUBB, and between 13th and 30th of July for RUFA. The

data were collected after the schools were open after its closure between February 2020 and February 2022. However, students were still wearing masks and some classes were still conducted online using platforms such as Microsoft Team. The dataset includes 1547 respondents from the three public universities (536 samples from NUBB, 581 samples from RUP, and 430 samples from RUFA). The sample size in this research was larger than sample sizes in previous research on COVID-19, which was conducted in Cambodia. When the population size is large, a sample size of 400 can ensure a precision level of 5% at 95% confidence level (Yamane, 1973). Therefore, the sample size from each of the three universities is representative at both university level and students in public universities in Cambodia.

This research followed ethical standards. Official permissions from each of the three universities were obtained and participation of students was voluntary. The purpose of the research was well informed to respondents and students could agree or could not agree to answer our survey questions. Personal information of students was also kept confidential.

IV. RESULTS AND DISCUSSION

a. Socio-demographic of Respondents

Of the total respondents, the proportions of male and female students were 39% and 61%, respectively. About 72% were between 21 and 25 years old. About 33% were bachelor students in year 2. 93% were Buddhists and 4% were Christians. 74% were from urban areas and 26% were from rural areas as shown in Table 1.

Table 1
Socio-demographics of Respondents

Socio-demographics	Value	Frequency	%
University	NUBB	536	34.65
	RUPP	581	37.56
	RUFA	430	27.80
	Total	1547	100.00
Gender	Male	596	38.53
	Female	951	61.47
Age group	less than 20	397	25.68
	between 21 to 25	1,117	72.25
	between 26 and 30	23	1.49
	Above 31	9	0.58
Year in University	Year 1	396	25.6
	Year 2	507	32.77
	Year 3	369	23.85
	Year 4	275	17.78
Marital status	Single	1,515	97.93

	Married	30	1.94
	Divorced	2	0.13
Religion	Buddhist	1,444	93.34
	Muslim	14	0.9
	Christian	64	4.14
	No religion	22	1.42
	Others	3	0.19
Urban/rural	Rural	402	25.99
	Urban	1,145	74.01

b. Online learning environment: IT devices, learning platforms and internet service

The main device for online learning was smart phones, followed by computers and tablets. For online learning, about 92% of students used smartphones, 43% computers and 4% tablets (Table 2). There was no significant difference between rural and urban students in usage of smart phones for online learning. The proportions of rural and urban students who used smartphones were 93% and 91%, respectively (Pearson $\chi^2(1, 1546) = 2.0203$, $Pr = 0.155$). However, urban students had more access to computers than rural students. Only 33% of students from rural areas used computers, significantly lower than the proportion of students from urban areas, which was 47% (Pearson $\chi^2(1, 1542) = 22.6949$, $Pr = 0.000$). In addition, urban students had more access to tablets than rural students. Only 2% of students from rural areas used tablets, significantly lower than the proportion of students from urban areas, which was 5% (Pearson $\chi^2(1, 1547) = 4.2$, $Pr = 0.04$). Only about 0.5% of students responded they had no device for online learning.

Table 2
Devices for Online Learning (% of total N=1547)

	Smart Phone	Computer	Tablet
Rural	93%	33%	2%
Urban	91%	47%	5%
Total	92%	43%	4%

More than half of students (56%) used smartphones only. However, about 1 in 3 students (36%) used a combination of smartphones and computers for online learning (Table 3).

Table 3
Combination of Smartphones and Computer

Smart phones

		No	Yes	Total
Computers	No	16	859	875
		1%	56%	57%
	Yes	114	552	666
		7%	36%	43%
Total		130	1,411	1,541
		8%	92%	100%

Microsoft team, Telegram and ZOOM were the main platforms for online learning during COVID-19. Most students (85%) used Microsoft Team, followed by telegram (74.7%) and ZOOM (64.8%) (Table 4).

Table 4
Platforms for Online Learning

Online Platform	NUBB(N=534)		RUPP (N=572)		RUFA(N=441)		Total (N=1,547)	
	n	%	n	%	n	%	n	%
Moodie	3	0.6%	9	1.6%	7	1.6%	19	1.2%
Skype	4	0.7%	7	1.2%	26	5.9%	37	2.4%
Others	29	5.4%	27	4.7%	30	6.8%	86	5.6%
E-mail	71	13.3%	100	17.5%	102	23.1%	273	17.6%
Facebook	116	21.7%	95	16.6%	88	20.0%	299	19.3%
School platform	136	25.5%	176	30.8%	174	39.5%	486	31.4%
Google Classroom	109	20.4%	205	35.8%	185	42.0%	499	32.3%
Google Meet	209	39.1%	280	49.0%	185	42.0%	674	43.6%
Zoom	324	60.7%	314	54.9%	365	82.8%	1003	64.8%
Telegram	363	68.0%	443	77.4%	350	79.4%	1156	74.7%
Microsoft Team	433	81.1%	551	96.3%	337	76.4%	1321	85.4%

Regarding internet service, about 77% of all students used phone/mobile internet, 22% home Wi-Fi and 2% outdoor internet. There was a significant difference in types of internet services among different universities, Pearson $\chi^2(4, 1547) = 82.4249$, $P = 0.000$. The proportion of RUFA students who used home Wi-Fi was larger than those of NUBB and RUPP.

Table 5
Different types of internet services for Online Learning

University	Phone/Mobile internet	Home Wifi	Outdoor Wifi	Total
NUBB (N=536)	83%	15%	1%	100%
RUPP (N=581)	82%	17%	1%	100%
RUFA (N=430)	61%	37%	3%	100%
Total (N=1547)	77%	22%	2%	100%

The internet service was still poor, and the quality of the internet service was not much different between rural and urban areas. Only 8% of respondents were completely satisfied with the internet service, 9% mostly satisfied, 22% somewhat satisfied (Table 6). This means that about 38% of respondents were satisfied with internet service. Students from rural areas

seemed to have more difficulty in using internet service as 16% of rural students were completely dissatisfied with internet service, while this number was 10% for urban students.

Table 6
Level of Satisfaction with Internet Service by Urban and Rural Areas

Level of satisfaction	Rural	City	Total
Completely Dissatisfied	16%	10%	11%
Mostly Dissatisfied	9%	11%	10%
Somewhat dissatisfied	13%	16%	15%
Neither Satisfied nor Satisfied	24%	24%	24%
Somewhat Satisfied	21%	22%	22%
Mostly Satisfied	10%	9%	9%
Completely Satisfied	6%	8%	8%
Total	100%	100%	100%

c. Social/Extracurricular Activities

It is well recognized that physical activity or sport has a positive impact on academic achievement and health. Lack of exercise among young people has been found to contribute to obesity and health problems. The Ministry of Education, Youth and Sport of our country also encouraged all high school and higher education institutions (HEIs) to implement physical education and sporting activities during and after school hours because it is highly beneficial to health of students and plays a vital role in building the nation's human resources (<https://www.phnompenhpost.com/national/educational-institutions-urged-develop-sport-programmes>). Field et al (2001) confirmed that exercise contributes to improvement in adolescents' academic performance in a sense that students with a high level of exercise had higher grade point averages than did students with a low level of exercise. Stead & Nevill (2010) found that physical activity or sport can maintain or enhance academic achievement and has a positive impact on anxiety and depression. Zhai et al. (2022), using a sample of 2,324 college students representing three Chinese universities, found that physical fitness was positively associated with academic performance, even after controlling for the effects of lifestyle behaviours. It is reported that the exercises with a minimum of 30 minutes of moderate-intensity per day recommended in the guidelines improve the general physical condition for all age groups (Pitta et al., 2005). In this section, we explore sport activities, entertainment activities, and social communication activities of students during the past six months by asking various questions covering those three topics.

Regarding sport activities during the interview periods, Figure 15 shows the responses of students to our questions whether they did sport activities in the past six months. The bottom bar suggested that 23% of students never went walking/running, 42% rarely, 22% sometimes, 9% often, and 5% did (Table 7). The majority of students (90%) never or rarely did exercise at the gym.

Table 7
Sport Activities

Sport activities	Never	Rarely	Sometimes	Often	Always	Total (N)
Walking/running	23%	42%	22%	9%	5%	1,547
Swimming	76%	17%	5%	2%	0%	1,547
Cycling	48%	28%	14%	5%	5%	1,547

Dancing	58%	23%	12%	5%	2%	1,547
Doing exercise at gym	77%	13%	7%	2%	1%	1,547
Playing football/tennis	55%	24%	13%	6%	3%	1,547
Doing yoga/martial art	72%	17%	7%	3%	1%	1,547
Working on farms/garden	43%	29%	18%	8%	2%	1,547
Doing housework	6%	22%	32%	19%	21%	1,547

Female students seemed to be less active than male students in going walking or running, swimming, doing exercise at gyms, playing football or tennis, working on farms or in gardens. The proportion of females was 16% while this number was 28% for female students (Table 8). However, Female students seemed to be more active than male students in dancing, doing yoga or martial arts, and doing housework. About 23% of female students reported they did housework often while this number was only 18% for male students.

Table 8
Sport Activities by Sex

Sport activities	sex	Never	Rarely	Sometimes	Often	Always	Total	Chi-square test
Walking/running	Male	16%	40%	27%	11%	7%	100%	chi2(4) = 48.3798 Pr = 0.000
	Female	28%	43%	19%	7%	3%	100%	
Swimming	Male	67%	22%	7%	2%	1%	100%	chi2(4) = 44.4627 Pr = 0.000
	Female	81%	14%	3%	1%	0%	100%	
Cycling	Male	45%	28%	15%	5%	6%	100%	chi2(4) = 6.8381 Pr = 0.145
	Female	49%	28%	13%	6%	4%	100%	
Dancing	Male	62%	20%	12%	4%	2%	100%	chi2(4) = 9.9207 Pr = 0.042
	Female	56%	25%	12%	6%	2%	100%	
Doing exercise at gym	Male	67%	16%	10%	4%	3%	100%	chi2(4) = 58.0456 Pr = 0.000
	Female	83%	11%	5%	1%	1%	100%	
Playing football/tennis	Male	36%	27%	21%	10%	6%	100%	chi2(4) = 187.5497 Pr = 0.000
	Female	67%	21%	8%	3%	1%	100%	
Doing yoga/martial art	Male	77%	14%	6%	2%	1%	100%	chi2(4) = 10.2479 Pr = 0.036
	Female	69%	18%	8%	3%	1%	100%	
Working on farms/garden	Male	38%	30%	19%	11%	3%	100%	chi2(4) = 21.2509 Pr = 0.000
	Female	46%	28%	17%	7%	1%	100%	
Doing housework	Male	6%	29%	30%	17%	18%	100%	chi2(4) = 33.4844 Pr = 0.000
	Female	6%	17%	33%	21%	23%	100%	

Regarding entertainment activities during the interview periods, Figure x shows the responses of students to our questions whether they did entertainment activities in the past six months. The bottom bar suggested that 4% of students never watched TV or used a phone or PC (Table 9). 27% rarely, 22% sometimes, 9% often, and 5% did. The majority of students (86%) never or rarely went to a movie or art performance. 22% of students never went to the library or an art museum. And 31% never went shopping.

Table 9
Entertainment Activities

Entertainment activities	Never	Rarely	Sometimes	Often	Always	Total
Watching TV/Phone/PC	4%	27%	32%	17%	20%	1,547

Listening to radio/music	12%	27%	26%	16%	19%	1,547
Going to movie/art performance	53%	33%	11%	3%	1%	1,547
Playing games/internet	42%	29%	15%	8%	6%	1,547
Reading books/newspaper	9%	36%	33%	16%	6%	1,547
Going to library/art museum	22%	44%	23%	10%	2%	1,547
Going shopping	31%	40%	18%	8%	2%	1,547
Going for a walk with friends	37%	43%	15%	4%	1%	1,547
Going outdoor with friends	21%	47%	21%	9%	2%	1,547
Singing/dancing	47%	31%	14%	5%	3%	1,547

Regarding communication during the interview periods, Table 10 shows the responses of students to our questions whether they communicated with siblings or relatives, teachers or researchers, and classmates or friends in the past six months. The proportion of students who never communicated with classmates or friends, teachers or researchers, siblings or relatives were 4%, 11%, and 9%, respectively. The majority of students (94%) still communicated with their classmates or friends. Only 5% of students always communicated with their teachers, compared to 12% with siblings or relatives and 21% with classmates or friends.

Table 10
Communication Partners During COVID-19

Communication activities	Never	Rarely	Sometimes	Often	Always	Total (N)
classmates/friends	4%	24%	31%	21%	21%	1,547
teachers/researchers	11%	40%	29%	16%	5%	1,547
siblings and relatives	9%	31%	30%	17%	12%	1,547

d. Anxiety and Depression

In the past two weeks, about 1 in 4 students (26%) were severely depressed. The Patient Health Questionnaires (PHQ) and Generalised Anxiety Disorders (GAD) questionnaires were used in our survey to determine if students were affected by anxiety or depression. The PHQ-9 is a nine item questionnaire that measures response to treatment and the severity of depression. The GAD-7 is a seven item questionnaire that measures levels of anxiety. Each total score for GAD-7 and PHQ-9 is calculated by summing the score of each question by assigning scores of 0, 1, 2, and 3, to the response categories of “not at all”, “several days”, “more than half the days”, and “nearly every day”, respectively. For PHQ-9, when the score is between 0-5 = mild, 6-10 = moderate, 11-15 = moderately severe, and 16-20 = severe depression. For GAD-7, 0-5 =mild, 6-10 moderate, 11-15=moderately severe anxiety, 15-21= severe anxiety. Following these methods, the proportions of students who were severely depressed and severely anxious were 26%, and 13%, respectively (Table 11).

Table 11
Anxiety and Depression

Severity	GAD-7			PHG-9		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Mild	395	25.53	25.53	318	20.56	20.56
Moderate	528	34.13	59.66	436	28.18	48.74
Moderately severe	415	26.83	86.49	396	25.6	74.34
Severe depression	209	13.51	100	397	25.66	100

Depression and anxiety significantly varied by sex. Female students tended to have higher levels of anxiety and depression than male students. For anxiety, the proportion of female students with severe anxiety in the past two weeks was 15% while this number was 11% for male students (Table 12). For depression, the proportions of female and male students with severe depression were 29% and 20%, respectively. The distributions of GAD-7 and PHQ-9 by sex and area are shown in Figure 1.

Table 12
Anxiety and Depression by Sex

Variables	Sex	Mild	Moderate	Moderately severe	Severe	Total	Chi2 test
GAD-7	Male	31%	35%	23%	11%	100%	chi2(3) = 20.9212, Pr = 0.000
	Female	22%	34%	29%	15%	100%	
PHQ-9	Male	22%	33%	25%	20%	100%	chi2(3) = 19.0914, Pr = 0.000
	Female	20%	25%	26%	29%	100%	

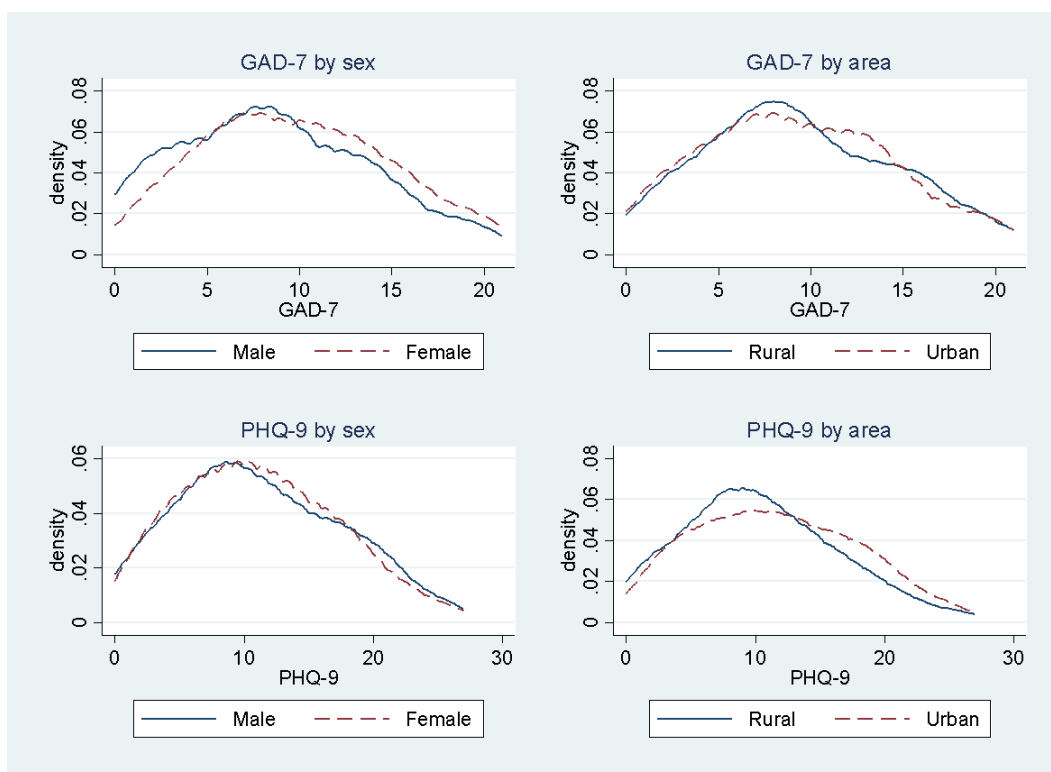


Figure 1: Distribution of anxiety, depression by sex and area

There was no significant difference in the levels of anxiety and depression between students from rural and urban areas, but female students had significantly higher levels of anxiety and depression. The average levels of anxiety for male and female students were 8.659 and 9.859, respectively, $t(1545) = -4.4099$, $p\text{-value} = 0.000$. The average levels of depression for male and female students were 10.42 and 11.656, respectively, $t(1545) = -3.7691$, $p\text{-value} = 0.0001$.

e. Econometric Specifications

Several logic regression models were used to analyse the determinants of perceived effectiveness of online learning and the influences on preferences for online learning. Logit

regression is nonlinear, specifically designed for binary dependent variables (Stock & Watson, 2003).

- β_i are the regression coefficients;
- X_i are the following covariates: gender, current residence, age, situation of family

$$P(y = 1/x_1, x_2, \dots, x_k) = \frac{\exp(\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k)}{1 + \exp(\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k)}$$

income during COVID-19, whether the student is receiving assistance or not, severity of economic impact, internet type, usage of computer, teacher teaching skill, level of anxiety, and sport activities.

- The dependent variable y is binary. We look at two different dependent variables: (1) if a student chooses online/hybrid learning in the next academic year, then $y=1$ and if he/she prefer face-to-face learning, then $y=0$; (2) if a student like online learning, then $y=1$, if he/she don't like online learning, then $y=0$.

For constructing an independent variable about sport activities, Principal Component Analysis (PCA) was used to reduce sport activities to one variable by using STATA command *predict* after we use command *pca*. The scree plot is in Appendix A.

The results in Table 13 from logistic regression when the dependent variable $y=1$ if a student chooses online/hybrid learning in the next academic year and $y=0$ if he/she prefers face-to-face learning, suggested that:

- Older students are more likely to choose online/hybrid learning.
- Students from families whose income was reduced during COVID-19 are less likely to choose online/hybrid learning in the next semester.
- The more severe the economic effect of COVID-19 has on students' families, students are more likely to choose online/hybrid learning.
- Students who use home Wi-Fi are more likely to choose online/hybrid learning than students who use mobile Wi-Fi.
- Teacher's skills for online learning are also important for students to choose online/hybrid learning.
- Students who are more active in sports are more likely to choose online/hybrid learning.

Table 13
Results of Logistic Regression: Part 1

Dependent variable (1=online learning/hybrid; 0= face-to-face learning)					
	Model 1	Model 2	Model 3	Model 4	Model 5
Gender (1=Female, 0=Male)	-0.0698 (-0.61)	-0.0401 (-0.35)	-0.0621 (-0.53)	-0.0245 (-0.21)	-0.0246 (-0.21)
Current residence (1=Urban; 0: Rural)	0.22 (1.72)	0.142 (1.08)	0.119 (0.90)	0.126 (0.95)	0.126 (0.95)
Age	0.0967*** (3.72)	0.0982*** (3.72)	0.0994*** (3.74)	0.101*** (3.79)	0.101*** (3.79)
Family income (1=decrease,0=other)	-0.288* (-2.49)	-0.295* (-2.51)	-0.286* (-2.43)	-0.274* (-2.32)	-0.274* (-2.31)

Assistance (1=Yes, 0=No)	0.217 (1.40)	0.233 (1.49)	0.233 (1.48)	0.229 (1.45)	0.229 (1.44)
Severity of economic impact	0.143* (2.29)	0.173** (2.72)	0.183** (2.87)	0.184** (2.88)	0.184** (2.85)
Internet (1=mobile internet, 0=Others)		-0.673*** (-5.09)	-0.678*** (-5.09)	-0.676*** (-5.07)	-0.676*** (-5.07)
Use Computer (1=Yes, 0=No)		-0.00995 (-0.08)	-0.000321 (-0.00)	-0.00226 (-0.02)	-0.00231 (-0.02)
Teacher's teaching skills (1=Yes, 0=No)			0.555*** (3.99)	0.544*** (3.90)	0.544*** (3.90)
Sport activities				0.0674* (2.07)	0.0674* (2.06)
Anxiety (GAD-7)					0.000073 (0.01)
Constant	-3.176*** (-5.31)	-2.752*** (-4.50)	-3.215*** (-5.11)	-3.676*** (-5.49)	-3.676*** (-5.48)
n	1546	1541	1541	1541	1541
chi2	30.52***	57.46***	74.17***	78.42***	78.42***
bic	1964.1	1943.4	1934.1	1937.2	1944.5

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

V. CONCLUSION AND RECOMMENDATION

COVID-19 adversely affects the economic situation of university students and their families. During the pandemic, students suffered from depression and anxiety and most students did not actively participate in sport activities and other extracurricular activities such as entertainment and recreation. However, students started to use ICT devices, mostly smartphones, for online learning through platforms such as Microsoft Team and Zoom. Telegram was also widely used by students for online study purposes. Availability of technology is a necessary but not sufficient condition for effective remote learning: access to the internet via smartphones has been a key to keep learning despite the school lockdown, opening new opportunities for delivering education at scale. In this research, it was found that teachers' knowledge about teaching online is important for effective online learning. Students who are more active in sports are more likely to choose online/hybrid learning in the next semester. Students who are active in sport activities are more likely to choose online/hybrid learning. The level of anxiety is positively related with the choice of online learning, but not significantly. The findings suggest that online learning is appropriate for senior students in year 3 or year 4 while face-to-face learning shall be provided to freshman students. With the spread of smartphones, rural students can learn with teachers who live far away. Rural universities shall provide online teaching options to teachers with competent online teaching skills who are not living close to the university. Encouraging students to do some sports can also promote desire to study/academic outcomes as it was found in other studies.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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