

## Observational Study

**Surviving the shift: College student satisfaction with emergency online learning during COVID-19 pandemic**

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The coronavirus disease 2019 (COVID-19) epidemic disrupted education systems by forcing systems to shift to emergency online learning. Online learning satisfaction affects academic achievement. Many factors affect online learning satisfaction. However there is little study focused on personal characteristics, mental status, and coping style when college students participated in emergency online courses.

**AIM**

To assess factors related to satisfaction with emergency online learning among college students in Hebei province during the COVID-19 pandemic.

**METHODS**

We conducted a cross-sectional survey of 1600 college students. The collected information included demographics, psychological aspects of emergent public health events, and coping style. Single factor, correlation, and multiple linear regression analyses were performed to identify factors that affected online learning satisfaction.

## RESULTS

Descriptive findings indicated that 62.9% (994/1580) of students were satisfied with online learning. Factors that had significant positive effects on online learning satisfaction were online learning at scheduled times, strong exercise intensity, good health, regular schedule, focusing on the epidemic less than one hour a day, and maintaining emotional stability. Positive coping styles were protective factors of online learning satisfaction. Risk factors for poor satisfaction were depression, neurasthenia, and negative coping style.

## CONCLUSION

College students with different personal characteristics, mental status, and coping style exhibited different degrees of online learning satisfaction. Our findings provide reference for educators, psychologists, and school administrators to conduct health education intervention of college students during emergency online learning.

**Key Words:** COVID-19; Emergency online learning; Online learning satisfaction; College students; Mental status; Coping style; Distance education; Psychiatric status

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**Core Tip:** We evaluated satisfaction with online learning and its associated factors, specifically demographic variables, mental status, and coping style of Chinese college students who participated in emergency online courses during the coronavirus disease 2019 pandemic. Little study has been focused on online acceptance of education. Our findings provide reference for educators, psychologists, and school administrators to conduct health education intervention.

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## INTRODUCTION

The SARS-CoV-2 [hereafter referred to as coronavirus disease 2019 (COVID-19)] pandemic disrupted the educational, economic, and social systems of many countries[1]. To reduce the spread of the virus, countries adopted diverse control strategies such as lockdown and social distancing. COVID-19 hampered education by disrupting student learning goals in many disciplines[2]. The Chinese Ministry of Education suggested “suspending classes without suspending learning”. Students across the nation were required to stay at home, and emergency online learning was widely practiced in February 2020[3]. College students urgently turned to distance education to minimize the pandemic’s negative impacts on health[4]. Teachers and students were suddenly thrust into an unplanned, unwanted, uncharted, online learning experiment during COVID-19-mandated confinement. This transition increased workload, altered curricula, and eliminated hands-on experiences. In online education, students had to act more autonomously and take more responsibility for their learning[5]. Students from various backgrounds and places were required to adapt to new environmental, technological, and psychological learning conditions that may have affected academics[4,6,7]. The COVID-19 pandemic impacted a cascade of detrimental effects on college student academic performance[8]. Online learning may have been an approach to ensure student knowledge and practice in this special period, although consideration of student satisfaction is mandatory to improve academics[9].

Learning satisfaction reflects how students view their learning experiences, a crucial indicator of online learning effectiveness that is related to academic achievement[10]. The effect of online learning quality on student performance was strongly mediated by satisfaction with online learning, and ensuring student satisfaction can increase the academic success of both the institution and the student[11]. Surveys of online learning satisfaction during the COVID-19 pandemic show conflicting results. Yekefallah *et al*[10] reported that 59% of college students had poor satisfaction with online learning. Arain *et al*[12] found that the level of satisfaction was only 30% among medical students. Wilhelm *et al*[13] found that undergraduate students reported lower levels of learning, engagement, and confidence with the course materials during remote teaching compared with the face-to-face portion of the class. Conversely, Eansor *et al*[14] showed that online learning had high satisfaction levels, and student knowledge scores and self-confidence were raised because of rich online educational resources and the ability to support asynchronous and synchronous communication between students and teachers and between the students themselves[15]. These differing findings make it necessary to clarify satisfaction with online learning and factors that affect satisfaction to provide effective and targeted interventions for academics and mental and physical health.

Student factors, instructor performance, system quality, and course evaluations all affect online learning satisfaction. Mohammed *et al*[16] found that student factors and system quality were the main elements that influenced student satisfaction. Online learning satisfaction during the COVID-19 lockdown has been assessed by self-efficacy and teacher attitude towards technology integration[17], the interaction between learners and content and lecturers and learners[18], higher education teacher emotional experiences[19], internet connectivity[20], curriculum arrangement[16], and learning environment[21]. Furthermore, the COVID-19 pandemic and related restrictions could impact mental health; college students and young adults had a high prevalence of anxiety, depression, sleep problems, and suicidal ideation[22]. Ionescu *et al*[23] reported that the higher the psychopathology scores, the less online learning satisfaction. Self-directed learning was negatively associated with negative emotions[24]. In addition, University period is a critical time for shaping a student's personality and developing talents; college students have unique psychological characteristics[25]. However, it is not clear which personal characteristics (demographic variables) and which emotions, *e.g.*, depression, fear, neurasthenia, compulsive anxiety or hypochondria, exerted important effects in online learning satisfaction early in the epidemic. Furthermore, coping style is a cognitive and behavioral feature that individuals adopt when facing stressful situations and events. Coping style has a positive and a negative dimension[26]. Positive coping helps individuals to actively manage adversity, which involves asking for advice and finding solutions to adjust to stressors quickly and maintain mental well-being. Negative coping includes social withdrawal and avoidance. Negative coping can increase anxiety and depression and increase the degree of procrastination, which have a negative effect on academic performance [27]. Positive coping is a protective factor for mental health[28]. Nevertheless, factors associated with emergency online learning satisfaction such as coping style have not been adequately defined for the specific pandemic period. Thus, we measured the influence of different characteristics of college students, their psychological state and coping style on their learning satisfaction. Our findings will provide references for colleges to conduct accurate mental health education for students and ensure student satisfaction with online courses. Also, our findings provide understanding of the challenges to fostering a productive learning environment threatened by epidemic outbreak and economic uncertainty.

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## MATERIALS AND METHODS

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### **Study design**

This study was a cross-sectional investigation. An online questionnaire was generated by Wenjuanxing. Wenjuanxing is a web-based, widely used, open questionnaire platform which was developed by the Changsha Ranxing Information and Technology Limited Company. A General Information questionnaire, Psychological questionnaire for Emergent Events of Public Health, and a Simplified Coping Style Questionnaire (SCSQ) were used to measure online satisfaction with learning and associated factors, particularly personal characteristics, mental status, and coping style.

### **Participants and data collection**

Study participants were undergraduates from four colleges and universities, Hebei Medical University, Hebei Normal University, Hebei Academy of Fine Arts, and Shijiazhuang Information Engineering Vocational College. Convenience sampling was used to select participants. Data collection was conducted between March 23, 2020 and April 9, 2020. Because of the pandemic, the students remained at home in different cities and received electronic questionnaires by WeChat. The questionnaire was distributed by school administrators or teachers.

### **Ethics statement**

The study protocol was approved by the Ethics Committee of Hebei General University and complied strictly with ethical requirements. Ethics Review No. (2020) scientific ethics No. (30). All participants provided prior informed consent. Participants were informed that they were free to withdraw at any time. Participants were asked to respond on their own merits and complete survey items in accordance with standardized guidelines. Participant identities were anonymous.

### **General information questionnaire**

The questionnaire was designed to investigate mainly demographic and sociological data, *i.e.*, gender, age, current role, grade, nationality, family location, academic year, monthly household income, parents' education, online status, average daily time paying attention to the epidemic, and whether bored at home for long time. In addition, online learning satisfaction, exercise intensity, and health status scores during the epidemic were rated 1-10 from "very dissatisfied or weak or poor" to "very satisfied, strong, good". Satisfaction scores were defined as poor (1-3), general (4-6), and good (7-10) for online courses.

### **Psychological Questionnaire for Emergent Events of Public Health**

Mental status was assessed with Psychological Questionnaire for Emergent Events of Public Health[29]. This questionnaire is composed of 25 items of five subscales, depression, neurasthenia, fear, compulsion-anxiety, and hypochondria. Each item is scored according to a four-point Likert scale (0 = seldom to 3 = severe) or (0 = seldom to 3 = always). The higher the score of a dimension, the more serious the emotional reaction. The prompt "Possible attitude or practice toward COVID-19" was set to match the actual situation of this survey. The Cronbach's  $\alpha$  of the questionnaire for this assessment was 0.776.

## SCSQ

Coping styles were assessed with the SCSQ[30]. This questionnaire reflects the attitudes and practices adopted when one experiences setbacks or difficulties. The questionnaire included 20 items in 2 dimensions: Positive coping styles (12 items, e.g., try to look on the bright side, find different ways to solve a problem) and negative coping styles (8 items, e.g., relieve troubles by smoking and drinking, imagine a miracle will come). A 4-point scale was used for each item (0 = never, 1 = seldom, 2 = often, and 3 = always). The total score of the positive coping subscale was from 0 to 36, and the total score of the negative coping subscale was from 0 to 24. High scores reflected high levels of the indicated coping style. The internal consistency coefficients of the positive and negative coping subscale were 0.890 and 0.680, respectively.

## Data analysis

Quantitative data were analyzed with descriptive and exploratory methods. First, the skewness and kurtosis values were used to determine whether the data were normally distributed. Data were skewed, continuous variables were expressed as median (interquartile range) and were assessed by Mann-Whitney test or Kruskal-Wallis H test. Second, the correlation of variables was represented by Pearson's and Spearman's coefficients based on the type of data. Third, multiple linear regression was performed to identify predictors of online learning satisfaction. All statistical analysis was performed using SPSS 22.0 (IBM Corporation). All tests were within the 95% confidence interval. When the confidence interval did not include zero, the mediating effect was significant at  $P < 0.05$ . A two-tailed  $P$  value of less than 0.05 was considered statistically significant.

## RESULTS

### Descriptive statistics

We collected 1600 questionnaires, of which 1580 (98.6%) were effective. The average answer time was  $294 \pm 165$  S. The average age of the participants was 19.9 years (range 17-29 years). There were 342 men (21.6%) and 1238 women (78.4%). There were 191 (12.1%) medicine and 799 (50.6%) and 590 (37.3%) arts and science students. Online learning satisfaction was poor for 3.9% (61/1580) of participants, general for 33.2% (525/1580), and good for 62.9% (994/1580).

### Demographic characteristics and single factor analysis

Table 1 lists demographic characteristics and single factor analysis. In the online learning satisfaction dimension, we found statistical significance ( $P < 0.05$ ) for age, major, academic year, family location, online status, average time attention to epidemic, whether following a regular schedule, whether bored at home, health condition, and exercise intensity.

### Correlation analysis of online learning satisfaction, mental status, and personal characteristics

We assessed the correlation matrix for all study variables (Table 2). Correlation analyses showed that fear, compulsion-anxiety, positive coping style, father's education, online status, exercise intensity, health condition, whether on a regular schedule, and whether bored at home were positively associated with online learning satisfaction. However, depression, neurasthenia, hypochondria, negative coping style, age, and average time of attention to the epidemic were negatively correlated with online learning satisfaction.

### Multiple linear regression of online learning satisfaction

To avoid interaction and multicollinearity, we constructed three models. The dependent variable was learning satisfaction, after confounding factors were excluded. Online learning at schedule, strong exercise intensity, good health, regular schedule, paying attention to epidemic less than one hour, and not bored at home had positive effects ( $P < 0.05$ ) on online learning satisfaction (Table 3). There was no statistical significance for other independent variables. Depression and neurasthenia had significant negative effects on online learning satisfaction, whereas fear positively affected online learning satisfaction ( $P < 0.05$ ; Table 4). Positive coping had a significant positive effect on satisfaction with online courses, whereas negative coping had a significant negative effect ( $P < 0.05$ ; Table 5).

## DISCUSSION

The COVID-19 epidemic disrupted education systems, and college students had to turn to distance education quickly. Online learning satisfaction affected academic achievement. As such, it is critical to assess online learning satisfaction, and we need to be aware of some implications. In this study, we showed a relation between online learning satisfaction, personal characteristics, mental status, and coping style. We propose recommendations and solutions to enhance student online learning satisfaction.

We found that online learning satisfaction was reported good by 62.9% (994/1580) of study participants, but nearly half of college students were less satisfied with their studies. Similarly, Maqableh and Alia[31] found that more than a third of surveyed undergraduate students were dissatisfied with the online learning experience. Our results might suggest that emergency online learning could be an optional approach when surviving the shift during the COVID-19 pandemic. On the basis of similar studies, we suggest that a more plausible explanation is that online learning laid a good foundation for promoting interest, effective in learning because of its unlimited access, ease of use, flexibility, innovation,

**Table 1 Demographic characteristics and single factor analysis among college students during coronavirus disease 2019 [median (interquartile range)], (n = 1580)**

Variable	n	Online learning satisfaction	Depression	Neurasthenia	Fear	compulsion-anxiety	Hypochondria	Positive coping style	Negative coping style
Sex									
Female	1238	7.0 (2.0)	0.2 (0.5)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.5)	20.0 (11.0)	7.0 (5.0)
Male	342	7.0 (4.0)	0.3 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.2)	0.0 (0.0)	19.0 (13.0)	7.0 (6.0)
Z value		-0.56	-2.90	-0.09	-3.56	-1.86	-1.71	-1.56	-1.01
P value		0.606	0.004 <sup>2</sup>	0.928	<0.001 <sup>2</sup>	0.063	0.088	0.120	0.312
Age (yr)									
17-20	1219	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (5.0)
21-29	361	7.0 (3.0)	0.3 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.5)	20.0 (11.0)	7.0 (2.00)
Z value		-3.27	-2.98	-2.46	-0.44	-0.53	-1.078	-0.77	-2.59
P value		< 0.001 <sup>2</sup>	0.003 <sup>2</sup>	0.014 <sup>1</sup>	0.660	0.600	0.281	0.440	0.010 <sup>1</sup>
Currently role									
Volunteers	44	7.0 (3.0)	0.3 (0.8)	0.2 (0.8)	0.5 (0.8)	0.0 (0.2)	0.0 (0.5)	17.5 (12.5)	7.5 (7.5)
At home	1536	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (5.0)
Z value		-0.62	-1.66	-0.17	-0.03	-1.92	-1.57	-0.05	-0.84
P value		0.538	0.097	0.242	0.974	0.055	0.116	0.961	0.399
Major									
Medicine	191	7.0 (3.0)	0.3 (0.8)	0.4 (0.8)	0.5 (0.7)	0.0 (0.2)	0.0 (0.5)	19.0 (11.0)	7.0 (6.0)
Art	799	7.0 (2.0)	0.2 (0.5)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (6.0)
Science	590	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	20.0 (10.0)	6.0 (5.0)
$\chi^2$		14.80	14.42	12.20	2.54	-0.96	-0.32	7.76	7.01
P value		< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	0.002 <sup>2</sup>	0.281	0.617	0.850	0.021 <sup>1</sup>	0.030 <sup>1</sup>
Academic year									
1 <sup>st</sup>	708	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	18.0 (12.0)	6.0 (7.0)
2 <sup>nd</sup>	308	7.5 (3.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.5)	20.0 (13.0)	7.0 (6.0)
3 <sup>rd</sup>	430	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.6)	22.0 (10.3)	7.0 (5.0)
4 <sup>th</sup>	134	7.0 (3.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.8)	0.0 (0.2)	0.0 (0.5)	19.5 (11.3)	7.0 (6.0)

$\chi^2$		13.48		-0.49	1.84	0.37	2.339		3.104	36.63		15.21
<i>P</i> value		0.004 <sup>2</sup>		0.181	0.607	0.946	0.505		0.376	< 0.001 <sup>2</sup>		0.002 <sup>2</sup>
Family location												
Country	865	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.6)		0.0 (0.0)	19.0 (11.5)		7.0 (5.0)
Town	292	7.0 (3.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)		0.0 (0.4)	20.0 (11.0)		7.0 (5.0)
City	423	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.2)		0.0 (0.0)	20.0 (12.0)		7.0 (6.0)
$\chi^2$		10.24		4.73	1.75	0.38	4.42		0.101	16.05		10.77
<i>P</i> value		0.006 <sup>2</sup>		0.093	0.417	0.829	0.110		0.951	< 0.001 <sup>2</sup>		0.005 <sup>b</sup>
Nationalities												
Ethnic minorities	71	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.8)	0.0 (0.0)		0.0 (0.0)	17.0 (11.0)		7.0 (5.0)
Han Chinese	1509	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)		0.0 (0.0)	20.0 (12.0)		7.0 (6.0)
<i>Z</i> value		-0.95		-0.74	-0.86	-0.49	-0.32		-1.03	-0.90		-0.47
<i>P</i> value		0.342		0.460	0.389	0.625	0.749		0.304	0.367		0.639
Whether student cadres												
Yes currently	770	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)		0.0 (0.0)	19.0 (11.0)		7.0 (5.0)
Used to be	436	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.2)		0.0 (0.0)	20.0 (11.0)		7.0 (6.0)
No	374	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)		0.0 (0.0)	20.0 (12.0)		7.0 (5.0)
$\chi^2$		1.28		5.20	1.30	4.46	6.49		3.41	6.62		3.21
<i>P</i> value		0.528		0.074	0.521	0.108	0.039 <sup>a</sup>		0.181	0.037 <sup>a</sup>		0.201
Monthly household income (Yuan)												
< 5000	950	7.0 (2.0)		0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)		0.0 (0.0)	19.0 (12.0)		7.0 (5.0)
5000-10000	523	7.0 (2.0)		0.2 (0.5)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)		0.0 (0.0)	20.0 (12.0)		7.0 (6.0)
10000	107	7.0 (2.0)		0.3 (0.8)	0.4 (0.6)	0.7 (0.7)	0.0 (0.2)		0.0 (0.5)	20.0 (13.0)		8.0 (6.0)
$\chi^2$		0.35		4.26	4.65	2.52	4.78		0.40	5.68		3.49
<i>P</i> value		0.840		0.119	0.098	0.284	0.092		0.819	0.058		0.174
Online status												
No network or not well	46	5.5 (3.0)		0.4 (1.2)	0.4 (1.3)	0.6 (0.7)	0.0 (0.5)		0.0 (0.1)	16.0 (12.3)		7.0 (7.5)
Can not online learning at schedule	16	4.0 (3.8)		0.8 (0.7)	1.0 (0.8)	0.8 (0.8)	0.1 (0.9)		0.0 (0.5)	17.0 (12.0)		8.0 (6.5)

Can online learning at schedule	1518	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	20.0 (12.0)	7.0 (5.0)
$\chi^2$		49.80	17.92	29.13	6.90	20.59	1.09	10.57	0.93
P value		< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	0.032 <sup>1</sup>	< 0.001 <sup>2</sup>	0.579	0.005 <sup>2</sup>	0.628
Average time attention to epidemic									
Almost all day	165	7.0 (3.5)	0.0 (0.5)	0.2 (0.6)	0.7 (0.8)	0.0 (0.0)	0.0 (0.5)	20.0 (11.5)	7.0 (5.0)
About 1-3 h or more	231	8.0 (3.0)	0.2 (0.5)	0.2 (0.6)	0.7 (0.7)	0.0 (0.0)	0.0 (0.5)	21.0 (11.0)	6.0 (5.0)
< 1 h	1132	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (6.0)
Not concerned	52	5.0 (3.0)	0.2 (0.8)	0.2 (0.8)	0.3 (0.5)	0.0 (0.2)	0.0 (0.0)	14.5 (17.5)	6.5 (6.8)
$\chi^2$		43.39	2.23	1.03	14.75	3.45	1.37	22.51	0.73
P value		< 0.001 <sup>2</sup>	0.526	0.794	0.002 <sup>2</sup>	0.327	0.713	< 0.001 <sup>2</sup>	0.866
Whether regular schedule									
No	427	6.0 (3.0)	0.5 (0.7)	0.4 (0.6)	0.7 (0.7)	0.0 (0.2)	0.0 (0.5)	21.0 (12.0)	7.0 (5.0)
Yes	1153	7.0 (2.5)	0.0 (0.5)	0.2 (0.4)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	17.0 (9.0)	7.0 (5.0)
Z value		-9.97	-11.51	-9.979	-4.62	-7.05	-2.22	-6.32	-3.89
P value		< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	0.027 <sup>1</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>
Whether bored at home for long time									
Yes	643	7.0 (3.0)	0.3 (0.8)	0.4 (0.8)	0.7 (0.7)	0.0 (0.2)	0.0 (0.5)	19.0 (9.0)	7.0 (5.0)
No	937	7.0 (2.0)	0.0 (0.5)	0.2 (0.4)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	20.0 (12.0)	7.0 (5.0)
Z value		-6.86	-10.73	-9.54	-4.52	-6.86	-3.05	-2.31	-4.35
P value		< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	0.002 <sup>2</sup>	0.021 <sup>1</sup>	< 0.001 <sup>2</sup>
Mother's education									
Junior secondary and below	975	7.0 (2.0)	0.7 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (5.0)
High School	358	7.0 (3.0)	0.7 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (6.0)
University and above	247	7.0 (2.0)	0.7 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	21.0 (13.0)	7.0 (6.0)
$\chi^2$		3.38	0.23	0.33	1.85	0.67	0.50	2.08	2.27
P value		0.185	0.890	0.853	0.396	0.710	0.779	0.353	0.322
Father's education									
Junior secondary and below	963	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	19.0 (12.0)	7.0 (5.0)

High School	348	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.8)	0.0 (0.0)	0.0 (0.5)	19.0 (12.0)	7.0 (6.0)
University and above	269	7.0 (2.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.1)	0.0 (0.0)	20.0 (12.5)	7.0 (6.0)
$\chi^2$		4.88	0.54	0.68	2.08	2.05	2.18	1.95	1.11
<i>P</i> value		0.087	0.763	0.711	0.354	3.359	0.337	0.378	0.575
Health condition									
Poor (grade 1-3)	28	4.5 (4.0)	0.9 (1.3)	0.9 (1.4)	0.7 (0.8)	0.2 (0.6)	0.0 (0.5)	14.0 (11.5)	8.5 (6.5)
General (grade 4-6)	239	6.0 (2.0)	0.5 (0.7)	0.6 (0.6)	0.7 (0.7)	0.0 (0.2)	0.0 (0.5)	17.0 (10.0)	8.0 (6.0)
Good (grade 7-10)	1313	7.0 (2.0)	0.2 (0.5)	0.2 (0.4)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	20.0 (12.0)	6.0 (5.0)
$\chi^2$		168.63	113.22	91.40	20.51	97.75	21.05	24.56	21.62
<i>P</i> value		< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>
Exercise intensity									
Weak (grade 1-3)	272	5.0 (3.0)	0.5 (0.7)	0.4 (0.6)	0.7 (0.7)	0.0 (0.2)	0.0 (0.5)	17.5 (10.0)	8.0 (6.0)
General (grade 4-6)	702	7.0 (3.0)	0.2 (0.7)	0.2 (0.6)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	19.0 (11.3)	7.0 (6.0)
Strong (7-10)	606	8.0 (2.0)	0.0 (0.3)	0.2 (0.4)	0.5 (0.7)	0.0 (0.0)	0.0 (0.0)	21.0 (12.0)	6.0 (6.0)
$\chi^2$		382.38	129.73	91.37	21.38	43.24	17.25	17.13	22.50
<i>P</i> value		< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>	< 0.001 <sup>2</sup>

<sup>1</sup>*P* < 0.05.

<sup>2</sup>*P* < 0.01 (two-tailed).

repeatedly watching for the future and review, and online learning was effective, applicable and acceptable in education [32]. However the challenge is to find the associated factors and take measures to improve satisfaction according to those factors.

Our findings indicated that college students who participated in online learning at schedule were more satisfied than students who could not get online either because of a lack of a schedule or no network accessibility. That is to say, online learning satisfaction may be related to the degree of participation. Similarly, Hensley *et al*[33] found that students who were able to participate in online courses at schedule had greater learning satisfaction and were more likely to complete their courses successfully. Also, mobile connections and the quality of internet were main factors related to student negative emotions that associated with the quality, performance, and timeliness of study obligations[34]. We suggest forming a home-school joint mechanism, constructing more and improving existing networks, and urging students to attend classes at schedule, to enhance participation and increase online learning satisfaction.

We found that strong exercise intensity, good health, and regular schedule were positively associated with learning satisfaction. Zhang *et al*[35] reported that college students who participated in physical activity < 3 d/wk had symptoms of depression compared with students who exercised  $\geq 3$  d/wk. There was also an interaction between long screen use,



**Table 2 Correlation analysis of online learning satisfaction, mental status and characteristics**

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Online learning satisfaction	-															
Depression	-0.307 <sup>3</sup>	-														
Neurasthenia	-0.245 <sup>3</sup>	0.624 <sup>3</sup>	-													
Fear	0.091 <sup>3</sup>	0.381 <sup>3</sup>	0.575 <sup>3</sup>	-												
Compulsion-anxiety	0.193 <sup>3</sup>	0.531 <sup>3</sup>	0.490 <sup>3</sup>	0.301 <sup>3</sup>	-											
Hypochondria	-0.075 <sup>2</sup>	0.271 <sup>3</sup>	0.397 <sup>3</sup>	0.463 <sup>3</sup>	0.289 <sup>3</sup>	-										
Positive coping style	0.122 <sup>3</sup>	-0.085 <sup>2</sup>	-0.089 <sup>3</sup>	0.057 <sup>1</sup>	-0.104 <sup>3</sup>	-0.001	-									
Negative coping style	-0.089 <sup>3</sup>	0.274 <sup>3</sup>	0.264 <sup>3</sup>	0.220 <sup>3</sup>	0.212 <sup>3</sup>	0.162 <sup>3</sup>	0.363 <sup>3</sup>	-								
Age	-0.093 <sup>3</sup>	0.069 <sup>2</sup>	0.054	0.030	0.005	0.043	0.023	0.036	-							
Father's education	0.055 <sup>1</sup>	0.005	-0.018	-0.024	0.024	-0.013	0.031	0.026	-0.057 <sup>1</sup>	-						
Online status	0.171 <sup>3</sup>	-0.099 <sup>3</sup>	0.118 <sup>3</sup>	-0.044	0.111 <sup>3</sup>	-0.017	0.080 <sup>2</sup>	-0.020	-0.018	-0.019	-					
Exercise intensity	0.537 <sup>3</sup>	-0.305 <sup>3</sup>	-0.264 <sup>3</sup>	-0.119 <sup>3</sup>	-0.169 <sup>3</sup>	-0.097 <sup>3</sup>	0.111 <sup>3</sup>	-0.113 <sup>3</sup>	-0.184 <sup>3</sup>	0.044	0.073 <sup>2</sup>	-				
Health condition	0.418 <sup>3</sup>	-0.351 <sup>3</sup>	-0.298 <sup>3</sup>	-0.166 <sup>3</sup>	-0.290 <sup>3</sup>	-0.182 <sup>3</sup>	0.101 <sup>3</sup>	-0.161 <sup>3</sup>	-0.180 <sup>3</sup>	0.020	0.096 <sup>3</sup>	0.462 <sup>3</sup>	-			
Average time attention to epidemic	-0.132 <sup>3</sup>	0.035	-0.005	-0.088 <sup>3</sup>	0.023	-0.029	-0.094 <sup>3</sup>	0.010	0.019	-0.016	-0.022	-0.144 <sup>3</sup>	-0.138 <sup>3</sup>	-		
Whether regular schedule	0.251 <sup>3</sup>	-0.290 <sup>3</sup>	-0.251 <sup>3</sup>	-0.116 <sup>3</sup>	-0.177 <sup>3</sup>	-0.056 <sup>1</sup>	0.159 <sup>3</sup>	-0.098 <sup>3</sup>	-0.044	0.060 <sup>1</sup>	0.105 <sup>3</sup>	0.284 <sup>3</sup>	0.224 <sup>3</sup>	-0.030	-	
Whether bored at home for long time	0.173 <sup>3</sup>	-0.270 <sup>3</sup>	-0.204 <sup>3</sup>	-0.114 <sup>3</sup>	-0.173 <sup>3</sup>	-0.077 <sup>2</sup>	0.058 <sup>1</sup>	-0.110 <sup>3</sup>	-0.053 <sup>1</sup>	-0.013	0.091 <sup>3</sup>	0.121 <sup>3</sup>	0.104 <sup>3</sup>	-0.016	0.183 <sup>3</sup>	-

<sup>1</sup> $P < 0.05$ .<sup>2</sup> $P < 0.01$ .<sup>3</sup> $P < 0.001$  (two-tailed).

less physical activity, and symptoms of depression. High levels of depression were associated with difficulty in paying attention to academics[36] and ultimately deficient learning satisfaction. A poor physical condition leads to lack of energy, which directly affects learning satisfaction. College students who work and sleep irregularly often use the screen too long before going to bed; this behavior can cause sleep deprivation and sleep rhythm disorder, increased sleep-related disorders[37], induced adverse emotions such as anxiety and depression[38], affected cognitive function and learning [39], and eventually poor learning satisfaction. Also, sleep disturbance predicts the development and persistence of posttraumatic stress disorder and depression[40] which impair health and academic performance. Therefore, we suggest that a network interactive platform of individual-family-school-society should be established as an effective linkage mechanism to make sports and exercise programs congenial and encourage college students to participate in sports and exercise at home, or receive exercise prescription teaching to mobilize student initiative, enthusiasm, an consciousness,

**Table 3 Demographic characteristics with online learning satisfaction (Model 1)**

Variable	Unstandardized coefficients		Standardized coefficients beta	t value	P value
	B	Std. Error			
Can online learning at schedule (reference)					
Can not online learning at schedule	-2.490	0.394	-0.129	-6.327	< 0.001
No network or not well	-0.981	0.236	-0.085	-4.156	< 0.001
Exercise intensity	0.334	0.020	0.401	16.860	< 0.001
Health condition	0.166	0.025	0.158	6.671	< 0.001
Whether regular schedule					
No (reference)					
Yes	0.266	0.094	0.061	2.828	0.005
Average time attention to epidemic					
< 1 h (reference)					
Not concerned	-0.889	0.223	-0.082	-3.989	< 0.001
Whether bored at home for long time					
Yes (reference)					
No	0.343	0.082	0.087	4.199	< 0.001

**Table 4 Mental status with online learning satisfaction (Model 2)**

Variable	Unstandardized coefficients		Standardized coefficients beta	t value	P value
	B	Std. Error			
Depression	-0.776	0.134	-0.199	-5.807	< 0.001
Neurasthenia	-0.654	0.151	-0.163	-4.334	< 0.001
Fear	0.337	0.111	0.087	3.031	0.002

**Table 5 Mental status with online learning satisfaction (Model 3)**

Variable	Unstandardized coefficients		Unstandardized coefficients	t value	P value
	B	Std. Error			
Positive coping style	0.040	0.006	0.172	6.383	< 0.001
negative coping style	-0.061	0.012	-0.140	-5.183	< 0.001

and to expand personalities[41]. As well, students need to keep regular bedtimes and wake-up times to promote physical and mental health and ensure online learning satisfaction.

Our data suggest that low levels of online learning satisfaction were more likely to be reported by students who spent more than one hour per day looking for information about COVID-19. Previous studies have been focused on the relation between depression, anxiety, and online learning satisfaction. Wong *et al*[42] reported that students who had poor online learning satisfaction were more likely to experience stress. Kecejevic *et al*[36] found that students who spent more than an hour a day searching for information about COVID-19 were more likely to report higher levels of anxiety, depression, and somatization. These findings demonstrate that excessive attention to the epidemic was associated with high levels of anxiety, depression, and difficulty paying attention to academics, which led to low academic satisfaction. Additionally, there should be organized learning about COVID-19 to improve protection skills and avoid gossip and information overload.

Our findings indicate that college students who were bored staying at home for a long time were more likely to experience poor online learning satisfaction. Giusti *et al*[43] reported that students who studied at home either alone or with classmates were nearly three times more likely to have poor academic performance. Li *et al*[44] found that college students who lived at home for a long time tended to lack social interaction and support, and they felt lonely; family dysfunction, low social support, and low physical exercise have negative impacts on mental status. Similarly, Wissing *et*

al[45] mentioned that perceived peer support can promote collaborative learning and improve medical student learning satisfaction and participation. Therefore, in a special period of limit, we suggest that relevant organizations guide college students to increase contact and interaction with teachers and classmates and provide social and family support to promote positive feelings of long-term home confinement.

We found that high levels of depression and neurasthenia and negative coping styles had negative effects on online learning satisfaction, whereas positive coping styles had positive effects. On the basis of the control-value theory, investigators consider academic emotion to be an important factor that affects student learning satisfaction and academic performance in online learning context; negative adaptive coping strategies are associated with depression and anxiety [46]. Loneliness causes depression and anxiety, whereas procrastination completely mediates the effect of depression on academic performance[47]. Neurasthenia did not disappear; it continues to enjoy a marginal life in international classification schemes and is a common diagnosis in China[48]. Also, International Classification of Diseases (ICD)-11 Bodily Distress Disorder encompasses Neurasthenia which in the ICD-10 was classified in the grouping of "Other neurotic disorders" [49]. Huang *et al*[50] reported that 23.5% of adolescents were prone to anxiety, of which 1.7% had severe anxiety, and 26.3% of adolescents were prone to depression, of which 1.4% had severe depression. Therefore, on the basis of a study by Liu *et al*[51], we suggest that college students who experienced depressive disorders not only need support and personalized interventions from educators and school administrators, but also they need professional interventions such as cognitive behavioral therapy and online medication therapy from psychologists and psychiatrist. College student personality and psychology are still in a period of maturation. The coping styles of college students are closely related to their psychological health and learning satisfaction. Positive, mature coping is a protective factor of mental health, and it promotes developing individual adaptation. Negative, immature coping has a negative effect on mental health. To alleviate symptoms of depression, young adults who experience stressful life events may need to reinforce problem-focused coping and minimize emotion-focused coping strategies[52]. Therefore, we suggest that educators train student positive coping styles when conducting psychological intervention and educate and help students to adopt positive coping styles such as self-adjustment, help-seeking, and problem-solving. Doing so will improve college student mental health and online study satisfaction.

Our study may have some limitations. Considering differences in individual physical quality and endurance, we choose the ten grades of exercise intensity and did not use the sports scale. A standardized exercise intensity scale can be used to further refine our study. Interestingly, we found that fear was positively related to online learning satisfaction. As is well known, moderate anxiety or fear of failure in learning can motivate, and high fear of COVID-19 may have kept college students alert, promoted study of relevant topics, and mobilized their subjective initiative to respond positively, which may have increased online learning satisfaction. However, Al-Nasa'h *et al*[53] reported that fear of COVID-19 diminished the satisfaction of online learning. This difference may be related to differences in scales, sample sizes, and regions used in each study. We enrolled a large number of participants located in one metropolis of China. Hence, samples from other contexts are needed to assess the generality of our findings.

## CONCLUSION

Our findings enrich our understanding about the impact of the COVID-19 pandemic on satisfaction of the college population toward emergency online learning. Although there was high online learning satisfaction, online education is still an imperfect substitute for in-person learning. College student online learning satisfaction was affected by whether it was scheduled and by depression, neurasthenia, fear, exercise intensity, attention to the epidemic, emotion at home, and coping style during the early stage of COVID-19. We suggest that college students with different characteristics should receive attention at different levels. Psychological intervention should be conducted, publicity and knowledge about COVID-19 should be strengthened, interaction between teachers and students and classmates should be strengthened when teaching online, and support from family and school should be enhanced to alleviate bad emotions that affect online learning satisfaction. Additionally, online group or individual psychological assistance, even psychotropic drugs for high-risk groups, should be made available. Students should adjust coping style and strengthen psychological defense skills. Students, families, schools, and the community can establish a joint mechanism. Related institutions can form mental health guidelines to promote safe and effective learning and a healthy life.

## ARTICLE HIGHLIGHTS

### Research background

The coronavirus disease 2019 (COVID-19) pandemic disrupted all facets of everyday life. Students turned to online education to minimize the pandemic's spread and negative impacts on health. Students from various backgrounds and places were required to adapt to new learning conditions. Student learning satisfaction is a crucial indicator of the effectiveness of online learning that is related to academic achievement.

Surveys of online learning satisfaction during the COVID-19 pandemic show inconsistent results. Some studies showed that the higher the psychopathology scores, the less online learning satisfaction. University period is a critical time for shaping a student's personality and developing talents, they have unique psychological characteristics. However, it is not clear which personal characteristics (demographic variables) and which emotions, e.g., depression, fear, neurasthenia, compulsive anxiety or hypochondria, had important effects in online learning satisfaction early in the pandemic.

Furthermore, coping style is a cognitive and behavioral feature that individuals adopt when they face stressful situations and events. Coping style has a positive and a negative dimension. Positive coping helps individuals to actively manage adversity. Negative coping includes social withdrawal and avoidance. Negative coping can increase anxiety and depression and increase the degree of procrastination, which have negative effects on academic performance. Positive coping is a protective factor for mental health. Nevertheless, factors associated with emergency online learning satisfaction such as coping style have not been adequately defined for the specific pandemic period.

### Research motivation

Our study will clarify satisfaction with online learning and identify personal characteristics and the emotions that had important effects on online learning satisfaction early in the pandemic. Furthermore, this study will clarify which coping style was associated with emergency online learning satisfaction in the specific period. Our findings will provide references for colleges to conduct accurate mental health education and ensure student satisfaction with online courses for a good quality academic experience and mental health.

### Research objectives

Our objective is to provide references for colleges to conduct accurate mental health education for students and ensure their satisfaction with online courses. In addition, we will explain challenges to fostering a productive learning environment threatened by epidemic outbreak and economic uncertainty.

### Research methods

We measured the influence of college student psychological states and coping styles on their learning satisfaction. Measurements were based on questionnaires designed to investigate mainly demographic and sociological data, *i.e.*, gender, age, current role, grade, nationality, family location, academic year, monthly household income, parents' education, online status, average daily time paying attention to the epidemic, and whether bored at home for long time. Mental status was assessed with the Psychological Questionnaire for Emergent Events of Public Health (PQEEPH). The PQEEPH scale is specially designed for public health emergencies; it is composed of 25 items of five subscales, *i.e.*, depression, neurasthenia, fear, compulsion-anxiety, and hypochondria that describe emotional status precisely and in detail. Coping styles were assessed with the Simplified Coping Style Questionnaire. Quantitative data were analyzed with descriptive and exploratory methods. First, the skewness and kurtosis values were used to determine whether the data were normally distributed. Data were skewed, continuous variables were expressed as median (interquartile range) and were assessed by Mann-Whitney test or Kruskal-Wallis H test. Second, the correlation of variables was represented by Pearson's and Spearman's coefficients based on the type of data. Third, multiple linear regression was performed to identify predictors of online learning satisfaction. All statistical analysis was performed using SPSS 22.0 (IBM Corporation). All tests were within the 95% confidence interval.

### Research results

We collected 1600 questionnaires, of which 1580 (98.6%) were effective. Online learning satisfaction was poor for 3.9% (61/1580) of participants, general for 33.2% (525/1580) participants, and good 62.9% (994/1580). Demographic characteristics and single factor analysis showed statistical significance ( $P < 0.05$ ) for age, major, academic year, family location, online status, average time attention to epidemic, whether following a regular schedule, whether bored at home, health condition, and exercise intensity. Correlation analysis of online learning satisfaction, mental status, and personal characteristics showed that fear, compulsion-anxiety, positive coping style, father's education, online status, exercise intensity, health condition, whether on a regular schedule and whether bored at home were positively associated with online learning satisfaction. Depression, neurasthenia, hypochondria, negative coping style, age, average time of attention to the epidemic were negatively correlated with online learning satisfaction. Multiple linear regression of online learning satisfaction showed online learning at schedule, strong exercise intensity, good health, regular schedule, paying attention to epidemic less than one hour, and not bored at home had positive effects ( $P < 0.05$ ) on online learning satisfaction. Depression and neurasthenia had significant negative effects on online learning satisfaction, whereas fear had positive effects ( $P < 0.05$ ). Positive coping had a significant positive effect on satisfaction with online courses, whereas negative coping had a significant negative effect ( $P < 0.05$ ).

### Research conclusions

The new theory is that this study assessed factors especially on personal characteristics, mental status, and coping style related to satisfaction with emergency online learning among college students during the COVID-19 pandemic. Little study has been focused on online acceptance of education in early time of COVID-19 pandemic. Our findings provide reference for educators, psychologists, and school administrators to conduct health education intervention.

The new method we used is the PQEEPH. This scale is specially designed for public health emergencies, it is composed of 25 items of five sub scales, depression, neurasthenia, fear, compulsion-anxiety, and hypochondria which describe the emotional status detailed and precisely.

### Research perspectives

On the basis of our methods and findings concerning factors that affect online learning satisfaction, we suggest that it will be possible to assess the effects of psychological intervention for college students during the next emergency online learning period and then formulate corresponding and mature programs.

## FOOTNOTES

**Author contributions:** Wang XY and Ni AH contributed to conception and design of the study; Jing P organized the database; Zhao Y, Zhang K, Lei DC, and Han JT collected data; Zhai XY performed the statistical analysis and write the article; All authors contributed to manuscript revision, read, and approved the submitted version.

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**Informed consent statement:** All study participants or their legal guardian provided informed written consent about personal and medical data collection prior to study enrollment.

**Conflict-of-interest statement:** Dr. Wang has nothing to disclose.

**Data sharing statement:** Technical appendix, statistical code, and dataset available from the first author at [13832346369@163.com](mailto:13832346369@163.com). Consent was not obtained but the presented data are anonymized and risk of identification is low.

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