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The influence of benefit finding on academic engagement among Chinese college students: A moderating effect model

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ABSTRACT

Objective: To explore how college students' academic engagement has changed in the outbreak of coronavirus disease 2019 (COVID-19) (hereinafter referred to as "in the outbreak"), this research will encompass more than just looking into the relationship among anxiety, benefit finding (BF) and academic engagement, but also involve evaluating how anxiety moderates the positive impact of BF on academic engagement.

Method: Among college students, this study comprised an online-based cross-sectional survey in cities where COVID-19 broke out. Convenience sampling method was used. The survey took place between November 10 and November 19, 2021, during which all the cities surveyed were in the outbreak. With language revision, scales include Student Version of the Utrecht Work Engagement Scale (UWES-S), recompiled Benefit Finding Scale (BFS) and 7-item Generalized Anxiety Disorder Scale (GAD-7), as methods for gauging the academic engagement, BF and anxiety experienced by college students, respectively.

Results: Academic engagement in the outbreak is higher than that before the outbreak stage of COVID-19 (hereinafter referred to as "before the outbreak") ($Z = -18.201$, $P < 0.001$). Between anxiety and BF, a negative correlation can be observed in the outbreak ($P = 0.001$), whereas BF and anxiety have an adverse correlation with academic engagement ($P < 0.001$). The positive effect of BF on academic engagement will be debilitated by anxiety. Further analysis shows that college students who are close to medium-and high-risk areas, worried about the infection, unvaccinated and concerned about the epidemic, are more likely to be anxious ($P < 0.001$). Those with confidence in government's ability to prevent and control the epidemic, as well as increased trust in medical workers, have a higher BF ($P < 0.001$).

Conclusions: While COVID-19 could still exert adverse effects on psychology of college students, but it can also stimulate college students to perceive the meaning of life. In the outbreak, an

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increase in academic engagement seems to be a manifestation of growth in adversity. Compared with short-term negative emotional intervention, life meaning and gratitude in education may stimulate their potential ability for a longer time.

1. Introduction

Emerging adulthood (18–30 years old) is a crucial period of development, characterized by mental health challenges, especially for undergraduates with obvious mental health problems [1]. While college students are maturing in their physical development, they are accompanied by rapid changes in psychology, unstable and greatly volatile development of emotion, and rich emotion. In this phase, college students often grapple with a variety of pressures stemming from academic demands, social obligations, and the task of charting their future course. Among them, anxiety stands out as the most widespread and significant concern, particularly among female students [2]. The epidemic has put college students under psychological pressure [3], which has resulted in approximately 40% of Chinese college students with symptoms of anxiety [4]. Alternatively, young people seem at a lower risk of experiencing severe complications related to COVID-19, who can still be psychologically affected by the epidemic in some degree [5]. And a notable rise in the occurrence of anxiety, acute stress, and depressive symptoms can be seen since the early stages of the epidemic [6]. Uncertainty and change can exacerbate feelings of tension and anxiety. Studies show that in the spring of 2020, the incidence of stress perception, disorder symptoms and alcohol intake were notably higher among college students than that before the outbreak. Moreover, concerns about the outbreak are negatively correlated with happiness. And symptoms have greatly returned to levels that before the outbreak by the autumn of 2020 [5]. It was inevitable that college students had a sense of fear and panic in the early outbreak. It has been about 2 years since the spread of the epidemic, during which time college students tend to adapt to the epidemic and the establishment of routine practices in preventing and controlling the epidemic, as well as seek support and adopt proactive coping strategies. Therefore, the negative psychological state of students in universities during the epidemic in 2021 will may be quite different from that in 2020. Implementing research at this time point holds value in foreseeing potential future mental well-being issues among college students and making proactive arrangements. Moreover, it assists in evaluating the effectiveness of societal actions taken to address mental health issues affecting students in colleges.

The psychological changes that reflected in emotions of college students can significantly affect their behavior. Grasping the psychological shifts they undergo and comprehending how emotions influence their actions is essential for delivering accurate support and assistance. The stressors caused by the epidemic for students include poor concentration, heightened apprehensions about academic achievements, and sleep disorders [7], which directly affect their learning status. Meanwhile, colleges have diversified their teaching methods, including the incorporation of online education, due to the epidemic's effects, leading to transformations in students' learning styles. There are a range of problems with online learning, such as inadequate support of academic guidance, limited access to resources, insufficient socialization, poor motivation in class, and increased stress and anxiety [8]. Over the long haul, the uncertain repercussion of COVID-19 is excessively concerned by college students on their future study and career prospects [9]. These research discoveries underscore the psychological strain and hurdles confronted by college students. Nonetheless, every medal has its own reverse, as the old adage goes. Mitigating anxiety and leading a fulfilling and purposeful life are both essential for us [10]. When the public experiences anxiety and unease, they may feel that life lacks meaning and purpose. However, by actively addressing anxiety and searching for the meaning of life, the public can lead more fulfilling and meaningful lives. While reminders of mortality can (sometimes) evoke negative and defensive responses (the "dark side"), they possess the capacity to steer individuals toward favorable life paths and produce beneficial consequences, such as assistance and forgiveness [11]. Facing death, we may come to realize the brevity and preciousness of life, leading us to cherish the present moment even more. In China, the benefit finding (BF) of patients infected with COVID-19 falls within a moderate range [12]. The positive ramification of COVID-19 extends beyond patients with COVID-19, but also on the lifestyle of college students, such as improving daily sleep and dietary habits of college students [13]. Escalated fear and anxiety can likewise have profound significance, fostering growth resulting from trauma [14]. The increase in mortality related to COVID-19 is tied to an increase in BF (e.g., relationship investments, gratitude, patience) aroused by the epidemic [11]. Many individuals have begun to value life and health more, placing greater emphasis on interpersonal relationships and social connections. They have also started to appreciate and be grateful for the things around them. The epidemic has forced people to adapt and adjust their plans at any given moment. This process of adaptation and adjustment has provided opportunities for personal growth and change, which exist in adversity may be positive. Overall, college students have received more social support, enhanced their ability to cope with difficulties, and begun to rebuild a new lifestyle over the course of the past two years amid the COVID-19. Also, they may begin to re-examine their learning goals and reset learning goals in the face of the new social situation under the background of the COVID-19. Understanding their personal evolution within the context of the changing social landscape carries importance.

Developed by American psychologist Deci Edward L. and his collaborator Richard M. Ryan, along with their colleagues, the Self-Determination Theory (SDT) offers insights into the motivational intricacies driving human self-determination behavior [15]. Some of the needs in the intrinsic motivation proposed by the theory refer to relatedness, competence and autonomy [16]. They are innate to all people, yet their significance and precedence can differ based on the individual, the circumstances, and the timing. When individuals engage in intrinsically motivated activities, they naturally improve their focus and generate more energy, with a more positive attitude. Then, they can be more conducive to make things done. When individuals engage in activities that align with their interests and values, they are inclined to feel that their actions are autonomous rather than controlled by external factors. This sense of self-determination and autonomy can promote personal growth and enhance their adaptability as well. Intrinsic motivation

characterizes pleasurable behavior and thus is manifested "for their own sake" [15]. This process is accompanied by a sense of pleasure and happiness, which does not require additional management and coordination of various elements by individual rationality. The cost is very low and the efficiency is very high. This is also why intrinsic motivation is considered a more natural and sustainable driving force. On the contrary, external motivation requires additional rational force to focus attention, adjust mentality, and create vitality to do things well. This process is costly, inefficient, and the effect is uncertain. In this situation, individuals' focus and effort are often driven by external motivation rather than intrinsic interest and values. While external motivation might initially boost individuals' enthusiasm for an activity, it can wane over time, causing a decline in their interest and drive. This underscores the need for a continuous infusion of external motivation to sustain individual engagement, which is not a viable long-term solution. In the field of student education, many researchers are exploring how to better utilize both intrinsic and extrinsic motivation to promote students' academic progress.

Changes in the mental well-being of college students are attributed to discrepancies in countries, regions and points of survey [17]. In China, there are four discernible stages in the course of COVID-19. The first phase is incubation stage. The second phase is outbreak stage. The third phase is resolution stage. And the fourth phase is stable stage. For detailed explanation, the wide-ranging distribution of the epidemic across the nation and a surge in new daily infections is described as the outbreak stage [18]. These four stages can also be used to describe the progression of an epidemic in a city, from its onset through its control. In China, our project was integrated into preventing and controlling COVID-19 in effort regularly. In our research, the survey was administered in the midst of the outbreak, which was defined as "the outbreak stage of COVID-19" (hereinafter referred to as "the outbreak"). In the outbreak, the Chinese government primarily took appropriate control measures in response to the characteristics associated with the Delta variant, which is to largely control the epidemic during a maximum incubation period [19].

In recent years, the number of articles on positive psychology had steadily grown, indicating the mounting interests of positive psychology and deeper yearning for human knowledge [20]. Our study elucidated the favorable influence of the epidemic on college students through the prism of positive psychology, contributing as a complement to the realm of positive psychology theory. To be more specific, our research delved into the following the following aspects. A close relationship among anxiety, BF and academic engagement in the outbreak has been explored. Psychological status of college students might undergo shifts in the outbreak than before the outbreak. Furthermore, anxiety, BF and academic engagement may also change accordingly. To appraise the mental wellness, adaptability and response of students in universities faced with COVID-19 in their cities, the discussion of the changes and possible correlations of these variables is necessary. Nonetheless, few research have been conducted to investigate their dynamic changes. And among college students, our study will assess the link between academic engagement, BF and anxiety in the outbreak, along with their dynamic changes with the development of the COVID-19.

2. Methods

2.1. Questionnaire composition

The self-designed items of the questionnaire in this study include the following: (1) Age, (2) Gender, (3) Education stage, (4) Majors, (5) The distance from the campus to the nearest medium- and high-risk area, (6) Have you been vaccinated, (7) Are you worried about being infected, (8) What's your attitude to follow the latest epidemic news, (9) Do you believe that the local government has the ability to control the epidemic, (10) Do you have more trust in the medical staff when you see the efforts made by them to fight the epidemic? The majors covered 12 disciplines in China. Social science includes 8 disciplines, which are literature, history, law, philosophy, pedagogy, economics, management, art. Natural science includes 4 disciplines, which are science, engineering, agriculture and medicine. The main part of the questionnaire is composed of scales with language revision, which are Student Version of the Utrecht Work Engagement Scale (UWES-S), Benefit Finding Scale (BFS) and Seven-item Generalized Anxiety Disorder Scale (GAD-7). (Appendix 1).

2.2. The formal investigation

The questionnaire came from the questionnaire that had been developed previously and distributed in Guangzhou, which had a good reliability and validity. Language revision was made to the items of the questionnaire. With the aim of mitigating the potential for virus spread by avoiding contact and to take into account the restrictions on the access of local school personnel, on the platform of "Questionnaire Star" (https://www.wjx.cn), electronic questionnaires were produced and administered online. The questionnaire responses were kept private. And respondents filled it out voluntarily and their right to privacy was protected. All respondents should confirm their informed consent before formally answering the questions. Subsequently, they can proceed to respond to questions. Questionnaires were distributed across various cities, encompassing Beijing, Dalian, Chengdu, Lanzhou, Zhengzhou, Shangrao, Heihe, strategically spanning different directions within China. The survey period extended from November 10 to November 19, 2021, when all the surveyed cities were in the outbreak. Through convenient sampling method, 3732 questionnaires were collected and 124 questionnaires were excluded for the answer time of them was less than 150 s. According to the quality control standard (as is shown below), 3602 valid questionnaires and 130 invalid questionnaires were screened. 73 questionnaires were excluded for the incorrect answers to common sense questions. 7 questionnaires were excluded for repeated responses. 50 questionnaires were omitted for the respondents' IP address were not consistent with the city filled by them). Finally, the questionnaire's effective rate was 96.52%.

2.3. Quality control

By means of the "questionnaire star" platform's VIP functionality, the system automatically removed the questionnaire with an answer time of less than 150s. It locked the IP address of the respondents, and only respondents in Beijing, Dalian, Chengdu, Lanzhou, Zhengzhou, Shangrao and Heihe can fill in the questionnaire on the online platform. Screening items (common sense question: Ambulance emergency call) should be answered correct. The displayed IP address should be consistent with the city filled in by the respondents. According to the personal identification code (initial letter of their name plus the ultimate quartet of mobile phone digits), IP address, major, gender, age and education stage filled in, an assessment would be conducted to ascertain if the questionnaire had been completed by the same individual multiple times. Age and educational stage should be matched. Respondents would be stopped from answering the questions if they were identified as "non-college students" before filling out the questionnaire. BFS is designed with reverse scoring items.

2.4. Instruments

2.4.1. GAD-7

GAD-7 has a total of 7 items (Cronbach's $\alpha = 0.92$), which is commonly employed in scientific investigation and clinical application [21]. Employing a four-point Likert scale, options of GAD-7 (never, a few times, more than a week, almost daily) were assigned a score of 1–4 when the respondents filled in the questionnaire online. Based on the classification standard of GAD-8, responses to GAD-7 items (never, a few times, more than a week, almost daily) were scored 0 to 3 when calculating the total score, yielding a comprehensive score range from 0 to 21. A score within the range of 0–4 signifies no anxiety, while 5 to 9 signifies mild anxiety. Within the 10 to 14 point range, there is an indication of moderate anxiety. Severe anxiety is signified by any score exceeding 15 [22]. Scenario limitations have been incorporated into the original scale to enhance respondents' ability to perceive substitution, such as "The current epidemic in my city has made me feel nervous, anxious or on edge.". (Appendix 2).

2.4.2. BFS

Considering that learning is the main state of college students, BFS is needed. Based on the Benefit Subscale developed by Cheng et al., BFS was recompiled [23]. The recompiled BFS has 3 topics: (1) The recurring epidemic has made me more aware of the meaning of my work or study; (2) The recurring epidemic has made me realize that I have to do more meaningful and valuable things; (3) The recurring epidemic has made me have a clearer plan for my future life and study (work). With Likert 5-point scale reverse scoring (5–1 points), The options presented in a sequential manner, which include fully disagree, moderately disagree, uncertain, moderately agree, fully agree. Within the BFS assessment, the total score can be anywhere from 3 to 15, and lower scores correspond to higher levels of BF (Appendix 2).

2.4.3. UWES-S

UWES-S developed by Wilmar Schaufeli and Arnold Bakker has a total of 17 questions, including vigor, dedication, and absorption, with Cronbach's α as 0.78, 0.84 and 0.73, respectively [24]. On the basis of various UWES-S and epidemic factors, UWES-S was recompiled to 3 items: (1) In the outbreak, I can experience happiness when I concentrate on learning; (2) In the outbreak, I can be energetic and continue to study for a long time; (3) In the outbreak, I can concentrate and am not easy to be distracted when studying. The options are sorted in sequence: never, almost never, rarely, sometimes, often, very often and always, with seven-point Likert scale (1–7 points). Items of UWES-S before and in the outbreak were set up respectively (Appendix 2).

2.5. Statistical analysis

P–P plots and histograms were used to test whether the continuous variables obey the normal distribution. For non-normally distributed data, quartiles were employed. To assess the correlation between two variables displaying non-normal distributions, Spearman's rank correlation test was utilized. When the samples within each group did not satisfy the assumptions of variance's normality and homogeneity, Kruskal-Walli's test was employed to evaluate whether multiple sample groups originated from the same population with respect to their medians. Subsequently, the level of significance for post hoc comparisons was adjusted via using the method of Bonferroni. To analyze differences between the two groups of continuous variables in a paired design, the Wilcoxon Signed Ranks Test was utilized. The Mann-Whitney *U* test was employed to perform a rank sum test for comparing two independent samples.

2.6. Analysis of moderating effect

Analysis of moderating effect was used to test whether the influence degree of X on Y would be significantly different when the moderator M varied across the course of how the independent variable X affected the dependent variable Y. In cases where the moderator was a continuous variable, standardization was applied to the independent variable, dependent variable, and moderator, and the hierarchical regression analysis was performed, whose equation were $Y = aX + bM + e1$ and $Y = aX + bM + cXM + e2$. The coefficient of determination R1 could be obtained by doing the regression of Y on X and M, and by doing the regression of Y on X, M and XM, R2 could be obtained. A significant moderating effect was established if R2 exhibited a statistically significant increase compared to R1. Alternatively, the linear regression coefficient test of XM could be chosen, if c was significant, then the moderating effect was significant.

2.7. Analysis of reliability and validity

2.7.1. Validity analysis

Considering that scales were language revised according to the epidemic's situation, each of them underwent exploratory factor analysis (EFA) to uncover the dimensions inherent to the scales. The EFA for GAD-7 incorporated the employment of maximum variance rotation, whose KMO value was 0.926 ($P < 0.001$). Its common factor, which had an eigenvalue greater than 1, was able to clarify 69.793% of the variation. By the same method, the KMO value of UWES-S in the outbreak was 0.710 ($P < 0.001$). With a common factor exhibiting an eigenvalue surpassing 1, it was possible to account for 72.519% of the variation. Before the outbreak, KMO value of UWES-S was 0.703 ($P < 0.001$),whose common factor with a characteristic value greater than 1 could explain 76.566% of the variation. The KMO value of BFS was 0.713 ($P < 0.001$). Its common factor, which possessed an eigenvalue greater than 1, could account for 76.986% of the variation.

2.7.2. Reliability analysis

Reliability analysis were used to test consistency of the items in the scales. The GAD-7 had a Cronbach's α of 0.927. The BFS demonstrated a Cronbach's α of 0.850. A Cronbach's α of 0.801 was calculated for UWES-S. Before the outbreak, UWES-S exhibited a Cronbach's α of 0.847. Each item within the mentioned scales displayed a great degree of consistency.

3. Results

3.1. Demographic characteristics

Among those surveyed in this study, the median age was 20 years. The postgraduate stage includes master's classification and doctoral classification. College students and undergraduates were the majority in this survey. 86.6% of the students in the campus were far away from the nearest medium-and high-risk area (distance more than 5 km). The students who had received the second or third dose accounted for 83.2%. The number of people who paid active attention to the epidemic situation was similar to that of those who paid passive attention to the epidemic situation. 31.7% of college students were worried that they would be infected. As a result of seeing the efforts made by medical staff to fight the epidemic, 74.4% of college students had increased trust in them. 91.3% of the students believed that the local government had the ability to control the epidemic [insert Table 1].

Table 1
Demographic characteristics of the students (N = 3602) N (%) = number (percentage).

Items	N (%)
Age	
≤20-years-old	1818 (50.5)
>20-years-old	1784 (49.5)
Gender	
Male	1761 (48.9)
Female	1841 (51.1)
Education stage	
Junior college student	1750 (48.6)
Undergraduates	1802 (50.0)
Postgraduates (including masters and doctors)	50 (1.4)
Majors	
Natural science	1958 (54.4)
Social science	1644 (45.6)
The distance from the campus to the nearest medium- and high-risk area	
Long distance (>5 km)	3118 (86.6)
Short distance (≤5 km)	484 (13.4)
Have you been vaccinated	
No	202 (5.6)
Have received the first dose	404 (11.2)
Have received the second or the third dose	2996 (83.2)
Are you worried about being infected	
Yes	1142 (31.7)
No	2460 (68.3)
What's your attitude to follow the latest epidemic news	
Active	1619 (44.9)
Passive attention (only be mentioned)	1561 (43.3)
No	422 (11.7)
Do you have more trust in the medical staff when you see the efforts made by them to fight the epidemic?	
Yes	2681 (74.4)
No	921 (25.6)
Do you believe that the local government has the ability to control the epidemic	
Yes	3289 (91.3)
No	313 (8.7)

The option before the outbreak was the result recalled by the respondents. In order to guide the respondents to make a conscious comparison and evaluation, the items of UWES-S before and in the outbreak were set as matrix questions. Through Wilcoxon Signed Ranks Test, it was found that before and in the outbreak, the Z values of the items and total scores of UWES-S were -3.450 ($P < 0.01$), -15.197 ($P < 0.001$), -28.363 ($P < 0.001$) and-18.201 ($P < 0.001$), respectively. Among them, test of happiness from learning was based on positive rank, and the tests of others were based on negative rank. Combined with the median and rank mean, happiness from learning in the outbreak was lower than that before the outbreak, but the persistence and concentration of learning in the outbreak were higher than that before the outbreak. Generally speaking, academic engagement in the outbreak was higher than that before the outbreak [insert Table 2].

3.2. Analysis of the influence of demographic variables on BF and academic engagement (in the outbreak)

The outcome of Mann-Whitney U test revealed that in the outbreak, the academic engagement of college students older than 20 years old was higher than that of college students less than 20 years old ($Z = -8.747$, $P < 0.001$). Higher levels of academic engagement and BF were observed in female college students in contrast to their male counterparts ($Z = -14.838$, -6.334, $P < 0.001$). The BF and academic engagement of college students majored in social science were higher than those of college students majored in natural science ($Z = -4.007$, -5.628, $P < 0.001$). College students at different education stages exhibited noteworthy disparities in BF ($H = 6.124$, $P = 0.047$). Pairwise comparison showed that the BF of postgraduates was higher than that of junior college students (adjusted $P = 0.042$). The academic engagement and BF of college students with long distance from the campus to the nearest medium- and high-risk area (>5 km) was higher than that of college students with short distance (≤5 km) ($Z = -6.013$, -4.371, $P < 0.001$). [insert Table 3].

3.3. The moderating influence of anxiety in BF and academic engagement (in the outbreak)

By means of Spearman correlation analysis, it was found that anxiety and BF had a significant negative correlation ($P = 0.001$), alongside a favorable correlation existing among anxiety, BF and academic engagement ($P < 0.001$). [insert Table 4].

Age, gender, majors and distance from the campus to the nearest medium- and high-risk area were taken as control variables, BF as independent variable, academic engagement as dependent variable and anxiety as moderator. To examine how anxiety moderated the impact of BF on academic engagement, hierarchical regression analysis was utilized. The multilinear regression model was statistically significant ($F = 87.083$, $P < 0.001$). As far as Model 4 is concerned, the control variables, BF, anxiety and anxiety × BF could explain the total variation of the dependent variable (academic engagement) by 26.5%. The R-square value of the Model 4 was greater than the first three models, and anxiety had an obvious moderating effect. The residual of the experimental data obeyed the normal distribution [insert Table 5].

From perspective of the standardized regression coefficient, the beta coefficient of BF was positive, while the beta coefficient of anxiety × BF was negative, which was meant that BF positively affected academic engagement, and anxiety diminished the beneficial impact of BF on academic engagement [insert Table 6].

A simple slope diagram illustrating the moderating effect was generated based on the findings from the regression analysis. As is shown in Fig. 1, the moderating effect of low-level anxiety is stronger than that of high-level anxiety, which means that students with low-level anxiety have a stronger positive impact on academic engagement. Comparatively speaking, students' high level of anxiety can weaken the positive effect of BF on their academic engagement [insert Fig. 1].

Based on the findings of regression analysis, the path map of moderating effect is established. Anxiety exerts an adverse influence on the association between BF and academic engagement, with a significant negative moderating effect [insert Fig. 2].

3.4. Further analysis

According to the classification standard of GAD-7, there were 1329 students without anxiety (36.9%), 1207 students with mild anxiety (33.5%), 777 students with moderate anxiety (21.6%) and 289 students with severe anxiety (8.0%).

The anxiety among college students whose distance from campus to middle and high-risk areas was less than 5 km was higher than that of students whose distance from campus to middle and high-risk areas was more than 5 km ($Z = -10.241$, $P < 0.001$). Students who expressed concerns about infection tended to exhibit a higher likelihood of anxiety compared to those who did not ($Z = -12.877$, $P < 0.001$). College students who had received different doses of vaccination displayed significant disparities in their levels of anxiety ($H = 329.813$, $P < 0.001$). After the post hoc comparison, it was found that the anxiety of unvaccinated college students was higher than that of vaccinated students (including one dose, two doses, three doses). The anxiety of college students received one-dose vaccine

Table 2
Changes in academic engagement before and in the outbreak.

	Happiness from learning	Persistence of learning	Concentration of learning	Academic engagement
Before the outbreak M (P_{25}, P_{75})	5.00(4.00, 6.00)	5.00(3.00, 6.00)	4.00(3.00, 5.00)	14.00(11.00, 16.00)
In the outbreak M (P_{25}, P_{75})	5.00(3.75, 6.00)	5.00(4.00, 6.00)	5.00(4.00, 6.00)	15.00(12.00, 17.00)
Z	−3.450	−15.197	−28.363	−18.201
P	<0.01	<0.001	<0.001	<0.001

Table 3
Comparison of benefit finding and academic engagement between different demographic characteristics (in the outbreak).

Groups		Academic engagement (in the outbreak)			Benefit finding		
		M (P_{25}, P_{75})	*Z*/H	*P*	M (P_{25}, P_{75})	*Z*/H	*P*
Age	≤20-years-old	14.00 (12.00,17.00)	−8.747	<0.001	11.00 (9.00,13.00)	−1.564	0.118
	>20-years-old	15.00 (13.00,18.00)			12.00 (9.00,13.00)		
Gender	Male	14.00 (11.00,16.00)	−14.838	<0.001	11.00 (9.00,13.00)	−6.334	<0.001
	Female	16.00 (13.00,18.00)			12.00 (10.00,13.00)		
Major	Nature science	15.00 (12.00,17.00)	−4.007	<0.001	11.00 (9.00,13.00)	−5.628	<0.001
	Social science	15.00 (12.00,18.00)			12.00 (10.00,13.00)		
Education stage	Junior college student	15.00 (12.00,17.00)	3.551	0.169	11.00 (9.00,13.00)	6.124	0.047
	Undergraduates	15.00 (12.00,18.00)			12.00 (9.00,13.00)		
	Postgraduates (including masters and doctors)	15.00 (13.00,19.00)			12.50 (10.00,14.00)		
Distance from the campus to the nearest medium- and high-risk area	>5 km	15.00 (12.00,18.00)	−6.013	<0.001	12.00 (9.00,13.00)	−4.371	<0.001
	≤5 km	14.00 (11.00,17.00)			11.00 (9.00,13.00)		

Table 4
Correlation among anxiety, benefit finding and academic engagement (in the outbreak).

	Anxiety	Academic engagement	Benefit finding
Anxiety	1.000	−0.236**	−0.056**
Academic engagement	−0.236**	1.000	0.347**
Benefit finding	−0.056**	0.347**	1.000

**: $P < 0.01$.

Table 5
Fitting degree of regression model.

Variables	R	R square	Adjusted R square	△R square	F	*P*
Control variable	0.297	0.088	0.087	0.088	87.083	<0.001
Anxiety	0.415	0.173	0.171	0.084	366.260	<0.001
Benefit Finding	0.512	0.263	0.261	0.090	439.234	<0.001
Anxiety × Benefit Finding	0.516	0.266	0.265	0.004	17.599	<0.001

Table 6
Coefficient test of regression equation[a].

Items	Unstandardized Coefficients		Standardized Coefficients	t	*P*	Collinearity Statistics	
	B	Std. Error	B			Tolerance	VIF
(Constant)	−0.368	0.027		−13.684	<0.001		
Age	0.200	0.029	0.100	6.965	<0.001	0.987	1.013
Gender	0.558	0.032	0.279	17.697	<0.001	0.822	1.216
Distance from the campus to the nearest medium- and high-risk area	−0.143	0.043	−0.049	−3.354	0.001	0.962	1.039
Majors	−0.001	0.031	−0.001	−0.043	0.966	0.850	1.176
Anxiety	−0.282	0.015	−0.282	−18.524	<0.001	0.882	1.134
Benefit finding	0.306	0.014	0.306	21.082	<0.001	0.972	1.029
Anxiety × Benefit finding	−0.058	0.014	−0.060	−4.195	<0.001	0.997	1.003

[a] Dependent variable: academic engagement in the outbreak.

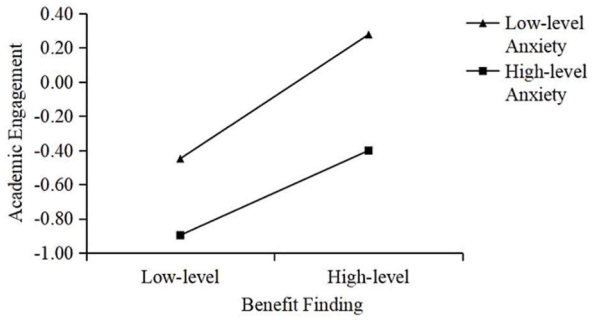

Fig. 1. Simple slope plot of moderating effect. The straight lines at both ends of the triangle indicate the relationship between low-level of benefit finding and academic engagement; the straight lines at both ends of the square indicate the relationship between high-level of benefit finding and academic engagement.

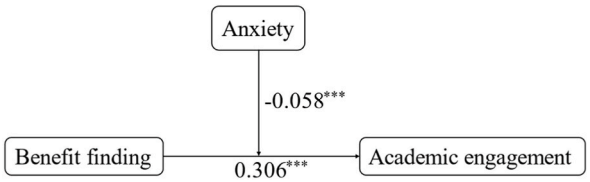

Fig. 2. Moderating effect roadmap. *** means $P < 0.001$.

was higher than that of college students received two-dose vaccine and three-dose vaccine (adjusted $P < 0.001$). From the perspective of the attitude to pay attention to the current epidemic situation, statistical disparities in college students' anxiety levels were observed ($H = 185.386$, $P < 0.001$). After the post hoc comparison, the study indicated that anxiety remained similar among college students who paid no attention and those who paid passive attention, with no significant difference (adjusted $P < 0.001$). The anxiety among college students who pay active attention was higher than those who pay attention passively and did not pay attention at all (adjusted $P < 0.001$). In the college student cohort, higher levels of BF were observed in those who had faith in the government, in contrast to those who did not ($Z = -3.587$, $P < 0.001$). Higher levels of BF were observed in them who greatly trust in medical staff, in contrast to those who did not ($Z = -5.937$, $P < 0.001$). [insert Table 7].

Table 7
Comparison of benefit finding and anxiety between influencing factors.

Anxiety				
Influencing factors	Groups	M (P_{25}, P_{75})	*Z/H*	*P*
Distance	>5 km	13.00(10.00,17.00)	−10.241	<0.001
	≤5 km	16.00(12.00,20.00)		
Worried about being infected.	Yes	15.00(11.00,19.00)	−12.877	<0.001
	No	12.00(10.00,16.00)		
Vaccination	No	19.00(17.00,23.25)	329.813	<0.001
	received first dose	15.00(12.00,20.00)		
	Received second or third dose	12.00(10.00,16.00)		
The attitude to the current epidemic situation	Active attention	15.00(11.00,18.00)	185.386	<0.001
	Passive attention (only be mentioned)	12.00(9.00,16.00)		
	No	12.00(10.00,15.00)		
Benefit finding				
Influencing factors	Groups	M (P_{25}, P_{75})	*Z*	*P*
Trust medical staff	Improved	12.00(9.00,13.00)	−5.937	<0.001
	Not improved	11.00(9.00,13.00)		
Trust the government	Yes	12.00(9.00,13.00)	−3.587	<0.001
	No	11.00(8.00,13.00)		

4. Discussion

4.1. Anxiety and BF

According to SDT, motivational sources for controlling behavior can include external stimuli, perceived value, and interests. The impact of the epidemic on studies and employment is an external stimuli. Intrinsic motivation is weakened when external incentives or threats are given to an ongoing intrinsically motivated activity. Students who perceive themselves as being at a substantial risk of infection and those who experience significant repercussions from the epidemic show increased anxiety levels [25]. Students in proximity to the outbreak's epicenter or in high-risk areas have direct feelings about the epidemic, showing ripple effects on risk perception and anxiety. They may become more vigilant and attentive to the epidemic's dynamics, taking more cautious protective measures to safeguard their own and others' health. This vigilance and sense of responsibility help reduce the risk of epidemic transmission and maintain the overall health and safety of society. Students residing well away from the outbreak's epicenter or in low-risk areas will view the epidemic from a bystander perspective, and the information they receive is often from news reports or social media, rather than personal experience, which leads to less negative emotions, rational psychology and more BF. They may see the side of people's anti-epidemic efforts and unity in cooperation, and derive a positive BF from it. Furthermore, their attention to the epidemic may be more focused on caring for and supporting others, such as helping regions and populations that are more severely affected by the outbreak through donations, volunteering, and other means. They may become more appreciative of their health and time, pay greater attention to societal issues and public interests, and also prioritize their family and friends more. These positive gains can assist college students in better coping with future challenges and difficulties. The apprehension of contracting an infection is notably linked to elevated anxiety [26]. Positive and negative emotions generated by perceptions of health risks may affect students' academic engagement [27]. When students experience risk and anxiety, they may have difficulty concentrating on their studies, as their attention can become scattered. Vaccines are an important means of preventing infection, and unvaccinated students have a higher perception of health risks. Findings from studies suggest that anxiety levels are typically higher among non-freshman students and individuals who dedicate over an hour daily to seeking for COVID-19 information [28]. This implies that both age and the frequency of monitoring epidemic information affect students' the psychological state in college, subsequently impacting their level of academic engagement. Older students may approach the epidemic with greater calm and rationality, and be better equipped to manage their emotions. Professional sentiment of medical staff in saving lives and helping the wounded in the outbreak has inspired contemporary college students to ponder the meaning of their lives. And college students' improved trust in medical staff makes them have a higher BF. The rapid control of sudden outbreak can improve the confidence of college students in the capacity of government to prevent and control the outbreak, and can promote college students to comprehend the meaning of life reflected in the epidemic prevention and control. When they see the efforts of the government and society effectively controlling the epidemic, reducing the number of infections and deaths, they may gain a heightened awareness of the significance of preventing and controlling the epidemic in safeguarding people's lives and well-being. When they witness effective control of the epidemic, college students may have a stronger belief in success to overcome the virus through scientific research and the efforts of medical staff. This belief can help ignite their motivation to learn and their desire to explore, encouraging them to engage in studies related to the field. The differences in academic engagement and BF between students majored in natural science and social science, as well as male and female, can be explained by the differences in behavior habits and values caused by the way of thinking. Social science students may be more inclined to prioritize collaboration with others and show greater concern for societal issues, whereas natural science students may place more emphasis on logical reasoning and empirical observation. Men may tend to focus more on theoretical analysis and technical aspects of problem-solving, while women may place a higher emphasis on practical applications and collaboration with others. Nonetheless, it is crucial to recognize that every individual has their unique personality and interests. These should not be simplified by attributing them solely to specific gender or academic characteristics.

4.2. Academic engagement

There exists a positive correlation between symptoms of mental distress and academic frustrations [29]. For students who have switched to online classes, there are many important factors that interfere with the effect of online learning, including poor internet connection [30], lack of interaction with teachers and students [31], and an unfavorable home-based learning environment [32]. According to conventional thinking, attention in leaning will be distracted by the infection of COVID-19. Interestingly, our research has found that academic engagement in the outbreak was actually higher than before the outbreak. We believe that this change comes from the internalization of external motivation, which effectively improves the effect of learning. Under these circumstances, students grasped the significance and worth of learning, translating it into self-motivated initiatives. After the implementation of epidemic prevention and control for about two years, colleges and universities have more experience in managing emergencies. The universities enhanced its services and support for students, providing necessary material assistance and medical guidance, ensuring the students' well-being in the campus environment. With various support of the college, including humanistic care, service guarantee and material reserves, students can adapt more swiftly to the implications of COVID-19, bolstering their psychological resilience. This care and support can enhance students' sense of belonging and self-worth, assisting them in better coping with the challenges and pressures brought about by the epidemic. With an in-depth understanding of the epidemic, college students show a rational and peaceful attitude, and the vast majority of students show no anxiety or mild anxiety. They may have a more accurate assessment of the risks associated with the epidemic and base their judgments and decisions on professional information and scientific evidence. This rational and composed mindset can help students in college better control unnecessary panic and anxiety, facing the epidemic with a calmer

attitude. They may be more inclined to take protective measures based on professional advice and official guidance, maintaining good hygiene practices, and ensuring personal protection. The overall psychological status of college students has changed from the state of acute stress, anxiety and depression that increased significantly at first to the state of coexistence of anxiety and rationality [6]. College students may gradually adapt to this new learning and lifestyle, and develop more mature coping strategies. Judging by the internal behavior of the students and negative emotions, such as tension, anxiety. Fear will affect their academic engagement, and their happiness of learning will be reduced. From the perspective of environmental factors, affected by the epidemic, it is difficult for small and medium-sized enterprises to survive, the demand for recruitment market is declining, and the employment pressure of graduates is increasing. The higher the grade and age, the closer the time to graduation and work, the driving effect of employment pressure on learning becomes greater. Students realized the need to prepare and compete to meet the demands of the job market. Employment pressure fostered students' awareness of the job market and drove them to pay more attention to the cultivation of employment-related knowledge and skills. Under the influence of factors such as employment pressure, academic pressure in the middle of the semester and other factors, focus and persistence in learning is promoted.

4.3. The relationship among anxiety, BF and academic engagement

College students are deficient in the experience reserve to navigate substantial public health emergencies. Lack of experiential reserves may lead college students to feel uncertain and powerless when dealing with unexpected events. This sense of uncertainty and powerlessness can lead to anxiety and panic. The pressure and restrictions related to the epidemic expose college students to greater mental health risks, which may seriously damage their academic performance [33] and test their self-discipline and self-study ability. Our research also confirms the negative effect of anxiety on academic engagement. According to SDT, it divides motivation into extrinsic and intrinsic motivation, and shows that extrinsic motivation can be integrated into a self-feeling, which is called internalization process. A meaningful life can serve as a buffer against anxiety and fight fear, which can also improve health [11]. A meaningful life can also offer a favorable psychological state, such as hope and happiness. A life filled with meaning can also strengthen our social relationships. Connecting with others, sharing experiences and feelings, can provide emotional support and social support, further mitigating the negative effects of anxiety and fear. In the outbreak, a considerable number of individuals grappled with the constraints imposed by lockdown measures, leading to feelings of fear, insecurity, and loneliness. Conversely, the unexpected "additional time" provided an opportunity for people to acquire fresh experiences, ponder upon life's essentials, and develop a heightened awareness of nature and relationships [34]. As a student, the most direct manifestation of the increase in BF may be reflected in learning. Intrinsic motivation is associated with students' success and well-being, while personal worth is highly associated with persistence [35]. Personal values can provide students with a clear direction, helping them understand why they should strive to learn and view education as a means of self-realization and personal growth. Through it, students can acquire important insights into coping with setbacks, tackling challenges, and nurturing self-growth. Our research findings corroborate that high levels of anxiety can inhibit the positive effect of BF on academic engagement. When students are capable of linking their education with their individual values and life aspirations, realizing that their efforts are important for achieving these meanings and objectives, they will experience a stronger commitment and motivation. However, high levels of anxiety can interfere with students' ability to translate this motivation into action. In addition to preventive measures, factors such as the cultural, social, and economic environment of the city can also potentially influence college students' levels of anxiety and their experiences of BF, thereby impacting their academic engagement.

4.4. Countermeasure

4.4.1. Eliminate negative psychology

There seems to be a "ripple effect" on risk cognition and anxiety among students in areas with different epidemic situation, and students in these areas should be given priority to psychological guidance. While the majority of individuals may not necessitate extensive psychological care, they can still benefit from interventions that assist them in reconstructing a sense of life's purpose. Colleges can encourage students to establish positive lifestyle habits, such as engaging in appropriate outdoor activities, maintaining social connections, and participating in mental health practices. These activities can assist students in developing a positive mindset and boosting their self-confidence, enabling them to better confront various challenges in life. Furthermore, they can also aid students in building healthy interpersonal relationships, thus allowing them to adapt more effectively to the ever-changing social environment. In instances of greater severity, more comprehensive psychological support becomes imperative [14]. Individuals with obvious mental health distress who have had mental health issues need to be found and targeted to provide them with online or telephone counseling services. Counselors can also strengthen their connection with students to identify these individuals and promptly improve their mental health. Additionally, colleges can create occasions for mental health involvement, such as lectures, seminars, and collective discussions, with the intention of deepening students' grasp of mental health challenges and presenting potential remedies. The more social support, the lower the level of anxiety [3]. College students are easily induced by all kinds of negative information. In order to prevent students from being immersed in the negative information in the virtual world for a long time, it is essential to establish a positive social support system, especially to give full play to the advantages of peer assistance. Colleges can encourage students to participate in offline team activities and social events to promote their interaction. Students can also form activity groups on their own, building relationships of mutual assistance and support. These activities provide students with the opportunity to showcase their talents and interests while also promoting emotional expression through teamwork and social interaction. Social media platforms should likewise disseminate information grounded in scientific research and substantiated evidence [36]. College students who received two or three doses of vaccine have the lowest level of anxiety. Individuals who remain unvaccinated, including guardians,

exhibit a greater propensity to experience psychological anxiety when contrasted with those who have received vaccinations [37]. The government, universities and the media should encourage the strengthening of vaccination to eliminate the root causes of anxiety. Online learning can be used as a supplement to face-to-face education, but cannot replace it [31]. Compared with online learning, college students prefer face-to-face learning [38]. Colleges and universities should make clear which courses are suitable for online learning and which courses are suitable for offline learning, and actively explore online and offline mixed teaching. On one side, online learning is suitable for those who primarily engage in self-directed learning and theoretical knowledge acquisition through textbooks, without the need for hands-on practice. On the flip side, face-to-face teaching is more appropriate for courses that require experiments and on-site investigations. Adapting various teaching methods and technological tools flexibly, according to the characteristics of the curriculum and the needs of students, can enhance the quality of instruction and the effectiveness of student learning. Furthermore, it is imperative for colleges and universities to bolster collaborative learning and student interaction, augmenting their passion for subject-based course engagement [39], which can ensure the effect of online learning.

4.4.2. Strengthen positive psychology

Fighting with the epidemic is a rare experience and sharpening for contemporary college students. While the sensation of awe or gratitude may not act as a direct buffer against life's challenges, it does facilitate the recognition of positive elements amid challenging circumstances [40]. Despite many challenges, students can gain valuable experiences and skills from them through adaptation and growth, laying a solid foundation for their future life development. Colleges should set up educational programs aimed at navigating the outbreak or unforeseen crises, which can improve adaptability of students and foster positive academic emotion so as to offset the epidemic's detrimental influence on their learning experiences and cultivating a heightened motivation for learning [27]. Through the study of these courses, students can better adapt to sudden epidemics or unexpected crisis events, enhance their adaptability and psychological resilience, and meanwhile, develop positive academic attitudes. Colleges should combine positive psychology with gratitude in education, pay attention to stimulating college students' potential ability, cultivate their positive mentality, and guide them to use a more positive mentality to solve academic and employment problems. Colleges can implement this educational approach through offering relevant courses, organizing related activities, and providing individual counseling, among other methods. Life crafting interventions in search of the meaning of life may help guide people through this grief-like process [14]. Some scholars have proposed that the meaning of life can be better found and discovered through the process of "life crafting interventions". Such interventions encompass the exploration of values and passions, introspection on current and prospective skills and habits, contemplation of present and future social connections, pondering possible career trajectories, outlining an ideal future, formulating specific goals and "if-then" plans, and publicly committing to set goals [10]. Colleges should encourage students to discover their strengths and potential, cultivate their optimistic and confident mindset, and learn to appreciate and give back to society. When facing epidemics and crisis events, various sectors of society have shown tremendous concern and support. Students should learn to be grateful and reciprocate to society through their actions. As individuals, students can harness adversity to learn and evolve, leveraging gratitude, patience, appreciation, and self-investment [11], re-find the rhythm of learning and life, and save the strength to grow. Specifically, gratitude can help students cherish the people and things around them. Patience can enable them to better understand their own and others' limitations, allowing for personal and collective growth over time. Appreciation can lead students to pay more attention to the beauty in life, enhancing their sense of happiness and satisfaction. Investing in oneself and others can facilitate continuous learning and the establishment of closer interpersonal relationships for students. These positive attitudes and behaviors will accumulate the power for students' growth and facilitate their personal development and success. Possessing a clearly defined life purpose has been associated with advantageous impacts on both mental and physical well-being [10]. The aim of students to study hard is to get a good job. Of course, it would be even better if one can achieve their career development and life values. When students realize that diligent learning is closely related to their future career development, they are inclined to devote extra time and effort towards enhancing their academic performance and honing their professional skills. Furthermore, clear career goals can help students better plan their learning and career development paths, enabling them to selectively choose specialized courses and engage in internships, practical experiences, and other activities to enhance their employability. Therefore, active promotion of online job opportunities by the government is crucial. Meanwhile, colleges should strengthen employment guidance, support graduates to achieve multi-channel employment, and enhance their employment confidence after graduation. They can also organize industry mentors or successful alumni to share their experiences, helping graduates understand industry trends and employment requirements in different social contexts.

5. Implications

Our research presents significant advantages. To begin with, this study serves not only as an augmentation of existing literature but also as a substantial extension thereof. It takes a positive psychology perspective to delve into the academic engagement of college students. It sheds light on the favorable repercussions of COVID-19 on their well-being, an aspect previously overlooked. In addition, it contributes to the enhancement of theoretical models pertaining to academic engagement in the outbreak, as well as the principles of positive psychology. This holds immense importance in terms of intervening and preventing psychological challenges among college students in the outbreak. It can assist college students across multiple dimensions, encompassing the enhancement of academic engagement, mitigation of anxiety, and the rebuilt of their life meaning and mental wellness. It bears invaluable guidance in steering college students towards improved learning, living, and professional trajectories. This research provides a valuable framework for intervening in the negative emotions of college students and cultivating a positive perception of the meaning of life among college students, which is not only from a perspective of negating negative psychology, but also from a perspective of championing the establishment of positive psychological paradigms. College students should surmount immediate anxiety and overcome emotional

impediments that hinder academic engagement, but also to fortify their long-term BF and stimulate the internal driving force of learning.

6. Conclusions

Although it has been about 2 years since the spread of the epidemic, perceived risk of infection from college students are still the inducing factors of anxiety. College students with increased confidence in the government's ability to prevent and control the outbreak and increased trust in medical staff, have a higher BF. The beneficial actions of the government and medical staff instill a sense of security, trust, and support in students, allowing college students to focus more on their studies and personal growth, reducing anxiety and stress. Adversity can unlock an individual's inner potential and foster a positive mindset, prompting individuals to develop stronger adaptability and crisis management skills. The epidemic is instrumental in fortifying college students' resilience, along with a simultaneous increase in their academic engagement in the outbreak seems to be a manifestation of growth in adversity. Both academic pressure and employment pressure may play a driving role. In the outbreak, there existed an unfavorable correlation between academic engagement and anxiety, while BF was positively correlated with academic engagement, which was statistically significance. The moderating effect of high-level anxiety can inhibit the positive effect of BF on academic engagement. The outbreak may still produce negative psychology in the city, but it should also be seen that the epidemic can stimulate college students to perceive the sense of meaning. This sense of purpose makes college students more focused on their own learning and growth, and they may be inclined to apply and address the knowledge they have acquired through proactive actions. This paper suggests that measures should be taken at the same time from the two aspects of eliminating negative psychology and establishing positive psychology. College students should not only overcome immediate anxiety and eliminate emotional obstacles that hinder learning, but also enhance the long-term BF and stimulate their internal driving force of learning. Of course, compared with short-term negative emotional intervention, education of life meaning and gratitude may promote college students to maintain a positive attitude and stimulate their potential ability for a longer time. Various sectors of society can provide support and guidance to help college students translate this sense of purpose into concrete actions and offer them more opportunities and resources for their future development.

7. Limitations

In order to reduce the heterogeneity of the sample, the selection of the sample should take into account not only the similar progress of the epidemic in the city, but also the selected city in the same period of time. Therefore, the choice of the city must have some limitations. But fortunately, this study expanded the sample size, and the sample covered many cities. This paper establishes stringent quality control criteria, which have been well-validated in previous similar studies. Through careful sample selection and statistical analysis, it minimizes this influence to the greatest extent possible. Furthermore, in the interpretation and inference of the results, this paper also prudently considers the potential impact of sample heterogeneity and provides corresponding discussion and explanations. Secondly, this study uses the recall results as the data of pre-coronavirus. Although the questionnaire design used matrix questions and artificial markers to make it convenient for respondents to fill in the front and back questions, but the recall results will inevitably deviate from the real results. The recall results may be influenced by various factors (such as time, memory capacity, emotions, etc.), leading to a certain degree of deviation from the actual situation. However, in the absence of other more direct and objective measurement methods, recall results can serve as an effective alternative to pre-epidemic data. This study conducted a questionnaire survey as soon as possible after the spread of COVID-19 to minimize the potential for recall bias. In the future, these cities will continue to be followed up and real data at different times will be collected for vertical comparison. What can be determined is that this study has been conducted, and the findings are interesting and meaningful. Finally, this study analyzes the positive effect of BF on academic engagement and the moderating effect of anxiety on it. Although it makes an exploratory analysis on the causes of BF and anxiety, the factors originally intended to be explored may not be comprehensive. In the future, more hypotheses will be put forward according to the causes of BF and anxiety, and will be improved combined with the results of the interview. The combined use of qualitative and quantitative methods can provide richer and deeper insights, enhancing the credibility and effectiveness of the research. Meanwhile, it is also worth considering the adoption of additional research methods, such as case studies, action research, and so on, in order to gain a more comprehensive understanding of this phenomenon. Such research would be more convincing and could provide more valuable guidance for policy-making and practice. Of course, we can also incorporate additional variables to enrich the hypothetical structure model, providing a more comprehensive explanation of the underlying mechanism and intricate pathways of influence. This helps students, educational institutions, and policymakers gain a more accurate understanding of how to promote students' engagement in learning and mental well-being, in order to address challenges and provide effective support.

Author contribution statement

All authors bear full responsibility for the entirety of this manuscript and consent to its submission. Lingmin Hu, Renjie Lu and Juan Wen: Conceived and designed the experiments; analyzed and interpreted the data; contributed reagents, materials, analysis tools or data; wrote the paper. Shenyu Zhao: Performed the experiments; analyzed and interpreted the data; wrote the paper. Jing Zhou and Weiyan Ou: Analyzed and interpreted the data; wrote the paper.

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Ethical approval and consent to participate

Approval from ethics committee of Changzhou Maternity and Child Health Care Hospital (No.2022[21]) was received. All participants' online informed consent was acquired prior to the survey.

Data availability statement

The data cannot be made public due to privacy limitations. Those interested in accessing the data presented in this study could reach out to the corresponding author.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e20245.

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