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The impact of college students ' online learning engagement on academic performance: The mediating role of perceived teacher support

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Abstract:

With the rapid development of information technology, college students ' online learning has become an important trend in the field of education. The purpose of this study is to explore the impact of college students ' online learning engagement on academic performance, and the mediating role of perceived teacher support in this process. The research questions focus on the relationship between online learning engagement, perceived teacher support and academic performance. In this study, a questionnaire survey method was used to sample college students participating in online courses in a university in Ningxia, China, and Spss 22 was used for data analysis. The results show that : 1.College students ' online learning engagement has a significant positive impact on academic performance. 2.Perceived teacher support plays a partial mediating role between college students ' online learning engagement and academic performance. 3.Behavioral engagement and social engagement have a significant positive impact on perceived teacher support. 4.Cognitive engagement and knowledge support can significantly positively affect academic performance.

Keywords:

College students, *Online learning engagement*, *Perceived teacher support*, *Academic performance*

1.Introduction

With the rapid development of information technology and the continuous change of education mode, the COVID-19 epidemic has not only catalyzed the wide application of online learning, but also had a profound impact on the traditional education mode. Students communicate and learn through various online platforms and digital media technologies. Online learning has been widely used in the field of higher education. As a new way of learning, online learning provides students with personalized and convenient learning methods with its autonomy and flexibility, but it also puts forward higher requirements for students ' self-management ability and learning engagement. Moreover, the rapid increase of network information may also lead to students ' negative emotions such as anxiety, disgust, stress and burnout, which affect the collgeg students' online learning experience and academic performance (He et al., 2024).

In recent years, research on the relationship between online learning and student engagement has become the focus of education. College students ' learning engagement, as an important indicator to measure the qual-

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ity of learning and an important variable to predict college students ' academic performance, has attracted new attention. Students ' learning engagement not only affects their learning experience (Yang et al., 2024), but also directly affects their academic performance. The effectiveness of online learning is significantly affected by the level of learning engagement, and students ' learning engagement has become a key factor in the success of online education (Johar et al., 2023). The research on this topic can provide learners with process-oriented learning support and targeted teaching intervention. The study of Johar et al. (2023) emphasized the importance of learning engagement in online education and pointed out that it is a key factor in determining the success of online education.Yang et al. (2024) further pointed out that factors such as academic self-efficacy, basic psychological needs satisfaction, difficulty of online courses, and completion of homework at the student level have a significant positive impact on online learning engagement.

At the same time, as an important part of online learning, perceived teacher support on students ' learning engagement has also received increasing attention. Feng et al. (2023) pointed out that perceived teacher support can significantly affect college students ' online English learning engagement. Brandisauskiene et al. (2021) found that students ' perceived teacher autonomy support behavior has the strongest correlation with learning emotional engagement and behavioral engagement. This shows that teachers ' emotional support has an important impact on students ' learning engagement. In addition, the study of Acosta-Gonzaga et al. (2022) also shows that perceibed teacher support can enhance students ' emotional engagement and thus improve academic performance. However, Bahar (2010) found that gender, perceived family support and social status can predict 15 % of academic success, while perceived friend support and perceived social support from a particular person cannot predict academic success.Li et al. (2023) also pointed out that although perceived teacher support plays an important role in students ' academic learning, none of the three dimensions of perceived teacher support can directly predict academic performance. Perceived teacher support can only indirectly affect academic performance through the complete mediating role of academic buoyancy, or through positive self-esteem and psychological regulation (Teng & Liu, 2017). Wijaya et al. (2022) found that teachers play a greater role than parental support. The academic and emotional support of teachers and parents reduces students ' stress levels, while increasing their feelings and interests in learning mathematics, thereby improving academic performance.

Through a comprehensive analysis of the existing literature, it can be found that teacher support has a significant positive impact on college students ' online learning engagement, and this impact acts on students ' academic performance through a variety of paths. Specifically, teachers ' emotional support, cognitive support and autonomy support have been proved to play an important role in improving students ' online learning self-efficacy, learning engagement and final academic performance. In addition, academic self-efficacy, as an intermediary variable, plays a role between teacher support and academic performance, and its influence path and degree vary according to students ' individual characteristics such as gender, grade and other factors. However, the discussion on whether perceived teacher support will play a mediating role between college students ' online learning engagement and academic performance is still relatively rare. Whether perceived teacher support can affect academic performance is also worth further exploration.

Based on the above research, we can construct a theoretical framework that assumes that online learning engagement has a positive impact on academic performance through perceived teacher support. Specifically,

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the following assumptions can be made :

Hypothesis 1 : College students ' online learning engagement positively affects academic performance ;

Hypothesis 2 : Perceived teacher support positively affects academic performance ;

Hypothesis 3 : Perceived teacher support mediates the relationship between online learning engagement and academic performance ;

2.Research design

2.1Research object, research process and statistical methods

In this study, students who participated in the online course of ' Modern Chinese ' in a university in Ningxia were selected as the research objects. A total of 150 subjects were selected to participate in the questionnaire survey by using the method of cluster convenient sampling. The questionnaire of this survey is made by the questionnaire star, and the students are organized by the class teachers to carry out the test on the spot, and the data are collected by the way of network filling.Prior to the administration of the positive test, a pretest was taken from 70 students who had taken a course on Modern Chinese in the same university and the same major, and the test data were analyzed by SPSS 22. The correlation coefficients between each topic and the total score ranged from 0.471 to 0.744, which is a medium-high correlation and meets the criterion of having a reference value greater than 0.4. The first 27 % of the total score was selected as the high score group, and the last 27 % was used as the low score group for independent sample t test. The CR values were all greater than 3, between 3.576 and 9.992, and the *p* values were significant. It can clearly identify the high and low groups, and has a high degree of discrimination in all questions, which proves that the questionnaire has a good degree of discrimination. The a value after deleting the item is less than the overall reliability of 0.969, and all the items of the scale are retained according to the above indicators.After ensuring the reliability and validity of the scale, the questionnaire was issued and recovered, the teacher 's instruction was unified, the test procedure was unified, and the students participating in the study were explained that the questionnaire results were only used for academic research. The results will be kept secret, and the subjects are required to complete the questionnaire independently and carefully within the specified time. 150 questionnaires were sent out and 145 questionnaires were returned, with an effective rate of 96.7 %. There were 131 valid questionnaires, and the effective questionnaire rate was 90.3 %. Among the valid questionnaires, 21.4 % were male and 78.6 % were female (the proportion of female students majoring in Chinese language and literature was higher) ; 94.7 % of the students enrolled in the first volunteer, and the students have a certain professional interest in the major ; 39.7 % of the students are from the city, 40.5 % of the students have online learning experience, and 45 % of the students online learning time is not more than 2 hours, less time to invest in behavior. After the completion of the survey, spss 22 was used for validity analysis, reliability analysis, descriptive analysis, correlation analysis and hierarchical regression analysis.

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2.2 Research tools

2.2.1 Perceived teacher support scale

This study adopts the ' Online Learners ' Perceived Teacher Support Model ' constructed by Jiang et al.(2018). This scale includes four dimensions : emotional support (6 questions), social support (6 questions), knowledge support (6 questions), and tool support (5 questions). A total of 24 items, using Likert's 5-point scoring method, 1-5 points indicate ' completely inconsistent ' to ' fully consistent '. Learners score the strength of perceived teacher support behavior based on their own personal feelings in four dimensions. Finally, the scores of all items are summed up and the average score is obtained. The higher the score of the questionnaire, the higher the dimension of teacher support services perceived by learners.The exploratory factor analysis of the scale was carried out by spss22. The KMO spherical test data was 0.934, and the bartlett value was significant. The eigenvalues of the four dimensions were all greater than 2, and the factor loading of each dimension was between. 479 and. 776. The specific values are shown in the table, and the explanatory variation is 65.25 %. Therefore, the validity of the scale is good. In this study, through the Cronbach's test of each dimension of the scale, the Cronbach's Alpha coefficients of each dimension are.831, .896, .812, .820, respectively. The internal consistency coefficients are all greater than 0.7, and the overall reliability of the scale is 94.4 %. Therefore, the scale has good reliability.

2.2.2 Online Learning Engagement Scale

This study uses the scale compiled by Fan (2019) based on the Dixon 'Online Learning Engagement Scale' (OSES) and the Online Learning Engagement Evaluation Scale (SEDE). This scale is divided into four dimensions, namely, behavioral engagement (5 items), cognitive engagement (6 items), emotional engagement (5 items) and social engagement (4 items), 20 items are all positive questions. The Likert 5-point scale was used to score, 1-5 points indicate ' completely inconsistent ' to ' fully consistent '. The higher the score of the questionnaire, the higher the engagement of online learning. Exploratory factor analysis of the scale was performed using spss22. The KMO spherical test data was 0.943, and the bartlett value was significant. The eigenvalues of the four dimensions were all greater than 2, and the factor load of each dimension was between.483 and.728. The specific values are shown in the table, and the explained variation is 66.6 %. Therefore, the validity of the scale is good. In this study, through the Cronbach 's test of each dimension of the scale, the a coefficients of each dimension are.883,.886,.913, and 8 respectively.

2.2.3 Academic Performance Scale

The measurement of academic performance is based on the revised scale of the Chinese version of the sub-scale revised by Xu (2013) on the ' self-reported educational performance ' of students in the North American College Students ' Learning Engagement Survey (NSSE) questionnaire. This study made appropriate modifications according to the actual situation, and changed the ' university learning ' in the scale to the ' learning of the course '. There are 8 items in the scale, and the two dimensions are application skills (4 items) and self-improvement (4 items). The Likert 5-point scale was used to score, 1-5 points indicate ' completely inconsistent ' to ' fully consistent '. The higher the score of the questionnaire, the higher the academic performance of the respondents in the course. The exploratory factor analysis of the scale was carried out by

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spss22. The KMO spherical test data was 904, and the bartlett value was significant. The eigenvalues of the four dimensions were all greater than 2, and the factor load of each dimension was between. 589 and. 872. The specific values are shown in the table, and the explanatory variation is 69.38 %. Therefore, the validity of the scale is good.In this study, through the Cronbach 's test of each dimension of the scale, the Cronbach's Alpha coefficients of each dimension are .851 and .799 respectively, the internal consistency coefficients are greater than 0.7, and the overall reliability of the scale is 90.6 %. Therefore, the scale has good reliability.

3.Results analysis

3.1 Control and test of common method bias

Because the source of the subjects in this study is relatively single, the questionnaire questions are all Likert five-point scale questions, and the questions are positive questions, so there may be a common method variation problem in the measurement. In order to avoid the common method bias problem, we adopt two measures : pre-procedure control and post-statistical test (Zhou & Long, 2004). In this study, the test was administered and guided by a trained instructor, who emphasized the anonymity and confidentiality of the questionnaire, as well as explaining to the subjects that the data obtained were limited to scientific research, etc., and gave the subjects sufficient time to perform the field test. The test program is effectively controlled. Then the harman single factor verification method was used for post-mortem verification. All the items in the questionnaire were put into the factor analysis in SPSS 22. In an unrotated way, the initial eigenvalues of 21 items were greater than 1, and the first factor explained 43.99 % of the variation (less than 50 %). The common method deviation of this study is not obvious.

3.2 Descriptive statistical analysis results of each variable

The average, standard deviation and correlation matrix analysis of each dimension of online learning engagement, each dimension of perceived teacher support and academic performance are shown in table 1. The average value of each dimension is higher than 3, which is above the middle level. According to the results of correlation analysis, we can see that the four dimensions of online learning engagement and the four dimensions of perceived teacher support are significantly positively correlated with academic performance. The correlation coefficient is between.530 and .839.There is no collinearity between variables.

In addition, the independent sample *t* test was used to analyze the gender of the participants, whether it was the first voluntary admission, the online teaching area, and whether they had been exposed to online courses before. It was found that there was no significant difference in the gender of the students in each dimension (Yang et al., 2024), but it was different from the research conclusions of Korlat et al. (2021) and Brandisauskiene et al. (2021), which may be related to the large proportion of female samples in this study and the imbalance of gender ratio. There are significant differences in knowledge support in terms of whether it is the first voluntary admission, social input in urban or rural teaching, and emotional support in terms of whether there is online learning experience.

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Table 1 Descriptive statistical results and correlation analysis of each research variable (n = 131)

	M	SD	1	2	3	4	5	6	7	8
1.Action engagement	3.7802	.62946								
2.Cognitive engagement	3.7023	.68781	.737***							
3.Emotion engagement	3.6626	.65590	.695***	.769***						
4.Social engagement	3.5611	.71394	.609***	.678***	.738***					
5.Emotion support	3.9695	.63239	.609***	.640***	.631***	.669***				
6.Social support	3.8486	.66102	.628***	.625***	.655***	.725***	.713***			
7.Knowledge support	4.0818	.65490	.531***	.566***	.554***	.545***	.771***	.778***		
8.Tool support	4.0321	.65484	.530***	.545***	.553***	.569***	.688***	.748***	.839***	
9.Academic performance	3.9046	.63848	.615***	.672***	.622**	.578**	.697**	.695**	.768**	.701**

Note:***p<0.001,**p<0.01 *p<0.05

3.3 Analysis of the mediating effect of perceived teacher support on academic performance in online learning engagement

Based on the above correlation analysis, the mediating effect of perceived teacher support between online learning engagement and academic performance is further tested. The mediating effect test procedure proposed by Wen and Ye (2014) was adopted. On the basis of correlation analysis, hierarchical multiple regression was adopted, and the first professional admission, home in the city, and online learning experience were controlled. Category variables that are significantly different from each dimension of the independent variable in the t-test process are controlled, and a multivariate analysis linear regression model is established. The data of each model are entered into the regression analysis in the way of enter, and the specific data of table 2 are obtained.

In model 1, each dimension of online learning engagement is used as independent variable X, academic performance is used as dependent variable Y, and control variables are added. The results show that online learning engagement can explain 53.4 % of academic performance. The cognitive engagement of online learning engagement has a positive predictive effect on academic performance, F value is significant, β = 0.333, t value is significant ; the first step regression equation is established.

In model 2, online learning engagement is used as independent variable X, perceived teacher support M is used as dependent variable Y, and control variables are added. The results show that online learning engage-

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ment can explain 57.1 % of the total variation of perceived teacher support, and △ R^2 is 3.7 %. Behavioral engagement and social engagement in online learning engagement have a positive predictive effect on perceived teacher support, *F* value is significant, *β* value is positive, and *t* value is significant. The second step regression equation is established.

Model 3 takes online learning engagement X and perceived teacher support M as independent variables, academic performance as dependent variable Y, and after adding control variables, the results show that : online learning engagement can explain 71.1 % of the total variation of academic performance through perceived teacher support, *F* value is significant, cognitive engagement and knowledge support can positively predict academic performance, *β* value is positive, *t* value is significant ; the third step regression equation is established. The test of the three-step regression equation is significant, but the predictive power of model 1 has been reduced from 0.333 to 0.220 compared with model 3, while the explanatory power of model 3 has been enhanced (△ R^2 = 14 %), so the perceived teacher support has a partial mediating effect between online learning engagement and academic performance.

Table 2 Online learning input through the mediating role of academic performance through teacher support

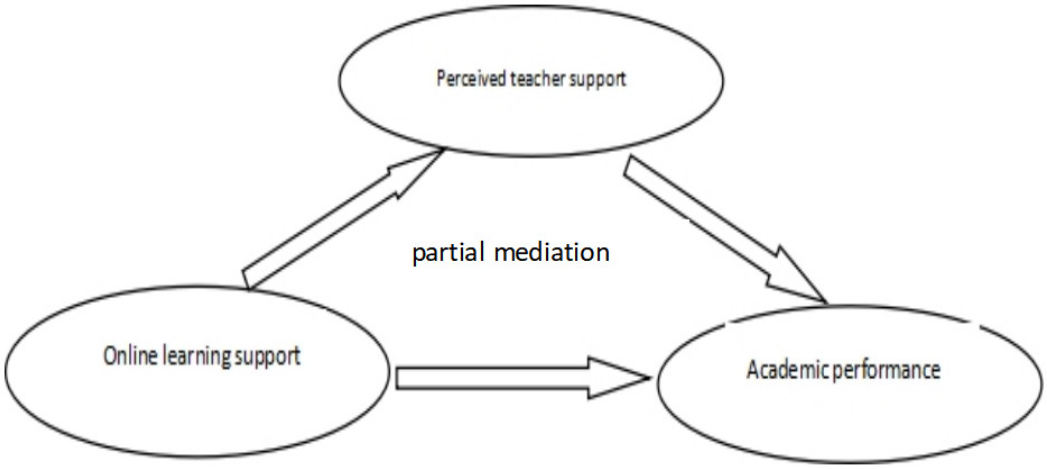
	model 1			model 2			Model formula. 3		
dependent variable	Academic performance			perceived teacher support			Academic performance		
Academic performance	Beta	*t*	VIF	Beta	*t*	VIF	Beta	*t*	VIF
Control variables									
Enrollment in the first major	-.044	-.710	1.031	-.006	-.105	1.031	-.047	-.933	1.039
Home in the city	-.077	-1.246	1.019	-.013	-.225	1.019	-.050	-.977	1.067
Have an online learning experience	.149	2.371*	1.049	.007	.123	1.049	.148	2.918**	1.053
Independent variable									
Behavioral engagement	.186	1.922	2.465	.208	2.247*	2.465	.080	1.004	2.634
Cognitive engagemen	.333	3.039***	3.163	.163	1.548	3.163	.220	2.474**	3.264
Emotional engagemen	.116	1.028	3.366	.119	1.094	3.366	.049	.541	3.405
Social engagemen	.127	1.335	2.392	.365	3.998***	2.392	-.035	-.397	3.208
Mediator variable									
Emotional support							.067	.740	3.384
Social support							.058	.579	4.127
Knowledge support							.428	3.752***	5.360
Tool support							.055	.579	3.766
F	20.138***			23.410***			26.560***		
R^2	.534			.571			.711		
△ R^2				.037			.14		

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Note:

1. *p < .05 **p < .01 ***p < .001

2.The setting rules of control variables : the first professional admission is the reference group, the home in the city is the reference group, and the online learning experience is the reference group.



4.Discussion of results

The results of this study show that under the full online teaching mode, the level of students ' learning engagement shows a moderately high trend. At the same time, students ' perception of the various types of support provided by teachers in the teaching process (especially knowledge support and tool support) is also above the average level. In addition, students ' evaluation of their academic performance also shows the characteristics of above average. These results show that the online teaching mode is relatively ideal in teaching effect. Further analysis shows that there is a significant positive correlation between online learning engagement, teacher support and academic performance. Specifically, the higher the students ' online learning engagement, the stronger the perception of teacher support, and the higher the academic performance. Teacher support plays an important role in promoting students ' academic performance, which is consistent with the research conclusions of Feng et al. (2023) and He et al. (2024).

4.1 College students ' online learning engagement positively affects academic performance

The results show that there is a significant positive relationship between college students ' online learning engagement and academic performance, that is, the increase of college students ' online learning engagement will promote the improvement of academic performance. Specifically, the cognitive engagement of online learning engagement has a positive predictive effect on academic performance, which means that the cognitive engagement of college students in the process of online learning, such as learning time, learning depth, learning breadth and so on, has a significant positive impact on the improvement of their academic performance. However, we should also note that although behavioral engagement, emotional engagement and social engagement cannot positively affect academic performance in the data of this study, the relationship between online learning engagement and academic performance may be affected by many factors, such as the

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learning time paid by learners, the degree of preference for courses, the degree of social participation in the online learning community, learning habits, learning environment, learning motivation, etc.

4.2 Perceived teacher support positively affects academic performance

Through multiple regression analysis of the collected data, we found that knowledge support in perceived teacher support has a significant positive impact on academic performance. Specifically, the coefficient of knowledge support is statistically significantly positive, which means that the more professional knowledge support provided by teachers, the better the students ' academic performance. This may be because knowledge support is directly related to students ' learning outcomes, which can help students better understand and master the course content, thereby improving academic performance.

4.3 College students ' online learning engagement has a positive predictive effect on perceived teacher support

The results of this study show that behavioral engagement and social engagement in online learning engagement also have a positive predictive effect on perceived teacher support. Behavioral engagement mainly refers to students ' active learning behaviors, such as reading, taking notes, thinking, etc. ; social engagement involves students ' cooperative learning behaviors, such as group discussions, team projects, etc. This shows that the higher the students ' behavioral engagement and social engagement in online learning, the stronger their perception of teachers ' support. Cognitive engagement and emotional engagement in online learning engagement do not affect perceived teacher support in this study, and further analysis and research are needed.

4.4 Perceived teacher support mediates the relationship between online learning engagement and academic performance of college students

The results of this study reveal that students ' perception of teacher support has a partial mediating effect on the impact of online learning engagement on academic performance. In particular, when students perceive teachers ' effective use of Internet teaching tools and in-depth understanding and imparting of professional knowledge, they will be more active in online learning, which will have a positive impact on academic performance. In addition, the higher the degree of action engagement and social engagement of students in the online learning process, the more teacher support they perceive, and the more teachers ' engagement and dedication to the curriculum, thereby further enhancing the correlation between teacher engagement and students ' academic performance. However, we also need to pay attention to other factors that may affect academic performance, such as students ' prior knowledge reserve, academic self-efficacy, basic psychological needs satisfaction, online course difficulty, homework completion, etc., in order to prevent excessive perceptions attributed to teacher support (Yang et al., 2024).

5. Conclusions and recommendations

The conclusions of this study can be summarized as four points : 1.College students ' online learning engagement has a positive impact on academic performance. 2.Perceived teacher support plays a partial mediating role between college students ' online learning engagement and academic performance. 3.Behavioral

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engagement and social engagement have a positive impact on perceived teacher support. 4.Cognitive engagement and knowledge support can positively affect academic performance. The research results provide important guidance for the teaching strategies of online learning. Based on the above conclusions, this study puts forward the following suggestions :

First of all, educators should pay attention to the cognitive engagement of online learning and provide knowledge support for college students. Because cognitive engagement is directly affected by metacognitive engagement, learning engagement is affected by cognitive engagement, and these are caused by motivation. The support of teachers can cultivate students ' enthusiasm, interest in the classroom, pleasure in learning activities, pride in learning outcomes and other emotions (Acosta-Gonzaga et al., 2022). Educators can optimize online learning strategies and methods to improve academic performance by improving students ' learning initiative and depth. Because teachers ' knowledge support has a significant impact on academic performance, teachers should be familiar with various tools of online teaching and use online teaching software flexibly to provide students with rich resources to meet their learning needs.In addition, teachers should have extensive scientific and cultural knowledge to stimulate students ' learning motivation and broaden their professional vision. In the teaching process, teachers need to reasonably organize the course content to ensure that the knowledge points are properly divided, so as to accurately express the concept, clear pronunciation, smooth expression, and moderate speech rate. At the same time, teachers should use open and enlightening questions to guide students to think. Teachers ' emotional support also plays an important role in online education, which can improve students ' learning engagement (He et al., 2024). School administrators should encourage teachers to pay attention to students (Feng et al., 2023). At the same time, it also provides educators with an important assessment tool that can predict students ' academic performance by measuring their online learning engagement, thus providing a basis for personalized teaching.

Secondly, participants in online courses should strive to improve behavioral engagement and social engagement, because enhancing college students ' academic engagement helps to enrich their educational experience (Zhang et al., 2022). In view of the fact that behavioral engagement and social engagement have a significant predictive effect on perceived teacher support, and the former has a significant impact on academic performance, students should reflect and evaluate their learning process in online learning, and continuously explore and improve learning methods to improve learning efficiency. Students should combine the course content with previous experience and knowledge, apply concepts, theories or methods to practical problems or new situations, and promote understanding by in-depth analysis of the constituent elements of a point of view or experience.

In addition, online course participants should strive to improve their cognitive engagement, ensure regular participation in online courses, seriously study various resources in the course, and complete online testing and learning tasks on time. In the process of learning, we should pay attention to taking notes and summarizing what we have learned in time. In the course group, students should actively use social software or e-mail to discuss with teachers and classmates, and participate in online learning discussions to deepen their understanding of what they have learned.

6.Future research and prospect

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This study uses a questionnaire survey method to conduct an empirical study on the relationship between online learning engagement, perceived teacher support and academic performance in online courses in the post-epidemic era. The results verify the partial mediating role of perceived teacher support between online learning engagement and academic performance, and provide a preliminary exploration on how to improve students ' learning engagement in online education and mixed education in the post-epidemic era, and how to improve academic performance by enhancing perceived teacher support . However, future research can still be further deepened from the following aspects.First, broaden the choice of research objects.Future research can consider students from different areas universities or courses to enhance the universality and applicability of the research. Secondly, a cross-sectional design was adopted in this study, and students were investigated after the end of the course. If future research can adopt multi-time point longitudinal research, it will be more helpful to understand the dynamic relationship between online learning engagement, teacher support and academic performance, so as to provide more timely insights.

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