



# Influence of OTC on OLE for college students: mediating effect of academic emotion and moderating effect of gender

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## Abstract

With the impact of the global epidemic, online learning has become an irreplaceable form of learning for students, and has been widely concerned by the education circles. Based on Noddings' caring theory and social role theory, A survey of 1954 college students was conducted to examine students' on-line teacher care (OTC), online academic emotion (OAE) and online learning engagement (OLE). The results of correlation analysis find that: (1) There are significant positive correlations among the three variables: OTC, OAE and OLE; (2) OAE plays a part of mediating role between OTC and OLE; (3) Gender has a significant moderating effect on the first half of the mediation path in the model of "OTC→OAE→OLE". OTC has a significant positive predictive effect on OAE, and among them, the positive predictive effect of male college students is stronger. The conclusion of this study contributes to reveal the formation mechanism and individual differences of college students' OLE, which has reference value for the intervention of college students' OLE.

**Keywords** Online teacher care · Online academic emotion · Online learning engagement · Moderating Effect · Mediating Effect

## Introduction

As an effective medium for providing education or enhancing education, online learning has become a major component of global education in the United States (Singh, 2019). In the recent three years during the COVID-19 pandemic time, online learning has become essential that some colleges and universities around the world have begun to operate teaching fully digitally (Dhawan, 2020). It has acted as an indispensable learning pattern accepted by college students due to its various advantages, for instance, no time or space constraints, convenient knowledge acquisition, greater access, flexible format, universality of technology, and low cost (Larreamey-Joerns & Leinhardt, 2006).

Moreover, it has increased the coverage and sustainability in the fiercely competitive higher education market (Angolia & Pagliari, 2016).

However, while students are experiencing the wonderful learning experience of using various devices (such as mobile phones, laptops, etc.) as the internet access in a synchronous or asynchronous environment, some potential problematic issues came out at the same time. For instance, firstly, students get less learning monitoring and face-to-face emotional motivation due to the separation between teachers and students in online teaching. It results in a lack of teacher-student communication, leading to poor performance, less continuity and efficiency in online learning (Salas-Pilco et al., 2022). Students' typical symptoms, such as laziness, distraction, separation from goals, sleepiness, and lack of personal/physical attention occur from time to time. In the post-pandemic era, the uncertainty of online learning causes students' depression and anxiety, awakening and confusion, as well as the negative emotions and psychological problems, such as panic, anger, and rebellion caused by early online fragmented learning and network socialization (Zhang, 2022). Secondly, some college students also come across difficulties related to modern technology, including download errors, installation and login

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issues, and audio and video issues, etc. (Dhawan, 2020). It directly leads to the decline in learning engagement and less effective participation caused by poor network connection or simple technical operations. Some students may even withdraw from online learning courses or log in only with their devices, but depart from the field from time to time. Insufficient engagement also leads the learning to stay only on the superficial level. For instance, when facing with aimless discussions, uninteresting materials, and low-level assignments on online platforms, students are reluctant to think deeply but only perfunctorily. Lastly, when large amount of learning assignments flow into online courses, students easily feel helpless or powerless. In summary, students who lack the community, technology support, and have difficulties in understanding instructional goals are the major barriers to the online learning (Song & Lu, 2007), which greatly affect the positive effects of online learning. Therefore, while adapting and experiencing the benefits of online learning during the crisis, it is imperative to assess and improve the quality of courses offered online during such emergencies (Affouneh et al., 2020). Based on Noddings' caring theory and Fredrickson's (2001) "emotional response theory", this study aimed to reveal the relationship between OTC and OLE as well as its mechanism with the empirical research, and then expanded the intermediary role of OAE in the entire online learning process.

## Background

There have been hot debates regarding emotions, however, little has discussed emotions as an intermediary role. The traditional online learning analyses methods are still the main approaches in explaining emotional ambivalence (Baker et al., 2010; Mellon et al., 2014). For example, frustration was found to be more associated with poor learning. Only with properly management, it may be helpful for learning (Baker et al., 2010). However, it creates the illusion that positive emotions can play a positive regulating role and should be promoted, while negative emotions can be detrimental to their studies or learning and should be controlled or avoided. Nonetheless, the motivational power of negative emotions has rarely been considered. For example, confusion, a kind of emotions that is generally considered as negative, has been proved to be positively related to learning (Craig et al., 2004). Other so-called "negative emotions" like anger, fear and sadness can sometimes be a rewarding experience, and "positive emotions" like joy and love are at times unwelcome—as with guilty pleasures or unwanted infatuation (Jäger & Bartsch, 2006).

In addition, an individual's emotion undergoes a series of changes after being affected by the online environment, plus

"meta emotion", a process monitors and appraises emotions and recruits affective responses toward them. It results in a motivation to maintain and approach emotions, or to control and avoid them (Bartsch et al., 2008), and makes the mediating mechanism of OAE not as single and rigid as before. Specifically, for instance, "live positive emotions" (e.g., task enjoyment) retains cognitive resources, and promotes interest and intrinsic motivation; "deactivate positive emotions" (e.g., relaxation) reduces task attention and leads to superficial information processing; and "activating negative emotions" (e.g., test anxiety) reduces cognitive resources for task purposes and intrinsic motivation (Ramirez-Arellano et al., 2019), but it can also generate strong motivation. These concepts greatly enrich the research content, which greatly add significance in further clarifying the factors affecting OLE in the context of the current pandemic.

## The relationship between OTC and OLE

Learning engagement is a mechanism in which learners' individual factors interact with environmental factors (Schaufeli et al., 2002). In this mechanism, teachers' caring behaviors is an important external environmental supporting factor. It refers to a comprehensive embodiment of various behaviors and activities, for instance, in the process of education and teaching, teachers fulfill their teaching tasks with due diligence. To ensure the expected results and build a good teacher-student relationship, teachers invest enough time and energy to support students' development (Lei, 2014). During online teaching, teachers cannot accurately obtain the information from students in the first time by observing their facial expressions. It is difficult for teachers to provide care as accurately as that in the traditional classrooms. Teachers have to figure out the complex and changeable psychological states of students with the absence of observations, which brings great challenges to teachers' caring behaviors. Therefore, to enhance the students' sense of online presence and learning engagement, teachers should always pay attention to the students' learning process, master the general situations of their learning performance, and reduce the limitations of real-time communication. For this purpose, teachers not only need to provide technical guidance, but also psychological and emotional support. Teachers' caring behavior is like a "heart saving pill", which may play a powerful role when students may consider giving up. Research have shown that teachers' participation, behaviors, attitude, and expectations of online learning affect the learning engagement of online learners (Dixon, 2010). Teachers' caring behaviors not only have a direct impact on *online learning engagement* (OLE), but also work through some intermediaries. For instance, it improves OLE by enhancing

learners' sense of social existence (Shea & Bidjerano, 2009). In addition, *online academic emotion* (OAE) itself is also an important medium. For example, the perception of teachers' caring often leaves individuals in a state of high arousal such as joy, pleasure, and pride. These positive emotional experiences can stimulate their interest in learning, promote the information processing, and improve the students' learning motivation in online learning (Chaffar & Frasson, 2004).

According to the interactivity in Noddings' caring theory, there should be a two-way interactive relationship between *online teacher care* (OTC) behaviors and OLE. Specifically, if teachers provide students with enough care and encouragement in online teaching, students tend to have positive recognition and produce positive effects (Noddings, 2013). In turn, if students believe their teachers care for them and their well-being, positive learning outcomes could occur, such as attendance, attitude, self-esteem, effort, and identification with school (Noblit et al., 1995; Noddings, 1995; Steele, 2003). Consistent with Rosenthal's "Expectations Fulfilled Effect", if teachers give students enough care and encouragement in their daily life, students will be led to a more positive state of devotion to cope with difficulties and adapt to the school environment, and develop in the direction as expected.

In addition, students' OLE could be promoted by OTC according to the self-determination theory. It supports that "when people complete a task, if significant others exert influence on their motivation or behaviors, the individuals' behaviors will be affected to a certain extent" (Ryan & Deci, 2017). When these kinds of behaviors are teachers' care or encouragement, individuals tend to express to their fullest potential and actively devote themselves to work and study. As a special kind of caring behaviors, OTC belongs to an important "event" besides "teaching" and "learning" in an online teaching context. It is different from the teachers' caring behaviors in the traditional teaching situations. It aims at improving students' sense of classroom atmosphere and promoting the real occurrence of learning. With the separation of teachers and students, it is to achieve the ideal teaching effect in the online teaching (Li et al., 2021). Language, tone, speed of teachers' caring behaviors, online emotional comfort as well as online technical operation can all directly help students get involved. Moreover, to stimulate students' learning engagement, learning enthusiasm and initiative, teachers' literacy in knowledge, attitude, values, and other aspects can also indirectly affect the occurrence level of students' individual behaviors. In conclusion, OTC can help individuals produce psychological identity, thus help generate positive feedback psychology, and finally increase the degree of OLE. Accordingly, we propose hypothesis H1: there is a positive correlation between OTC and OLE.

## The mediating effect of online academic emotions

The above hypothesis only discusses the correlation between the two variables OTC and OLE. To better prevent and intervene academic emotions (Mackinnon & Fairchild, 2009), it is necessary to pay close attention to its functional process, for instance, the investigation of the mediating mechanism. OAE mainly refers to the various psychological emotions caused by such as, the online learning environment, technical operation, the problem of online learning platform, and the structure or nature of online materials. (Levy, 2007). It appears as a lasting and diffuse academic emotion (Bieleke et al., 2021). Specifically, the role of OAE plays in online learning exhibits in three ways:

First, OTC plays a critical role in OAE. Since teachers and students are in the state of field separation in an online learning environment, it is difficult for students to seek help from the surroundings, which easily leads them to be in an isolated learning environment with the weak teachers' emotional support. Students easily feel excluded and emotional instability from the online learning community (Delahunty, 2012) due to the online environment itself or online technical operations. They face the pressure of reduced self-confidence, increased self-study and independent workload (Dyment & Downing, 2018). Studies also showed that teachers and students in the online courses exhibited negative attitudes (Stephan et al., 2019).

Moreover, as an important psychological environmental factor, OAE inevitably affects OLE significantly (Fredrickson & Branigan, 2005; Marchand & Gutierrez, 2012; Ouweneel et al., 2011). It is believed that positive academic emotion is more conducive to the emergence of positive learning behaviors. It can indirectly improve students' learning engagement by expanding their attention span, strengthening their cognitive ability, increasing their learning motivation (Meyer, 2002) as well as autonomy (Zhao, 2013). Prior studies have shown that the unique psychological atmosphere formed by OLE can affect students' sense of learning efficacy, which in turn can positively affect their OLE (Gao, 2016). In addition, negative OAE can reduce the success rate of learning (Liew & Tan, 2016). Students easily have unpleasant learning experiences due to negative emotions, which reduces their enthusiasm to participate in classroom learning and damages their learning engagement (Zhang & Zhao, 2017). Therefore, positive and negative OAE can directly strengthen or weaken OLE through a certain intermediary effect (Gao, 2016).

Finally, OTC can affect OLE through OAE. According to the *Emotional Response Theory*, previous studies have found that OTC can be related to OLE through the mediating role of academic self-efficacy (Li et al., 2021). Teachers'

behaviors have impacts on learners' emotions in the teaching process, and learners' emotional states also affect students' learning behavior tendencies (Horan et al., 2012). Therefore, OTC can promote learners' OLE by creating an external factor that motivates learners' active construction of meaning and learning generation.

Based on the relevant theoretical and empirical studies, it is hypothesized that OAE is a mediating variable which plays an important role in the students' online learning process (Feng et al., 2020). In summary, we propose hypothesis H2: OAE plays a mediating role in OTC and OLE.

## Gender regulation

Mediating variable is used to explain how teacher caring affects learning engagement, however, it cannot answer how this effect varies in different contexts. To answer this question, according to the social role theory and other relevant empirical research, a moderating variable gender is introduced.

According to the *Gender Role Socialization* theory, both sexes are assigned different roles and responsibilities through socialization, which makes individuals exhibit gender differences in the future development (Rudman & Glick, 2021). Such differences are not only reflected in behaviors, but also in how the same behavior affects males and females differently (Yu et al., 2013). Boys and girls exhibit different reactions when facing difficulties and complex situations in schools. Some studies have shown that girls have significantly higher scores in positive academic emotional experience than boys', and their scores of negative experiences are significantly lower than boys' (Hao et al., 2019; Parkins, 2012). In universities, students showed control and domination over many fields, as well as a sense of rejection of the families' and schools' authorities. Male students often show disobedience, rebellion, shyness, and self-doubt to express their dissatisfaction (Zughira, 2019), while female students usually do not challenge the teacher-student relationship even if they are not being cared of (Srivastava et al., 2010; Tennant et al., 2015).

In addition, males and females have different levels of socialization in the emotional expression that females are more willing to express themselves (Brody & Hall, 2010). Taking the college students' exam anxiety as an example, studies have confirmed that female students are more prone to anxiety than male students, and are also more inclined to express anxiety (Yang, 2022). Also, compared with males, females tend to use more emotion regulation strategies and are more inclined to reassess, solve problems, accept, or seek emotional support (Nolen-Hoeksema, 2012). In terms of ways of expressions, females tend to cry more often than

males (Van Hemert et al., 2011), and are more likely to overcome the pressure and difficulties in school and life through communication.

In terms of teacher care, on the contrary, boys are more sensitive. When they feel less in teacher care, they improve the level of positive emotions themselves (Patterson, 2019) and are bolder and more straight forward in life. When teachers provide the same level of support, boys may consider it more like a kind of respect, care, and help, and then they produce more positive emotions (Yu & Liang, 2017). It may be related to the differences of personality characteristics in genders. Male students are more in need of teachers' care because their learning process depend more on teachers' attention (Katz, 2017). Their emotional void can't be filled, and their emotions can only be comforted through the care of teachers' words, behaviors, or body languages in the online learning. On the contrary, female students can usually get a certain degree of care from their peers, classmates, and roommates.

In terms of academic emotions, male students are more sensitive. Prior studies have shown that male students showed higher level of emotional support than that for female students (Bru et al., 2021). Male students' negative academic emotions are also relatively stronger. For instance, males react more frequently and intensively to anger than females (Sun & Stewart, 2007). Especially during the pandemic time, it has left students a lack of attention. The prolonged time of stay at home and the uncertainty of the pandemic have brought a certain degree of negative emotions and psychological issues to college students, such as panic, anger, rebellion, and other emotions and behaviors (Zhang, 2022). If they can be cared, encouraged, or supported, they can quickly get rid of the negative emotions and get through the psychological crisis (Bru et al., 2021). However, if such bad emotions cannot be intervened and resolved in time, it may eventually lead to more profound psychological stress and traumatic experiences and even ferment into extreme situations. In severe cases, students may vary in risk of aberrant behaviors including violence and substance use (Hawkins, 2022). Research also shows male students tend to be stronger and more restrained, but also more likely to use forces (Zhai et al., 2014), which is extremely detrimental to their later health development. But for girls, their academic emotions are relatively positive and stable (Lamote et al., 2013). They are more eager to learn than male students, which makes them more confident in achieving academic success (Lamote et al., 2013). Females also experience greater depth of learning (Anderson & Haddad, 2005), are more inclined to benefit from high-level thinking and learning activities when feeling external care than male students (Diseth, 2014). Moreover, compared with males, females tend to be more organized and better

able to manage their own time (Ruffing et al., 2015). Such self-discipline and planning in learning will enable female students to be more courageous to face difficulties in school, and naturally their academic emotion will be more stable. Therefore, when facing with teacher care, their academic emotional changes are less obvious. Accordingly, hypothesis H3 is proposed: gender plays a moderating role between OTC and OAE. Compared with girls, OTC has a stronger impact on academic emotions for boys.

In conclusion, based on the caring theory and social role theory, a moderated mediation model was constructed to examine the impact of teacher care on learning engagement and its mechanism. Specifically, this study would firstly examine the mediating effect of OAE between OTA and OLE, followed by the moderating effect of gender on the first half of the mediation effect (Fig. 1). It aimed to provide empirical support and theoretical guidance for the intervention work of college students' learning engagement.

## Methods

### Participants

A sample of 2,348 students from 65 large colleges or universities across 28 provinces in China was collected for this study. Student volunteered participated the research. The informed consent was first gathered from these students, and their guardians by their class teachers and the school counselors as well as relevant school administrators. The participants were asked to log into a web link to fill out an online format questionnaire through mobile phones or computers. The questionnaire includes three parts (OTC, OLE and OAE), and there is no sequential issue among them, which means they are edited in the same network connection

and distributed at the same time. The students or teachers involved were given training to ensure that participants to follow the researchers' corresponding filling instructions. The importance of ensuring the data authenticity was briefly presented by their monitors or event organizers. Students were asked to answer the surveys independently in their own specific circumstances within about 15 min.

All procedures were approved by the Institutional Review Board of the first author's university. A total of 2348 questionnaires were collected by the researchers, among which 1954 were valid and 394 were deleted. According to the prediction and judgment, it takes 15 min to complete the questionnaire, among which 200 questionnaires take less than 15 min to answer, and some questionnaires even take 2–3 min. Among them, 194 questionnaires choose the same answer. For example, when choosing the answer to the questionnaire item, some students choose to "completely disagree" or "completely agree". For those questionnaires that did not meet the requirements, the researchers decided to remove these in the data analysis (Table 1).

### Measures

#### Online teacher care questionnaire

OTC is a well-established 24-item instrument for measuring the teachers' caring behaviors in the educational research, which is beyond the Teachers' Caring behaviors Scale in Online Teaching (Li et al., 2021). It consists of four factors: clarity, inclusiveness, participation, and timeliness. The results of confirmatory factor analyses (CFA) were as follows:  $\chi^2/df=4.83$ ,  $RMSEA=0.04$ ,  $CFI=0.98$ ,  $TLI=0.98$ ,  $SRMR=0.02$ . The sample used a 5-point Likert scale test and the scores of each item were added to obtain the total score. The higher the total score, the higher degree the

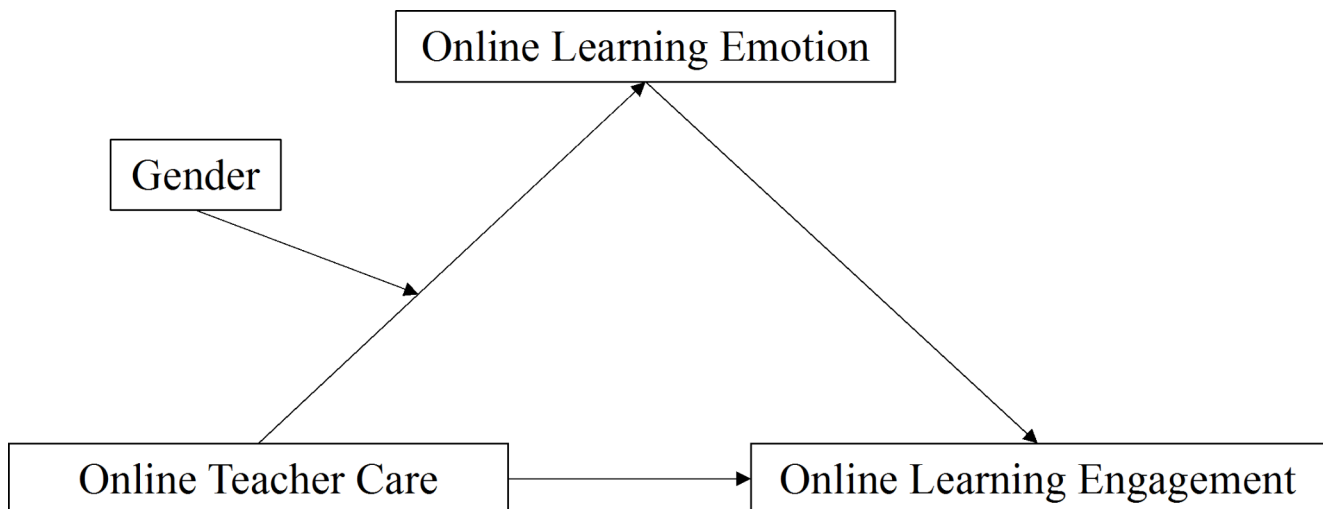


Fig. 1 Moderated mediation model

**Table 1** Demographic information

Basic information		Sum N	Ratio %
Gender	Boys	604	31
	Girls	1,350	69
Family structure	Only child	593	30.3
	Non-only child	1,361	69.7
Grade	Freshman	661	33.8
	Sophomore year	381	19.5
	Junior	507	25.9
	Senior	405	20.7
School level	Key university	838	42.9
	General university	1,024	52.4
	Colleges and universities	92	4.7
Profession	English Major	42	2.1
	Non-English major	1,912	97.9

teachers' caring. The Cronbach's coefficient of the total questionnaire reached 0.96. The scale had relatively high item discrimination, content validity, and construct validity, which met the psychometric standards and can be used to evaluate the caring behaviors of online teachers in China.

### Online learning engagement questionnaire

OLE is also an instrument with high reliability which has been widely recognized in the field of education (Guo & Hu, 2022). and the author's approval was obtained before using it. It consists of four factors: *cognitive engagement*, *behavioral engagement*, *emotional engagement*, and *interactive engagement*. The results of CFA were  $\chi^2/df=3.87$ ,  $RMSEA=0.04$ ,  $CFI=0.98$ ,  $TLI=0.98$ ,  $SRMR=0.02$ . This questionnaire is composed of 17 items, which have a good internal consistency and the Cronbach's coefficient reached 0.96. A 5-point Likert scale was used for this scale, with responses ranging from 1 to 5 (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, and 5 = *strongly agree*). The total score is the sum of the scores of each item and the higher the total score, the higher the students' engagement.

### Online academic emotion questionnaire

AEQ (Bieleke et al., 2021) was adopted to exam students' academic emotions. It includes 8 scales with a total of 32 items (4 items per scale) which respectively measure enjoyment, hope, pride, anger, anxiety, shame, hopelessness, and boredom in class-related settings. The CFA results were:  $\chi^2/DF=4.88$ ,  $RMSEA=0.05$ ,  $CFI=0.97$ ,  $TLI=0.96$ . The items were scored reversely, therefore, the higher the total score, the lower the students' engagement degree. The Cronbach's coefficient of the total questionnaire reached 0.95.

**Table 2** Descriptive statistics and correlation coefficient of the variables

Measure variables	M	SD	1	2	3
Online teacher care	3.73	0.68	1		
Online academic emotion	3.50	0.62	0.57***	1	
Online learning engagement	3.64	0.69	0.69***	0.56***	1

Note. \* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

### Analytical procedures

The online learning questionnaire for college students was distributed in the form of a link through mobile phones and WeChat (a popular communication app used in China). Before the subjects filled out the survey, it required an informed consent of the school administrators. In addition, the agreement with the data confidentiality, the corresponding filling rules, and the impact of the data authenticity were needed. Students were required to answer independently according to their own specific circumstances within approximately 15 min.

The statistical software SPSS22.0 and PROCESS3.3 were used to conduct factor analysis, independent sample t-test, variance analysis and adjusted mediation effect analysis. The SPSS22.0 was adopted for descriptive statistics and correlation analysis. According to the Bootstrapping method (Wen & Ye, 2014), the SPSS macro program PROCESS was used to test the moderated mediation effect model. The Harman single factor test was used to test the common method bias, and the results showed that there was no serious common method bias issue in this study (Zhou & Long, 2004). All variables are standardized, and the models were tested by Bootstrapping method with the test repeating 5000 times.

## Results

### Correlation analysis

The results of correlation analyses showed that the three variables of OTC, OAE and OLE of college students were all significantly positively correlated. The specific mean value and correlation coefficient were presented in Table 2.

In Table 2, the correlation analysis was conducted on the total average scores of OTC, OAE and OLE. It showed that OTC was significantly positively correlated with OAE and OLE; OAE was significantly positively correlated with OLE.

Among the college students, OTC as a critical external emotional support factor played an indispensable part in students' OAE. There was a significant correlation between OTC and OAE ( $r = .57, p < .001$ ). Positive OAE could make OLE develop in a better direction, therefore, OAE and OLE

**Table 3** Mediation effect test of mindfulness teaching

Regression equation		Overall fit index			Significance of regression coefficient	
Outcome variable	Predictor variable	R	R <sup>2</sup>	F	β	t
OAE	OTC	0.61	0.38	294.38***	0.59	32.50***
OLE	OAE	0.72	0.52	424.70***	0.27	13.73***
	OTC				0.53	27.16***

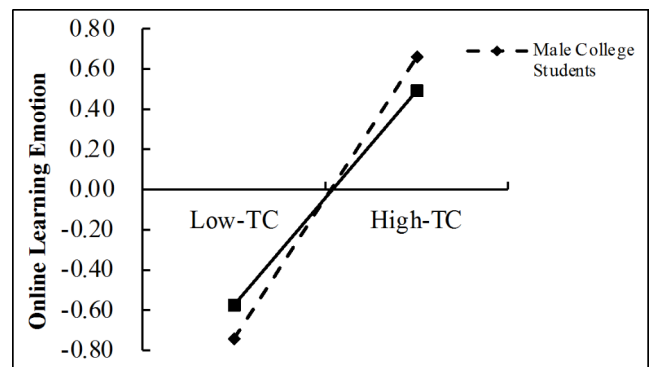
also showed a positive correlation ( $r=.56, p<.001$ ). In addition, OTC also enabled students to devote more energy to learning, so OTC was positively correlated with OLE ( $r=.69, p<.001$ ).

**Analysis of mediating effect with regulation**

The mediating effect between OAE, OTC and OLE of college students was tested by model 4 in the SPSS macro program PROCESS (Hayes, 2009; Wen & Ye, 2014). Table 2 presented the result after controlling for gender, grades, and school types. Specifically, OTC significantly positively associated with OAE ( $a=0.59, SE=0.02, p<.001$ ); when OTC, OAE were added into the model, OTC significantly positively associated with OLE ( $c'=0.53, SE=0.02, p<.001$ ), OAE significantly positively associated with OLE ( $b=0.27, SE=0.03, p<.001$ ), which indicated that OAE played a partial mediating role between OTC and OLE. The Bootstrap test of the deviation corrected percentile also showed the OAE had a significant mediating effect between OTC and OLE ( $ab=0.16, BootSE=0.02, 95\% CI=[0.12, 0.20]$ ). The proportion of intermediary effect to total effect was  $ab/(ab+c')=23.19\%$  (Table 3).

Subsequently, model 7 in the process program was used to operate the moderated mediation effect analysis. The results showed that after controlling for grade and school type, the interaction item of OTC and gender significantly negatively predicts OLE ( $\beta=-0.08, p<.001, \Delta R^2=0.01$ ). The PROCESS program further analyzed the mediation effect under different values of the regulatory variables. It was found that among male college students, the mediating effect of OTC on OLE through OAE was 0.19 ( $BootSE=0.03, 95\% CI=[0.14, 0.24]$ ). Among the college female students, the mediating effect of OTC on OLE through OAE was 0.15 ( $BootSE=0.02, 95\% CI=[0.11, 0.19]$ ). The judgment index INDEX obtained from the further PROCESS operation showed that the adjustment judgment index of gender on the mediating effect of OAE was  $-0.05$  ( $BootSE=0.01, 95\% CI=[-0.08, -0.02]$ ), which indicated the significant mediating moderation effect. In other words, there was a significant gender difference in the mediating effect of OAE.

To describe the gender differences in the mediating effect of OAE more intuitively and vividly, an interaction effect map was drawn according to the online academic emotional scores corresponding to the OTC of different genders, which



**Fig. 2** Gender’s regulating effect on the relationship between OTC and OAE

corresponded to plus or minus one standard deviation. The simple slope analysis (Fig. 2) showed that for female college students, OTC had a significant positive predictive effect on OAE ( $bsimple=0.54, SE=0.02, t=25.12, p<.001, 95\% CI [0.49, 0.58]$ ), but for female college students, the positive prediction effect was stronger ( $bsimple=0.70, SE=0.03, t=21.38, p<.001, 95\% CI [0.64, 0.77]$ ).

In conclusion, the moderated mediation model proposed in this study was empirically supported. OAE played a mediating role between OTC and OLE, and the first half of this mediating effect was mediated by gender.

**Discussion**

This study revealed the relationship between OTC and OLE as well as their internal operating mechanism. It illustrated how OTC affected OLE through the mediation of OAE; it also analyzed “when the effect is greater”, that is, the first half of this mediation process was regulated by gender. Compared with girls, teachers’ care for boys had a greater role in predicting learning engagement. It not only enriched the empirical research of online teachers’ caring behaviors, but also provided new thoughts on how to improve students’ OLE to urge schools and teachers to attach great importance to teacher caring behaviors.

## Influence of teachers' online care on learning engagement

Consistent with previous studies, this study found that OTC had a significant predictive effect on OLE, that is, the higher the degree of teacher care, the more positive the evaluation of students on online learning (Guo & Hu, 2022). Perceiving teachers' caring behaviors especially the supportive and inclusive teachers' caring can significantly positively predict students' learning engagement, which shows that teachers' emotional care, such as encouragement, support, respect, and acceptance, can significantly enhance students' confidence and enthusiasm and thus promote their learning engagement (Huang & Meng, 2017). It is consistent with Liu et al. (2017)'s study that verified the positive predictive effect of teacher support in OLE, the traditional environment (Fredricks et al., 2004), and the effect of teacher support on adult learners' learning engagement in the online environment (Wu et al., 2017). The caring behaviors of online teachers not only has a direct impact on OLE, but also has an indirect impact through some intermediaries, such as academic integrity (Wang, 2021). On the one hand, the fragmented learning and uncertainty of online teaching have brought anxiety and panic to students, making it difficult for them to concentrate on their studies. In this case, students' learning duration is relatively short that they are easily distracted, feeling tired, and their learning engagement is more difficult to last long (Guo & Hu, 2022), thus, their learning engagement showed the passive and shallow experiences (Wang, 2021). On the other hand, college students are at a critical stage of forming cognition that they have only formed the correct cognition initially but have not yet fully internalized and absorbed it. Thereby, they have not yet achieved the integration of inner stability and other values (Mojtabai et al., 2016). Therefore, they need more emotional support and guidance. Prior studies also believed that teacher support and many other factors also affected OLE (Cho & Cho, 2014; Xu et al., 2020). For example, the internal factors such as online learning self-efficacy, online learning attitude and perceived teacher support are all closely related to students' OLE (Xu et al., 2020; Cho & Cho, 2014) believed that teacher support can directly promote interactions, which in turn affects students' academic emotion and learning engagement. Ma et al. (2015) also believed that teachers, as an important external support element, played an active role in leading and guiding the online courses, which will also affect students to complete courses. High quality teacher support predicts higher student engagement over time (Engels et al., 2016). In summary, teachers' support and care will directly or indirectly affect OLE. Timely and appropriate online care behaviors will enrich students' emotions and the development of their

positive energy, so as to encourage students to form the idea of being willing to learning. In addition, according to the interactivity of Noddings' caring theory, a two-way interactive relationship exists between teachers' caring behaviors and learning engagement, that is, if teachers give students enough care and encouragement in online teaching, students will also have positive recognition and then produce positive effects, which finally can be reflected in the degree of students' learning engagement (Noddings, 2013). In turn, if students believe their teachers care for them and their well-being, positive learning outcomes will occur, such as attendance, attitude, self-esteem, effort, and identification with school (Noblit et al., 1995; Noddings, 1995; Steele, 2003).

## The mediating role of OAE between OTC and OLE

OAE is an internal mediating mechanism connecting OTC and OLE. Consistent with Hong's (2010a), the research found that OTC can significantly predict OAE. Positive and negative OAE play a parallel mediating role between OTC and OLE, and the total mediating effect is greater than 34%, which showed that nearly half of the OTC's effects on college students' OLE are through positive and negative OAE. It supported the statement of Motte & Beebe (2002) about the relationship between teachers' communication and student behaviors. Teachers' communication stimulates students' emotional responses and guides their behaviors' change. Specifically, support of external forces and environment in online teaching has become important means for college students to relieve emotions such as loneliness and helplessness, and regain confidence and strength. It enriches college students' psychological resources in various ways, thus inducing their positive academic emotions, as well as increasing their level of learning engagement. It also supports the view of Ryan et al. (1994) about "the emotional security provided by teachers to students will have a positive effect on students' learning engagement".

OAE as an internal intermediary mechanism connects OTC and OLE. It is an important factor of college students' psychological development (Wu et al., 2017). Therefore, regulating college students' OAE is crucial to enhance learners' OLE. According to the theory of *Control Value* (Pekrun et al., 2007), students' emotions are believed to affect their self-regulated learning and motivation, thereby affecting their learning engagement. This shows self-regulated learning and motivation regulate the influence of emotions on learning engagement. Therefore, academic emotion can sometimes affect learning engagement through a certain intermediary effect. In the mediation mechanism of academic emotions, positive academic emotions may not necessarily produce positive learning engagement because of individual differences or the regulatory role of emotions



(meta-emotions). On the contrary, negative academic emotions may also promote learning engagement. Taking exam anxiety as an example, Ramirez-Arellano et al. (2019) believed test anxiety as an “activates negative emotions”, can prevent failure by increasing internal motivation and effort. Therefore, negative academic emotions may not lead to learning failure. Conversely, eliminating negative emotions will reduce cognitive resources as well as external and internal motivation (Pekrun & Stephens, 2010), which can lead to academic failure. Consistent with González et al. (2017), they both believed hope and anxiety are mediators between motivation and learning engagement. That is to say, anxiety can also improve learning engagement through motivation and hope. On the contrary, some studies have shown that there is no significant correlation between positive academic emotions (or emotional involvement) and learning engagement. For example, relaxation, as a “deactivating positive emotions”, often occurs in online learning environment. Because online courses provide fewer opportunities to compare with others, students feel relaxed due to the lack of supervision and face-to-face interaction and communication opportunities. However, the relaxed environment can reduce task attention and lead to superficial learning (Ramirez-Arellano et al., 2019).

Existing studies have also shown that teachers’ concern for students’ learning in the traditional teaching process influences students’ emotions (Haertel et al., 1981). This is a relatively stable cognitive and emotional perception based on teachers’ face-to-face stimulation. It will play a role in promoting and motivating learning for a long period of time. Due to the complexity and uncertainty of the source of OAE influencing factors, students may be in a period of emotional stability in the last period, while the next period of emotions may have been fermenting. Teachers should be flexible to change their caring strategies at any time to do the right thing. At this time, timely and appropriate targeted OTC can enhance students’ emotional experience, play a role as a stimulant, or play a role in relieving short-term bad academic moods (Hong, 2010b).

### The role of gender in regulating the anterior half pathway

This study also found that the first half of the mediating effect of OAE was regulated by gender of college students. Compared with female students, OTC had a stronger predictive effect on male students’ OAE, indicating that male students cared by teachers had stronger OAE and were more likely to engage in learning. Consistent with previous study, Srivastava et al. (2010) believed that boys gain more praise, feedback, and remediation in learning, and these are all related to students’ high level of academic emotion. Below

are two possible reasons why the first half of the mediating effect of OAE is moderated by gender:

First, male and female students have different expectations for intimacy and care which can give them a sense of belonging when facing teacher-student relationship. From the perspective of psychology, sense of belonging is also summarized as an emotional experience (Liu et al., 2017). Students with a sense of belonging feel more positive emotions from their academic life, so that college students have an optimistic attitude towards life, a healthy and stable social circle to improve their sense of happiness (Feng et al., 2020). In other words, sense of belonging and intimacy that students get from teachers’ caring behaviors reflects their academic emotions, but male students’ sense of experience should be relatively strong, because female students experience more teacher support in online learning than male students (Anderson & Haddad, 2005). So, male students are much more eager to experience emotional support from teachers. However, out of a stronger sense of self-esteem and group consciousness (Dessel et al., 2017), when facing loneliness and depression in online teaching, they are difficult to open their hearts out of instinctive self-esteem. Therefore, male college students need more care from teachers to provide emotional support.

Secondly, in the development stage of university, female students have a higher level of self-discipline in school and are more inclined to learn independently (Joo et al., 2000). They use more planning, goal setting, structure, and self-monitoring than male students (Zimmerman & Martinez-Pons, 1990). In addition, many studies have shown that males’ self-control is generally lower than females’ (Hirschi & Gottfredson, 1993; Tittle et al., 2003). This makes males laxer in the free and loose management mode online. On the contrary, female students’ autonomy and self-discipline in learning make them more confident in learning and have more stable OAE, while male students’ low self-control increases their fear of difficulties and unstable emotions in learning, under this circumstances, they need more care from teachers to maintain stable OAE.

Finally, female students’ inhibitions in online learning are superimposed with the pressure caused by the online teaching environment, which makes them lack of channels to relieve their emotions. Since male students are better at covering up their emotions than female students (Brody & Hall, 1993), the regulation, coping strategies, and stress responses in western social and cultural norms stipulate those men to better at suppressing their emotions than women to some extent (Brody, 2000). They are also not good at relieving their own pressure by talking to others. There are also studies that hold the opposite opinions, girls are more polite, restrained, less confident, and less able to express themselves (Anderson & Haddad, 2005). In

addition, the differences in teachers' ways of encouraging and praising male and female students are also one of the reasons for boys' lack of emotional care. For male students, they focus on contents communication and guidance which is mainly rational heuristic and guidance. but for female students, it is mainly emotional counseling and self-esteem protection (Zhang, 2022), which makes OTC an important emotional support for male students. Therefore, male students' OAE is more likely to be affected by OTC.

In conclusion, on the one hand, generally speaking, teachers have higher expectations of male students. Most teachers showed that they had extra expectations for boys that they expect boys to have a stronger sense of responsibility, but most of them gave priority to "protection" for girls (Zhang, 2022). On the other hand, male students lack concern and supervision in online teaching. Boys not only have to bear higher expectations from teachers, but also lack of care, encouragement, and advice. Therefore, boys are more likely to lack goals and motivation, and their academic levels will decrease. It is worth noting that although OTC has a stronger positive predictive effect on OAE among male students, but also significant among female students, which indicates that although there are certain gender differences, OTC as an external supportive factor still has a positive impact on college students' OAE (Ma et al., 2015). However, the research results did not show the moderating role of college students' gender in the second half of the mediation model as well as the direct path. The above results indicate that there is no gender difference in the impact of OTC on the behavioral outcome of OLE, but the gender difference is only reflected in the impact on the cognitive factor of OAE. Other studies hold the opposite view that OTC has a stronger positive predictive effect on OAE among female students. therefore, the regulation of gender in this field needs to be further verified.

## Conclusion

To sum up, (1) The three variables of college students' OTC, OAE and OLE showed significant positive correlations between each other; (2) OAE played a part of mediating role between OTC and OLE; (3) Gender had a significant moderating effect on the first half of the mediation path "OTC→OAE→OLE". The significant positive effect of OTC on OAE was stronger for male than that for female college students.

## Limitations and future research directions

First of all, this is an investigation. During the data collection period, the pandemic went back and forth and many regions in the country have adopted the mode of a hybrid way of online and offline teaching. The complexity of the teaching environment may bring more trouble to the engagement of online learning. This study adopted a cross-sectional study design; therefore, the causal relationship is less certain. A longitudinal study design is needed to examine the bidirectional association between OTC and OLE. Our research showed that OTC not only had an impact on OLE through the regulation of OAE, but also can directly affect OLE. This means other variables may also affect OLE, and more abundant influencing variables need to be explored in the future studies. In the future research, we should stress the further understanding of existing relevant literature to obtain the latest theoretical and empirical support of online learning research, so as to improve the effective intervention of teachers on learners' OLE.

Secondly, another limitation is that this study was conducted in parts of the country, which limits the scope of interpretation. In the future, larger samples from different regions or cultures should be used to make the research more representative. While ensuring the diversity of research objects, it is also possible to change the investigation methods on learners' OAE and OLE to avoid the *Hawthorne Effect* affecting the reliability of the conclusion. Finally, due to the convenience sampling method, the sample size of different levels of colleges and universities is also distributed unevenly. The use of online surveys has become an obstacle for people without access to the Internet, which limits the representation of this group.

This study explored the micro emotional support in teachers' support for online teaching in the context of the pandemic, and it attempts to solve the problems in teaching from an empirical perspective. It also gives responses and explanations to the following questions: how to maintain students' OAE, how to ensure students' online learning effects, how to promote students' OLE, and how to improve students' academic performance.

First of all, this study provides referential behavioral strategies for teachers' effective care in online teaching. It is helpful for teachers to reasonably use and implement caring behaviors in online teaching. Most importantly, this study provided direct data support for improving existing problems in current online teaching and learning from an empirical perspective. It has reference significance for the development of teachers' online teaching and students' online learning in the later period. Secondly, this study analyzed the effect relationship among teachers' caring behaviors, OLE and OLE in online teaching, which expanded the scope of

the positive effect of OTC and the explanatory mechanism of OTC. It has also enriched the theoretical research on the influence mechanism of OLE. Finally, the online learning scale is strictly revised and tested for reliability and validity, which can provide a relatively mature online learning measurement tool for the subsequent research.

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**Data Availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Conflict of Interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

**Ethics statements** Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements. No animal studies are presented in this manuscript. No potentially identifiable human images or data is presented in this study.

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