

Article

Online Learning Self-Efficacy as a Mediator between the Instructional Interactions and Achievement Emotions of Rural Students in Elite Universities

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Abstract: Previous research has shown that social capital (teachers' and peers' interaction) is a challenge for rural students in China's elite universities due to underlying issues of online learning self-efficacy (OLSE) and the quality of interaction. To understand how interaction quality is influenced, the present study drew on the achievement emotion theory to explore the mediating role of OLSE between social interactions (teacher–student, student–student) and achievement emotions (enjoyment, hopelessness, shame). Data were collected using an online questionnaire with a sample of rural students studying at elite universities ($n = 479$) in China. The results analyzed through Structural Equation Modeling confirmed the mediation model in which self-efficacy is a mediator in the relationships between social interactions and three types of achievement emotion as participants learned online during the coronavirus disease 2019 (COVID-19) lockdown.

Keywords: online learning; self-efficacy; social capital; social interactions; COVID-19; achievement emotions



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1. Introduction

The spring of 2020 forced many schools and colleges to temporarily close due to the COVID-19 pandemic outbreak. To maintain social distance and to block the transmission route of the virus, the Chinese Ministry of Education first imposed a lockdown on colleges and universities, and a massive online teaching campaign was launched across the country, with online learning lasting for nearly a semester in some colleges and universities. Such a massive online learning situation has renewed the attention of domestic and international researchers on topics related to online learning environments, the teaching status of teachers, and the psychology of student learning (e.g., Hong et al. [1]). Moreover, students have shown that they have the ability and confidence to make use of Internet resources and to develop relationships with teachers using digital tools through the Internet, which indicates that social capital may affect the quality of their online interactions [2]. Two types of social interactions in online learning are emphasized by social capital theory, namely student–teacher and student–student interaction [3]. Zheng et al. [3] found that self-efficacy influenced the quality of online interactions, and that quality in turn had a significant influence on social capital (teachers' and peers' support) gains. Research has shown that social capital (teachers' and peers' support) is a challenge for rural students [4], particularly in elite universities [5]. However, few studies have examined how rural students perceive teachers' and peers' interactions in online learning, and how their perceptions affect their self-efficacy in online learning. Thus, the aim of the current study was to examine the mediating role of online learning self-efficacy (OLSE) between teachers' and peers' interactions in online learning during the lockdown of COVID-19.

Achievement emotions are specific emotions associated with the learning process and learning outcomes in academic settings [1,6]. As stated by the control-value theory, by combining values and activation, four types of achievement emotion can be generated, that is, emotions can be grouped into the four categories of positive activating emotions such as enjoyment, positive deactivating emotions such as relief, negative activating emotions such as anxiety, and negative deactivating emotions such as boredom [6]. It is likely that positive activating emotions (e.g., enjoyment) may occur if students judge the learning situation to be intrinsic and controllable based on their own experiences. Negative activating emotions (e.g., anxiety) may be triggered if the situation is assessed as being important but uncontrollable (e.g., relevant tests); and emotions may trigger, terminate, or interrupt information processing, leading to selective information processing, which is related to various individual (personality, self-concept, learning interests, etc.) and contextual (learning environment, teaching methods, etc.) factors [7,8]. Previous studies have focused on enjoyment, anxiety, boredom, and pride; however, few studies have examined the three types of achievement emotion of enjoyment, shame, and hopelessness. Thus, in this study, an attempt was made to explore the factors influencing the three online academic emotions of enjoyment, shame, and hopelessness.

Recent research draws on international studies of lower-middle and working class university students that have explored the cultural boundaries faced by rural students when they are studying at elite universities [5,9]. The research suggests that in order for rural college students to attain academic and social success, they need to overcome the sense that they are cultural outsiders and be able to integrate themselves into an environment that may seem foreign to them [10]. In Lareau and Weininger's study [11], emphasis was placed on the emergence of cultural squeamishness among college students from rural areas during micro-interactions, leading them to hesitate to connect with their peers [12]. In addition, there was a difference in the digital reporting of rural and urban students engaged in online learning during the COVID-19 pandemic, with lower levels of behavioral engagement in e-learning courses for rural students relative to urban students [4]. Social capital was discovered through potential Internet self-efficacy and quality of online interactions, with data obtained especially during the peak of the COVID-19 pandemic disease. Research shows that social capital (teachers' and peers' support) is a challenge for rural students [4], particularly in elite universities [5], but few studies have examined how rural students perceive teachers' and peers' interactions through online learning, and how they affect their achievement emotion in online learning. Thus, the purpose of this study was to explore the mediating role of OLSE between teachers' and peers' interaction in online learning and the impact on the three types of emotion of rural students engaged in online learning provided by elite universities during the COVID-19 lockdown.

2. Theoretical Background

2.1. Peer Interaction

Communication and information exchange are central to the development of online learning environments [13] and ongoing two-way communication between peers is important for distance education students [14]. As articulated by Land and Jonassen [15], different perspectives from peers and teachers can be mutually negotiated to help learners form a knowledge base. A few studies have detailed that teacher–student interactions and peer interactions can predict students' learning satisfaction, and that different perspectives from peers and instructor support can be facilitated to shape a knowledge base from which learners can evaluate and negotiate different sources of meaning. Some observational studies have revealed that instructor–student interaction and peer interaction can predict students' learning satisfaction [16,17]. LaPointe and Gunawardena [18] found that peer interaction exerts a strong direct influence on self-reported learning outcomes. In addition, previous research found that students' experiences of interacting with peers in distance courses have a strong emotional and social component, and that online interaction has the potential to reduce feelings of isolation, but may also make students feel more isolated

because in some online courses, peer connections are redundant, inconvenient, and unsupportive of their online learning process. Therefore, students feel uncomfortable and are unable to fit in, and can thus become isolated [14,19]. It is evident that there is no consensus on the effect of online learning peer interaction on learning; therefore, to understand how peer online interaction is perceived by rural university students, this study examined the quality of peer interaction as students were involved in online learning during the COVID-19 lockdown.

2.2. Teacher–Student Interaction

Teacher–student interaction is a traditional education model which focuses on student–instructor communication [20]. Previous studies have found that teacher–student interaction promotes teaching engagement, which has a direct connection with students’ perceptions of the teaching [21]. It is also connected to overall student satisfaction [22]. It was also found that there was a greater likelihood that students who reported having more frequent and higher quality interactions with faculty members would complete their courses [23]. Another study found that in online classrooms, the lack of teacher–student interaction may have been the main reason for learners’ poor performance [24]. Together with the results of other studies on online forums, this indicates the importance of student–teacher interaction in online learning environments. Therefore, during the COVID-19 pandemic, in online learning in elite universities, the quality of student–teacher interactions as perceived by rural students was explored in this study.

2.3. Online Learning Self-Efficacy (OLSE)

Self-efficacy for online learning can predict learners’ achievement emotions in the online learning process. Student–student interaction occurs at a high rate in online learning, and student–student interaction is generated by engagement, communication, and student discussion in either asynchronous or synchronous learning without the teacher needing to be directly involved. If students feel positive emotions during student–student interactions, it can contribute more effectively to their learning persistence [25] and can help them perceive higher levels of learning and acquire higher levels of knowledge and better learning outcomes [26,27]. Teacher–student interaction is also an important aspect of online learning, whereby teachers provide motivation and emotional support to students in such a way that it can enhance and maintain their interest. Social activities and teacher–student interactions have a direct or indirect positive effect on students’ active learning through emotional engagement [28]. The research result showed that students who like to interact with others have a greater tendency to have self-efficacy of interacting with their teachers [29]. One study found that classroom discourse engagement was associated with achievement motivation, and that students perceived that productive teacher talk directly and indirectly encouraged their discourse engagement in mathematics learning [30]. The relationship is one of lower learning anxiety and higher learning enjoyment. In conclusion, good teacher–student and student–student interactions contribute to students’ self-efficacy and promote deeper learning and good achievement emotions in the online learning environment. Elite university rural students’ online self-efficacy is an interesting and previously unstudied case which can shed light on the wider issues of self-efficacy in online learning during the COVID-19 lockdown.

This study therefore explored the role that elite university rural students’ self-efficacy plays in their online learning.

2.4. Achievement Emotions in Online Learning Contexts

Achievement emotions can directly affect students’ learning behaviors and learning outcomes. Some studies have shown that a range of achievement emotions are generated during online learning, and that these emotions are an important factor of online learning quality [31]. Therefore, it is important to explore the possible predictors of achievement emotions in online learning so as to improve online teaching and learning effectiveness.

Achievement emotions are the various emotions that students experience during the learning process which are directly related to the learning outcome and learning process [32]. Achievement emotions are the most important type of emotions in educational situations; they include nine different emotions categorized into three groups, namely enjoyment, boredom, and anger (the activity emotions); hope, anxiety, and hopelessness (the prospective outcome emotions); and pride, relief, and shame (the retrospective outcome emotions) [32,33]. Compared to traditional educational contexts, online learning may exhibit different achievement emotions in students due to changes in the learning environment, technical support, learning styles, and teaching models. The specific online education environment (technological issues, social isolation) may lead to negative achievement emotions (anxiety, frustration, boredom). On the other hand, online learning often leads to positive emotions such as excitement because of the “initiative”, “the ability to interact with more people”, and “a new way of learning” [34]. A previous study indicated that in online learning environments, achievement emotions including enjoyment, monotony, and anxiety are experienced the most frequently and are the highest intensity emotions in academic contexts [35]. Considering this, elite university rural students’ achievement emotions (enjoyment, hopelessness, shame) as they attended online courses provided by elite universities during the COVID-19 lockdown were considered in this study.

3. Research Hypotheses

Based on the above theoretical studies and achievement emotions in the control-value theory, the appraisal of control is associated with achievement emotions because activity and outcome emotions are caused by the ability to control activities and outcomes [8]. Therefore, in an online learning environment, if students perceive that teacher–student and student–student interactions are poor and do not perceive a comfortable learning climate, they may feel hopeless, be unable to enjoy the learning process, and feel ashamed of not being able to complete their learning tasks, thus affecting their online learning engagement. Numerous empirical studies have provided evidence that interaction is positively associated with learners’ online learning self-efficacy [36]. Ma et al. [37] found that, compared with learners in the control group, those in the interactive group experienced higher self-efficacy. Accordingly, to understand the correlates between the two types of instructional interaction, self-efficacy, and the three types of achievement emotion, the research model was proposed as shown in Figure 1. The following hypotheses were also proposed.

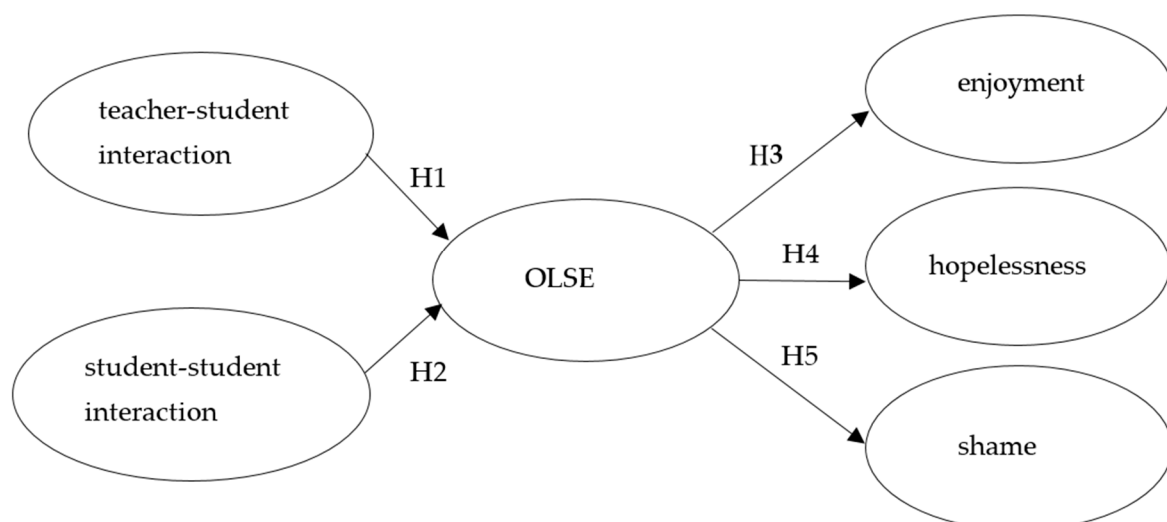


Figure 1. Research model.

In the various models of interaction and exchange, some researchers have focused the definition of interaction in online learning on social purposes and processes, especially teacher–student interaction and student–student interaction [38]. This study thus focused on the interactions between teacher–student and student–student. According to the theory of human–environmental adaptation, a lack of congruence between individual students’ needs and their learning environment was found to lead to reduced emotional and social engagement. In online learning environments, this theory can be adopted to address the relationship between interaction patterns and instructional topics, and to distinguish between teacher–student, student–student, and student–content interactions [39]. Interaction in online courses is defined as the process of interaction between two or more people in a given situation, where interaction always occurs in response to or in a relationship with others [40].

There has been unprecedented disruption to social interactions as a result of the COVID-19 pandemic. For example, students have not been able to take part in their usual social activities [3]. In distance learning environments, it has been recognized that instructional interaction is a critical factor of student satisfaction. Online self-efficacy is positively correlated with three types of interactions [41–43]. For example, Ma et al.’s [37] empirical study found that positive learner–learner interactions led to higher learning self-efficacy, while Alt [44] found that the teacher–student interaction variable played an important role in enhancing students’ intrinsic motivation to learn, contributing to their academic self-efficacy. To identify the relationships that exist for rural students in elite universities when they are involved in online learning, two hypotheses (Hs) were proposed:

Hypothesis 1 (H1). *Teacher–student interaction is positively related to OLSE.*

Hypothesis 2 (H2). *Student–student interaction is positively related to OLSE.*

Achievement emotions are those personal perceived emotions which have a direct relationship with the individual’s achievement activities or outcomes. Self-efficacy indicates a person’s beliefs about the ability to produce action [8,32]. Tang et al. [45] emphasized that self-efficacy contributes to success in specific domains. Achievement emotions are thought to control the multiplicative function of evaluations such as self-efficacy in learning engagement in which learners experience a variety of emotions in academic settings, such as enjoyment, anxiety, frustration, and boredom. Theories of achievement emotions suggest that self-efficacy beliefs and achievement emotions occur in the pathway from the learning environment to achievement-related outcomes, and that self-efficacy beliefs are antecedents of achievement emotions [32]. Numerous studies have shown that positive emotions such as excitement and pride are positively correlated with self-efficacy and have found that students who have high levels of self-efficacy put more effort into their learning difficulties, persist longer, and use richer information processing strategies. Negative emotions such as frustration and anger are negatively correlated with self-efficacy, and negative emotions such as boredom and disappointment reduce motivation and effort and affect students’ learning self-efficacy [7,8]. In addition, shame may be highly correlated with self-efficacy in a subset of students. If students have low self-efficacy for learning, it can lead to shame experiences, and shame has a negative effect on academics; it is not easy to recover quickly from the destructive emotion of shame [46]. Moreover, OLSE is students’ subjective beliefs about their ability to successfully cope with technological, content-related, and other challenges in a virtual learning environment [1]. Increasing students’ OLSE may help increase their positive achievement emotions while at the same time decreasing their negative achievement emotions [31]. The following hypotheses were therefore proposed:

Hypothesis 3 (H3). *OLSE is positively related to enjoyment.*

Hypothesis 4 (H4). *OLSE is negatively related to hopelessness.*

Hypothesis 5 (H5). *OLSE is negatively related to shame.*

Although a variety of emotions occur in online learning environments, this study attended to three specific emotions (enjoyment, hopelessness, and shame). Positive activating emotions (e.g., enjoyment) enhance the motivation to learn and promote learners' use strategies of deep learning [33]. Negative activating emotions (e.g., frustration) occur when students are required to complete difficult tasks [47]. Several studies have shown that positive emotions such as excitement and pride are positively correlated with self-efficacy, and students with high self-efficacy put more effort into their learning difficulties, persist longer, and use richer information processing strategies; while negative emotions such as frustration and anger are negatively correlated with self-efficacy, and negative emotions such as monotony and disappointment reduce motivation and effort and affect students' learning self-efficacy [7,8]. In addition, it has been suggested that shame and self-efficacy may be significantly highly correlated in a subset of students. If students have low self-efficacy for learning, it can lead to shame experiences; shame has a negative effect on academic performance, and it is not easy to quickly recover from [46]. To understand the role of OLSE in the relationship between OLSE and the three types of achievement emotion, the following hypothesis was proposed:

Hypothesis 6 (H6). *Two types of social interactions are significantly related to three types of achievement emotion mediated by OLSE.*

4. Method

4.1. Participants and Procedure

During the COVID-19 outbreak, the main online learning methods for college students in mainland China were lecturers' recordings (students independently studied the lecturer's teaching video and then interacted with the teacher on the teaching platform or in discussion forums such as WeChat), live streaming (teachers taught through live streaming software such as Tencent Conference), lecturer's recording + live streaming (students independently studied the lecturer's recording video and then the teacher answered questions live); Massive Open Online Courses (MOOCs) + live streaming (students learned from MOOCs before classes, then interacted with the teacher in the teaching platform or discussion forums such as WeChat); and MOOCs (students interacted with teachers on teaching platforms or discussion forums such as WeChat after independent study of MOOCs). Those students who were involved in at least one semester of full online learning and who were from rural areas were targeted as the sample of this study.

In this study, questionnaires were distributed through an online questionnaire platform in the spring semester of 2020. A purposive and snowball sampling method was used to deliver the questionnaire to different elite universities in eastern China. The questionnaire was posted on some WeChat groups that were strongly related to rural school alumni. Then, we asked the receivers to fill out the questionnaire and send the link to their acquaintances who were also from rural schools and were attending elite universities. In terms of ethical considerations, participants knew that they could withdraw at any time, and they knew this was academic and educational research.

After eliminating those responses that were filled in too quickly or which were too focused on a particular option, 479 valid questionnaires were obtained, with 31.9% from males and 68.1% from females, 48.2% from first year university students, 32.8% from second year students, 18.0% from third year students, and 1% from fourth year students.

4.2. Measures

4.2.1. Achievement Emotions Questionnaire (AEQ)

Achievement emotions were evaluated using the Achievement Emotions Questionnaire (AEQ) [32]. We selected enjoyment, hopelessness, and shame as the three outcome achievement emotions. The items that were not related to the online learning environment

were deleted, and the relevant items of the original scale were adapted to the characteristics of online learning, using a 5-point Likert scale which ranged from 1 (completely disagree) to 5 (completely agree). The revised AEQ included 11 items. In this study, three constructs were selected, with four items for enjoyment ($\alpha = 0.80$) (e.g., “I am happy to learn something through online learning”), three for hopelessness ($\alpha = 0.81$) (e.g., “During the interaction, I didn’t get feedback from teachers and other students in time, which made me feel hopeless”), and four for shame ($\alpha = 0.82$) (e.g., “I felt ashamed that I couldn’t consciously complete the online learning task on time”). The total scale’s internal reliability was considered to be adequate ($\alpha = 0.77$), and the fit of the confirmatory factor analysis was accepted ($\chi^2/df = 1.83$, Goodness-of-Fit-Index, GFI = 0.97, Adjusted Goodness-of-Fit-Index, AGFI = 0.95, Incremental Fit Index, IFI = 0.98, Tucker–Lewis Index, TLI = 0.98, Comparative Fit Index, CFI = 0.98, Relative Fit Index, RFI = 0.95, Root Mean Square Error of Approximation, RMSEA = 0.42, and Standardized Root-Mean-Square Residual, SRMR = 0.03).

4.2.2. Social Interaction

According to the previous literature synthesis, in online learning, instructional interaction mainly refers to teacher–student and student–student interaction. Accordingly, two dimensions of the online learning interaction questionnaire could be identified: the teacher–student interaction dimension and the student–student interaction dimension. The present study adapted the scale of interaction that was compiled by Kuo et al. [42] and was then revised by Cho [29] and which was designed according to the characteristics of online learning platforms in China. We designed 11 items to measure participants’ Interaction, including two interaction subscales: student–student interaction (seven items, $\alpha = 0.91$) and teacher–student interaction (seven items, $\alpha = 0.93$). Two examples of items are “Teachers often give us study tips or study suggestions” and “I share ideas and thoughts about what I am learning with other learners.” The questionnaire adopted a 5-point scale from “strongly disagree” to “strongly agree”, where a higher score indicated that the respondent perceived more interaction. The total scale showed adequate internal reliability ($\alpha = 0.94$), and the confirmatory factor analysis was acceptable ($\chi^2/df = 3.75$, GFI = 0.93, AGFI = 0.90, IFI = 0.96, TLI = 0.95, CFI = 0.96, RFI = 0.93, RMSEA = 0.076, and SRMR = 0.04)

4.2.3. OLSE

The present study adapted the OLSE scale [48], which consists of five items. It is a 5-point scale ranging from “strongly disagree” to “strongly agree”, where higher scores indicate that students perceive higher self-efficacy. To ensure its internal validity, items with a factor loading of less than 0.5 were deleted. The revised scale consists of four items. The internal reliability of the total scale was adequate ($\alpha = 0.92$) (e.g., “Even in the face of technical difficulties, I am certain I can learn the material presented in an online course”). The model fit indices were adequate ($\chi^2/df = 0.035$, GFI = 1.00, AGFI = 1.00, IFI = 1.00, TLI = 1.00, CFI = 1.00, RFI = 1.00, RMSEA = 0.00, and SRMR = 0.03)

4.3. Data Analysis

Statistical Product and Service Solutions (SPSS), Analysis of Moment Structures (AMOS), and structural equation modeling (SEM) were used for the analysis, which comprised two phases: a confirmatory factor analysis (CFA), which was performed to verify the construct validity of each latent construct, then SEM, which was conducted to confirm the hypothesized measurement model in which self-efficacy is a significant factor in explaining the relationships between teacher–student interaction, student–student interaction, and the three types of achievement emotion.

5. Result

5.1. Correlation Analysis

Table 1 reports the descriptive statistics and correlations between the measured variables. As expected, teacher–student interaction was positively related to self-efficacy ($r = 0.57, p < 0.01$); enjoyment ($r = 0.56, p < 0.01$) was negatively related to hopelessness ($r = -0.17, p < 0.01$) and shame ($r = -0.14, p < 0.01$); student–student interaction was positively related to self-efficacy ($r = 0.70, p < 0.01$); and enjoyment ($r = 0.59, p < 0.01$) was negatively related to hopelessness ($r = -0.19, p < 0.01$) and shame ($r = -0.25, p < 0.01$). Self-efficacy was also significantly related to achievement emotions (enjoyment: $r = 0.65, p < 0.01$; hopelessness: $r = -0.22, p < 0.01$; shame: $r = -0.33, p < 0.01$).

Table 1. Correlation Analysis.

Variable	Mean (M)	Standard Deviation (SD)	1	2	3	4	5	6
Teacher–student interaction	3.77	0.62	1					
Student–student interaction	3.65	0.67	0.68 **	1				
Self-efficacy	3.47	0.79	0.57 **	0.70 **	1			
Enjoyment	3.30	0.76	0.56 **	0.59 **	0.65 **	1		
Hopelessness	2.89	0.90	-0.17 **	-0.19 **	-0.22 **	-0.24 **	1	
Shame	2.95	0.89	-0.14 **	-0.25 **	-0.33 **	-0.39 **	0.59 **	1

** $p < 0.01$.

5.2. Mediating Effects

In order to explore the relationships between instructional interaction and achievement emotions, we established a SEM. Teacher–student interaction and student–student interaction were selected as the predictors of self-efficacy, which predicted enjoyment, hopelessness, and shame. The structural relationships among the variables are shown in Figure 2. The model fit indices indicated that the mediation models were able to adequately explain the data: $\chi^2/df = 2.32$, GFI = 0.89, AGFI = 0.87, IFI = 0.95, TLI = 0.94, CFI = 0.95, RFI = 0.91, and RMSEA = 0.053. All the indicators reached the SEM standards [49]. The parameter estimates shown in Figure 2 indicate that both teacher–student interaction ($\beta = 0.15, p < 0.01$) and student–student interaction ($\beta = 0.63, p < 0.001$) played positive roles in self-efficacy, and self-efficacy increased students' enjoyment ($\beta = 0.76, p < 0.001$) while decreasing their hopelessness ($\beta = -0.28, p < 0.001$) and shame ($\beta = -0.38, p < 0.001$).

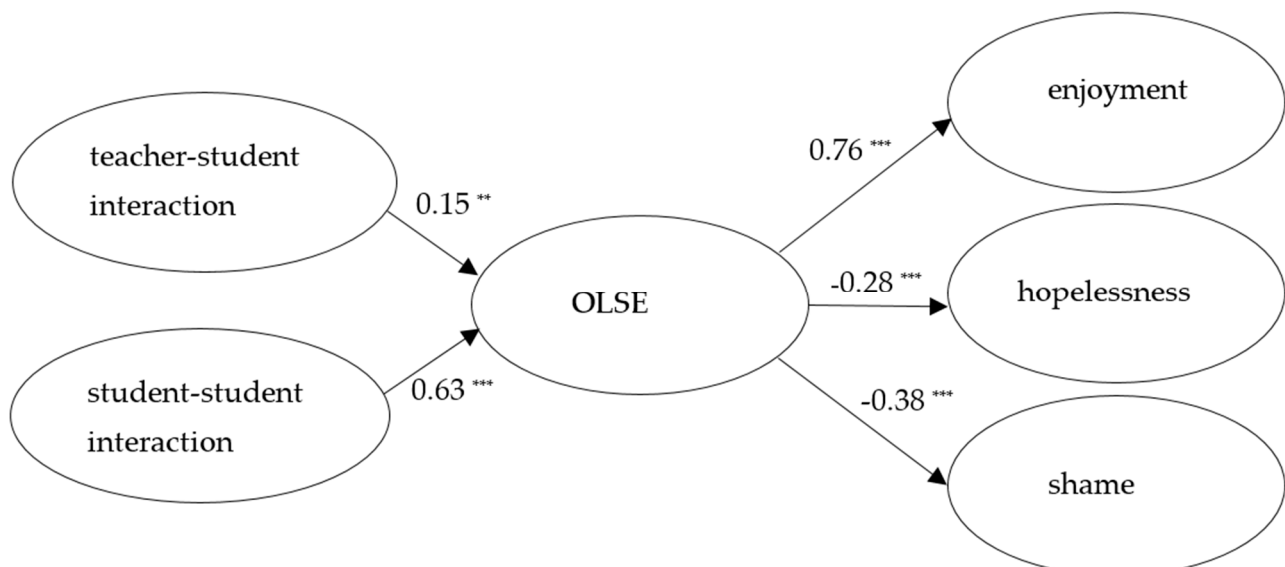


Figure 2. The verification of the research model. ** $p < 0.01$, *** $p < 0.001$.

We then further explored the mediating effect between self-efficacy and enjoyment, hopelessness, and shame in online learning. We employed bootstrapping to calculate the standard errors of the indirect effects and the confidence intervals among effects. When the confidence interval does not include 0, it shows that the effect is significant [50]. The results showed statistically significant indirect effects in all of the models, with the 95% confidence interval excluding zero (see Table 2), which means that the relations between teacher–student instruction, student–student instruction, and enjoyment, hopelessness, and shame were mediated by self-efficacy.

Table 2. Indirect effect analysis.

Indirect Effect	Teacher–Student Instruction		Student–Student Instruction	
	β	95% Confidence Interval (CI)	β	95% CI
enjoyment	0.12 *	(0.00,0.63)	0.48 **	(0.34,0.24)
hopelessness	−0.04 *	(−0.09,−0.09)	−0.18 **	(−0.28,−0.01)
shame	−0.06 *	(−0.01–0.15)	−0.24 **	(−0.34,−0.01)

* $p < 0.05$, ** $p < 0.01$.

6. Discussion

In micro-interactive processes, learners use their skills and intelligence in a strategic way in order to meet the requirements of the educational institution [11]. When studying in urban universities, rural students need to be able to conquer their sense of being cultural outsiders and learn how to integrate themselves into an environment that may seem foreign to them [10]. This cultural cringe can make people from rural areas feel embarrassed, resulting in hesitancy to connect with peers [12]. There are two types of social interactions in online learning, student–teacher interactions and student–student interactions [4]. Moreover, previous research showed that social capital (teachers’ and peers’ support) is a challenge for rural students [4], particularly in elite universities [5]. The achievement emotion theory of [8], which is an emerging concept in the literature on digital education, contributes a basis for describing the different relationships that occur in social networks [51]. Accordingly, this study examined the effects of the perceived teacher–student interaction and student–student interaction on three sub-constructs of achievement emotions (enjoyment, hopelessness, and shame) in relation to elite rural students in China, and explored how achievement emotions were mediated by OLSE. The research model was verified as follows.

Zheng et al. [3] found that students were concerned about social network interactions, especially in online learning contexts. This study found that teacher–student interaction predicted students’ self-efficacy during online learning. The result shows that H1 was positively verified, indicating that during the COVID-19 lockdown, for rural students who attended elite universities and used online learning, their perceptions of teacher–students’ social interaction were the antecedents of their OLSE. This finding echoes previous studies which demonstrated that teacher–student interaction positively influences students’ self-efficacy, that frequent contact between teachers and students is the most important factor in motivating students to learn [52], and that when there are limited resources, it is possible that online teachers will prioritize those teacher–student interaction factors which most strongly influence student satisfaction [6].

Due to the COVID-19 pandemic, social interactions have been limited. Because more education has moved online, OSLE has become a more important factor in students’ academic success. Therefore, their self-efficacy is an important factor in achieving online learning [3]. Moreover, online courses often rely on discussion-based activities in which students share, negotiate, and produce knowledge [53]. When students interact with their peers, they are able to express their ideas and share them with others, which helps them gain a deeper understanding of the online learning content, thus increasing their confidence in their online learning [6]. An empirical study found that positive learner–learner interactions resulted in higher learning self-efficacy [37]. To understand the relationship between peer

interaction in relation to the participants engaging in using online learning during the COVID-19 lockdown, this study found that student–student interaction could positively predict self-efficacy, and so H2 was positively supported. The result supports that positive student–student interactions led to higher levels of learning self-efficacy [37].

It has been argued that self-efficacy is a key factor in performance and persistence in learning [8,45]. A few studies have shown that positive emotions such as excitement and pride are positively correlated with self-efficacy, and that students with high levels of self-efficacy put more effort into their learning difficulties, persist longer, and use richer information processing strategies. Meanwhile, negative emotions such as frustration and anger are negatively correlated with self-efficacy, and negative emotions such as boredom and disappointment reduce motivation and effort and affect students' learning self-efficacy [7,8]. In addition, it has been suggested that shame and self-efficacy may be significantly highly correlated in a subset of students. If students have low self-efficacy for learning, it can lead to shame experiences. Shame has a negative effect on academics, and it is not easy to recover quickly from the destructive emotion of shame [46]. In comparison, OLSE is students' subjective beliefs regarding their ability to successfully cope with technological, content-related, and other challenges in a virtual learning environment [31]. Therefore, increasing students' OLSE may help enhance their positive achievement emotions and decrease their negative achievement emotions. In this study, self-efficacy was associated positively with enjoyment, and negatively with hopelessness and shame. H3, H4, and H5 were significantly verified. Evidence indicates that positive emotions are positively predicted by self-efficacy, and negative emotions are affected by students' learning self-efficacy while learning online during the COVID-19 lockdown.

Different social networks can help develop flexibility and can lead to the emergence of resilience capabilities at the individual level [54]. It plays a prerequisite role in explaining the relationship between the supportive learning climate in schools [55]. To understand the reciprocity between rural students' social interactions and achievement emotion in elite university online learning, the present study examined H6 in the SEM model. As shown in Figure 2, the result indicated that OLSE mediates the relationship between the two types of social interaction and the three types of achievement emotion in online learning during the COVID-19 lockdown. Teacher–student interaction and student–student interaction can increase enjoyment and reduce hopelessness and shame through OLSE. Social interaction has a distal influence on predicting achievement emotions and a proximal influence on cognitive control appraisals [8], which in turn influence achievement emotions. Students can elicit different achievement emotions through controlled evaluations of their learning activities. Students with high self-efficacy perceive online learning as controllable and feel more confident in completing the learning tasks [7], thus increasing their positive emotions (enjoyment) and reducing their negative emotions (hopelessness, shame).

7. Conclusions and Implications

Based on achievement emotion theory, relations among online learning instructional interaction, self-efficacy, and achievement emotions during the lockdown of COVID-19 were examined in this study. According to the findings, rural students' two types of social interactions (teacher-student, student-student) predicted their self-efficacy, and their self-efficacy predicted the three types of achievement emotion (enjoyment, hopelessness, shame) in online learning, while OLSE mediated the relationship between the two types of social interaction and the three types of achievement emotion.

According to the study results, we make the following recommendations for improving the quality of online instruction for rural students in top-tier universities in China. The biggest obstacle to online learning is the inability to carry out learning activities more effectively in real situations based on learners' facial expressions and body language, which can easily cause negative emotions such as hopelessness, shame, and anxiety when students work on cooperative learning tasks. Therefore, teachers should provide as many forms of meaningful guidance for students' online learning as possible, such as interactive activities

and timely feedback on assignments, to help students develop smarter learning strategies and improve their confidence in online learning.

Moreover, it is important to provide teachers with social interaction skills which are necessary to support students' online learning, including the use of online teaching techniques and methods of developing teaching resources for quality online courses. Teachers may change their teaching roles by exploring effective teaching methods which may promote students' achievement emotion in online learning. Specifically, teachers should carefully design teaching sessions, set up a safe and comfortable interactive environment (e.g., discussion, listening, feedback), and achieve good communication during the teaching process. This is because good communication will help teachers motivate students in the classroom, encourage them to learn, and enhance their online learning self-efficacy [56].

8. Limitations and Future Research

Several limitations to this study must be considered. This study only adopted students' self-reports and therefore the detailed causal factors influencing social interactions cannot be determined. To address this limitation, future research may combine focus interviews and in-depth interviews with target participants to discover more influencing factors of rural students' achievement emotions in online learning through qualitative data analysis. In addition, comparative research can be adapted to explore and validate the difference between rural and urban students in terms of those research variables, even for specific domain online learning environments, such as online learning in mathematics.

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