frontiers | Frontiers in Education

TYPE Original Research
PUBLISHED 09 February 2023
DOI 10.3389/feduc.2023.1046737

OPEN ACCESS

EDITED BY
Juzhe Xi,
East China Normal University,
China

REVIEWED BY
Kasiyah Junus,
University of Indonesia,
Indonesia
Yu-Chun Kuo,
Rowan University,
United States

*CORRESPONDENCE
Ping Hu
huping@ruc.edu.cn

†These authors have contributed equally to this work and share first authorship

SPECIALTY SECTION
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

RECEIVED 17 September 2022
ACCEPTED 24 January 2023
PUBLISHED 09 February 2023

CITATION
Xue J, Xu X, Wu Y and Hu P (2023) Student perceptions of the community of inquiry framework and satisfaction: Examining the role of academic emotion and self-regulation in a structural model.
Front. Educ. 8:1046737.
doi: 10.3389/feduc.2023.1046737

Student perceptions of the community of inquiry framework and satisfaction: Examining the role of academic emotion and self-regulation in a structural model

Jinyang Xue†, Xiaohui Xu†, Yuhang Wu and Ping Hu*

Department of Psychology, Renmin University of China, Beijing, China

As many schools remain closed during the COVID-19 pandemic, various courses have to be migrated online. Previous studies have showed that students' satisfaction of the courses could reflect the quality of online learning, which is determined by students' perception of online courses. Although the community of inquiry (CoI) framework provided an effective tool for measuring students' perception in online learning, the mechanisms between the CoI and satisfaction, especially the role of academic emotion and self-regulation, still need to be investigated in the online context. The present study aimed to (1) explore the relationships among three elements of the CoI framework; and (2) explore the relationships between the CoI and satisfaction, as well as the mediating role of academic emotion and self-regulation. The data was collected from 461 university students who were taking online courses in China. The results of Structural Equation Modeling showed that teaching presence significantly and positively predicted social presence and cognitive presence; both positive and negative academic emotions played the mediating roles between teaching presence, social presence and satisfaction; self-regulation played the mediating role between teaching presence, cognitive presence and satisfaction. The present study provided empirical evidence for the dynamics among the CoI framework as well as mechanisms between CoI and satisfaction in the online education environment.

KEYWORDS

community of inquiry, satisfaction, academic emotion, self-regulation, online learning

1. Introduction

According to the data provided by UNESCO (2020), since 2020, many educational institutions have been temporarily closed in order to contain the spread of the COVID-19 pandemic, impacting millions of students around the globe. During this hard period, schools and universities in China were fully closed from February to April in 2020 and partially opened from May to October (UNESCO, 2020), during which time they employed creative approaches to promote distance education and shifted from F2F (Face-to-Face) mode to online mode using Ding Ding, Tencent Meeting, and other office meeting softwares (Chen et al., 2020). In face of the challenge that teaching and learning must be migrated online, all the teachers and students had to adapt to online education mode quickly (Bao, 2020; Holme, 2020; Moorhouse, 2020). In an attempt to ensure the quality of online mode during this period, whether online courses could meet the requirements of teachers and students, whether teaching tasks could be completed with high quality, whether the online learning could be effective (Chen et al., 2020) and other issues are particularly important. The answers to the questions above are directly related to students' satisfaction which could serve as the

feedback on the development and improvement of online courses. According to the Online Learning Consortium (Alqurashi, 2019), one of the most important factors in determining the quality of online courses is satisfaction (Allen and Seaman, 2010; Moore and Kearsley, 2012), which is defined as the success and good experience that students have in online learning (Moore, 2011). In the process of online learning satisfaction is also determined by students' perception of online courses. The community of inquiry (CoI) is one of the theoretical frameworks for exploring the complexities and measuring student's perception of online learning. It is not just the guideline for designing courses and delivering online experiences, for instance, Tan et al. (2020) structured their online courses using the CoI framework. Also, it can function as a good measurement of students' perception of online courses (Garrison et al., 2010; Hosler and Arend, 2012), even for the courses migrated online in a such short notice that were not designed according to the CoI framework due to the limits of the subjects, the size of classes or software (Zhang et al., 2020). The CoI framework can provide lens through which we could not only explore the dynamics of presence and learning in the context of the pandemic but also analyze the ways in which the students' physical, psychological, and social presence interacted in the virtual learning environment. The present study aimed to explore students' perception of online courses under the framework of CoI, the relationship between the CoI and satisfaction as well as the core mechanisms underlying this relationship.

2. Literature review

The CoI framework consists of three elements: teaching presence, social presence and cognitive presence (Garrison and Arbaugh, 2007). First, teaching presence is described as the design, facilitation, and direction of cognitive and social processes, with the purpose of realizing personally meaningful and educationally worthwhile learning outcomes (Anderson et al., 2001). It is composed of three components: (1) instructional design and organization, including the planning and design of the structure, process, interaction and evaluation aspects of the online courses; (2) facilitating discourse, containing the means by which students are engaged in information provided by the course instructional materials; and (3) direct instruction, which refers to how the instructor presents the content, the types of feedback given to the students, and the types of questions posed during the discussions. Due to physical separation, face-to-face communication, instant feedback and direct instruction are reduced in online learning. Under the limitations of tools, the form of teachers organizing classrooms changes. The second element of the CoI framework, social presence, is described as the ability of learners to project themselves socially and emotionally thereby being perceived as "real people" in online learning (Short et al., 1976; Gunawardena et al., 1997). Social presence can be classified as (1) affective expression, for instance, self-disclosure, humor, and the expression of feelings related to learning; (2) open communication, which means that others recognize and respectfully attend to an individual's contributions, enabling risk-free exchanges; and (3) group cohesion, which can be exemplified by activities that build and sustain a sense of group commitment (Borup et al., 2012). Learning environment shifted to online, the most immediate change is the learning environment. It seems that affective communication, and open communication between instructor and learner could be affected in online learning environment. At last, cognitive presence reflects the process of learning and inquiry. Garrison et al. (2001) argued that cognitive presence in online learning is developed through a four-phase process: (1) a triggering event, where the desire to explore further knowledge; (2) exploration, where students can actively explore learning knowledge; (3) integration, where students can analyze, integrate and summarize knowledge; and (4) resolution, where students can use knowledge to solve problems. Since there is no physical space to attend to and no instructor to report to face-to-face, it is up to the student to take charge of their learning, follow the syllabus, and find ways to solve learning problems resulting from the lack of traditional, face-to-face education. The students suffered from cognitive challenges, such as experienced a lack of motivation and concentration and reported difficulties accessing the internet to complete their assignments (Borkotoky and Borah, 2021).

The relationships between satisfaction and three elements in the CoI framework have gained a lot of attention in previous research. Numbers of studies have reported the positive relationships between satisfaction and teaching presence (Garrison et al., 2010; Kranzow, 2013; Ladyshewsky, 2013; Khalid and Quick, 2016), social presence (Harrison et al., 2014; Richardson et al., 2017; Martin and Bolliger, 2018), as well as cognitive presence (Hosler and Arend, 2012; Kang et al., 2014). Kucuk and Richardson (2019) proposed that teaching presence was the dominant determinant of satisfaction, implying that effective instructional design and participatory teaching activities were extremely important in ensuring online learners' satisfaction. However, consistent with Wise et al. (2004), Joo et al. (2011), Kang et al. (2014), and Kucuk and Richardson (2019) found that social presence was not a significant predictor of satisfaction, even though it was significantly correlated with satisfaction, suggesting that social presence and satisfaction share a correlation rather than causal relationship. Likewise, we speculated that similar results would appear in online educational environment. Hence, we proposed the hypotheses between three elements and satisfaction:

> *H1a*: Teaching presence is positively correlated with and predicts satisfaction.
> *H1b*: Cognitive presence is positively correlated with and predicts satisfaction.
> *H1c*: Social presence is positively correlated with satisfaction but not positively predict satisfaction.

Garrison et al. (2010) proposed that the CoI framework attempted to outline not only the three elements, but also the dynamics of online educational experience, which means that the relationships among the three elements and their overlaps provided a key perspective to understand the deep and meaningful online learning experiences. In terms of the relationships among the three elements, the CoI framework suggested that teaching presence functions as the "glue" which combines the other two presences, creating and sustaining them (Garrison et al., 2010; Bissessar et al., 2020). Some previous empirical studies have provided supportive evidence for the central role of teaching presence. For instance, by bivariate correlation analysis, researchers found that there are high correlations between teaching presence and cognitive presence as well as teaching presence and social presence (Akyol and Garrison, 2008; Shea et al., 2010; Kozan and Richardson, 2014). Based on the observed data, Çakıroğlu and Kılıç (2020) found that students with high teaching presence scored high on social presence and cognitive presence as well. Several studies used Structural Equation Modeling (SEM) to examine the relationships among three elements, showing the significant direct effects of teaching presence on cognitive presence (Garrison et al., 2010; Hosler and Arend, 2012). As noted

above, teaching presence in the form of structure (e.g., design) and leadership (e.g., facilitation and direction) is essential for instructive and informative learning approaches, which is related to cognitive presence. Also, teaching activities are critical in establishing social presence by engendering an atmosphere of trust, open communication and group cohesion (Garrison et al., 2010). Combined together, we proposed the hypotheses of the relationships among three elements:

> *H2a*: Teaching presence is positively correlated with and predicts social presence.
> *H2b*: Teaching presence is positively correlated with and predicts cognitive presence.

Further, it is a challenge for researchers to get a comprehensive understanding of the inter-dependence of the three presences. In different educational contexts, the specific nature of this impact t varies depending on discipline, objectives, prior knowledge, and the nature of the communication (Garrison and Arbaugh, 2007). On one hand, the intersections of three elements including selecting content, supporting discourse, and setting climate are mainly carried out by teachers to achieve a meaningful and successful educational experience (Garrison et al., 2001). Bissessar et al. (2020) collected students' perception of the CoI by open- and close-ended questions, demonstrating that assignments and feedback are included in the cognitive and teaching presences, while cooperation, help, and flexibility are involved in both the social and teaching presences. On the other hand, several researchers argued that the complexity of online learning might not be fully captured by the CoI framework, proposing that the autonomy presence and the emotional presence might be the core variables at the intersection among three elements. More specifically, Akyol and Garrison (2011) found the essence of the metacognitive construct at the intersection of the cognitive and teaching presences. Especially, self-regulation is the core element of the metacognition. Likewise, Cleveland-Innes and Campbell (2012) defined emotional presence as the outward expression of emotion, affect, and feeling within individuals and among individuals, which is related to the interaction with students and instructor, implying the intersection of teaching presence and social presence. Hence, compared to complex phenomenon, self-regulation and emotion are variables with clear definition which might be at the intersection between teaching presence and cognitive presence, as well as teaching presence and social presence to better understand the specific nature of the CoI framework.

More specifically, the emotions that students experienced in learning, classroom and testing contexts were defined as academic emotion (Pekrun et al., 2002). Zembylas et al. (2008) found both positive emotions (e.g., excitement for the flexibility of online learning methodology) and negative emotions (e.g., stress for the inability to fulfill other obligations) co-existed and formed particular emotional climates that influenced students' learning experiences. Enjoyment and boredom were two of the most intensely and frequently experienced academic emotions in the online learning environment (Putwain et al., 2018). The relationships between academic emotion and teaching presence as well as social presence have received growing theoretical and empirical attention. First, academic emotion was the reflection and result of teaching presence. Academic emotion was expressed in relation to the various aspects of an online course such as design and organizational issues (O'Regan, 2003). It also reflected students are experiencing the new technologies which are employed in online class and adapting to the transition of learning method and environment (Cleveland-Innes and Campbell, 2012). Dweck (2007) proposed that teachers could decompose complicated learning activities into different and attainable parts and guide students with a clear standard for helping learners experience success. Next, the relationship between social presence and academic emotion was proposed by the CoI framework (Cleveland-Innes and Campbell, 2012) and supported by previous studies. For instance, lack of social presence could lead to a high level of frustration, as well as an unreasonably critical attitude toward the instructor's effectiveness (Garrison et al., 2010; Ke, 2010). Angelaki and Mavroidis (2013) found that approximately 86.2% of the students associated the social presence with positive emotions (e.g., joy, satisfaction), while 48.9% of the students did not connect them at all with negative feelings (e.g., stress, anxiety) during online learning. Zembylas et al. (2008) suggested that students who began to communicate more often and more systematically with their classmates and their instructor would feel enthusiasm more gradually. Furthermore, researchers found that academic emotion was closely related to satisfaction. For instance, both enjoyment and boredom have a strong impact on course satisfaction (Luo et al., 2019). Therefore, it can be concluded that academic emotion plays a mediating role between two presences and satisfaction in both positive and negative directions. Given the central role of teaching presence, we proposed the hypothesis of the mediating role of academic emotion:

> *H3a*: Positive emotion mediates the relationship between teaching presence, social presence and satisfaction.
> *H1b*: Negative emotion mediates the relationship between teaching presence, social presence and satisfaction.

Moreover, students need to improve their self-regulation ability in online learning (Broadbent and Poon, 2015), which is consistent with the goal of teaching and cognitive presence to facilitate learning experiences and outcomes. Kilis and Yıldırım (2018) suggested that self-regulation plays the important role among the three presence types of the CoI framework, which contribute to create a better community of online learning. Morosanova (2013) defined self-regulation in online learning by a self-regulation profile, including indicators of cognitive functional processes (e.g., goal planning, modelling of significant conditions, programming of actions, results evaluation) and instrumental personal-regulatory features (e.g., flexibility, independence, reliability, responsibility, etc). The relationships between self-regulation and teaching presence as well as cognitive presence have been well addressed in both theoretical and empirical levels. With regard to the relationship between self-regulation and teaching presence, it is responsible for instructors to provide structured and supportive guidance for students to improve control of their learning (Garrison, 2003), suggesting that the role of teaching presence maps directly onto self-regulation process (Akyol and Garrison, 2011). In addition, empirical studies provided support for the positive correlation between cognitive presence and self-regulation. Reisoglu et al. (2016) and Shea and Bidjerano (2010) found that cognitive presence was positively correlated with effort regulation. Shea et al. (2012) also found the level of cognitive presence increased with the level of students' self- and co-regulation. Furthermore, previous empirical studies suggested that self-regulation was positively correlated with satisfaction and attitudes (Artino, 2007; Puzziferro, 2008). To be concluded, self-regulation might play the mediating role between two presences and satisfaction. Given the central role of teaching presence, we proposed the hypothesis:

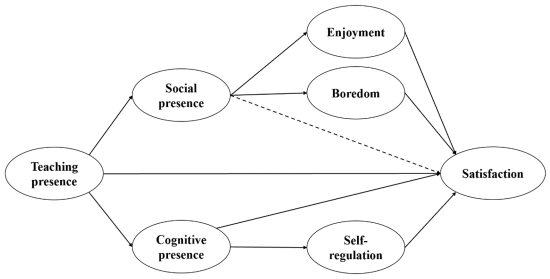

FIGURE 1
Assumption model.

TABLE 1 Information of online courses.

Items	Classification	Frequency (percentage)
"How long have you participated in the online course?"	<1 week	17 (3.7%)
	1–3 week	353 (76.6%)
	>3 weeks	91 (19.7%)
"How long did the courses last on average?"	<60 min	131 (28.4%)
	60–90 min	156 (33.8%)
	>90 min	174 (37.8%)
"How many students on average were there in your online courses?"	<30	84 (18.2%)
	30–60	210 (45.6%)
	>60	167 (36.2%)

> *H4*: Self-regulation plays the mediating role on the relationship between teaching presence, cognitive presence and satisfaction.

In summary, we argue that the CoI framework is a convenient tool to measure the quality of online courses, even for the online courses that are not designed according to the CoI framework. The present study stands in the position of students, aiming to (1) explore the relationships among three elements of the CoI framework; and (2) explore the relationships between the three elements and satisfaction, as well as the mediating role of academic emotion and self-regulation underlying the relationship between the CoI and satisfaction. A representation of the model tested in this study is illustrated in Figure 1.

3. Methods

3.1. Participants and procedure

The study sample included 711 university students in Beijing and Suzhou who were participating in online courses in March 2020. Participants were required to complete the online questionnaire anonymously and voluntarily. The participants who did not pass the items with fixed answers, had the monotonous pattern in answering all items, as well as spent less than 4 min were removed from the samples. Only 461 of 711 participants were valid for data analysis, forming a usable case of 64.8%. There were 103 (22.3%) male and 358 (77.7%) female participants. The majority of the participants (93.9%) were between 19 and 22 years old. 47.1% participants attended online courses for the first time. Table 1 details the information of online courses.

3.2. Measures

3.2.1. Community of inquiry

The scale was adapted from Shea and Bidjerano (2010), which contains three dimensions. Teaching presence (13 items) has 3 sub-dimensions: design and organization (4 items), facilitation (6 items) and direct instruction (3 items). Social presence (9 items) has 3 sub-dimensions: affective expression (3 items), open communication (3 items) and group cohesion (3 items). Cognitive presence (12 items) has 4 sub-dimensions: triggering event (3 items), exploration (3 items), integration (3 items) and resolution (3 items). Participants rated the items using a 5-point Likert scale (1 = "strongly disagree," 5 = "strongly agree"). In the present study, the Cronbach's alpha coefficients of the three subscales and total were 0.95, 0.91, 0.94 and 0.97, respectively.

3.2.2. Academic emotions

Two subscales were adapted from the Achievement Emotions Questionnaire (Pekrun et al., 2011), including a five-item boredom subscale and a four-item enjoyment subscale. Participants rated the items using a 5-point Likert scale (1 = "strongly disagree," 5 = "strongly agree"). In the present study, the Cronbach's alpha coefficients of the two subscales were 0.92 and 0.93, respectively.

3.2.3. Self-regulation

The self-regulation scale was adapted from the Metacognitive self-regulation subscale in the MSLQ developed by Pintrich et al. (1993), including 12 items. It assesses the extent to which the planning, monitoring, and regulating strategies learners utilized during learning. Participants rated the items using a 7-point Likert scale (1 = "strongly disagree," 7 = "strongly agree"). Two items were reverse scored, but their factor landings were smaller than 0.3, so they were deleted (Hair et al., 2019). The Cronbach's α coefficient after deleting items was 0.90.

3.2.4. Satisfaction

The satisfaction scale was adapted from Kuo et al. (2014), including 5 items. Participants rated the items using a 5-point Likert scale (1 = "strongly disagree," 5 = "strongly agree"). In the present study, the Cronbach's alpha coefficient was 0.94.

3.3. Data collection

In March 2020, the questionnaire was distributed to learners in China through an online social communication platform. Participants were told to answer questions according to their online learning experience. After completing the questionnaire, participants were entered in a lottery to win a random amount of money ranging from 5 to 20 RMB as an incentive. Participants should answer all questions before submitting the questionnaire. In the introduction of the questionnaire, the purpose, duration, and anonymity of the survey were explained. A total of 711 questionnaires were collected. The participants who did not pass the items with fixed answers, had the monotonous pattern in answering all items, as well as spent less than 4 min were removed from the samples. Only 461 of 711 participants were valid for data analysis.

3.4. Data analysis

First, the Statistical Package for Social Sciences (SPSS) Version 26.0 was used for the data analyses of descriptive statistics and correlation. Then, SEM was performed using Mplus 7.4 to assess the fitness of the proposed model including seven endogenous variables: teaching presence, social presence and cognitive presence, enjoyment, boredom, self-regulation and satisfaction (Wang and Wang, 2019). At last, we performed multiple mediation analysis to examine the mediating role of academic emotion and self-regulation between the CoI and satisfaction. We used 2,000 bootstrap samples and biases were corrected at 95% confidence intervals to calculate the indirect effect of each variable. If the confidence intervals of the indirect effect do not include zero, the indirect effect is significant at $p = 0.05$ (Hair et al., 2019).

4. Results

4.1. Descriptive statistics and correlations of the variables

The descriptive statistics (the means, standard deviations, and correlations for all variables) are presented in Table 2. All study variables were normally distributed and the results supported the univariate normality assumption, which met assumptions of normality for the purposes of SEM. The results of correlation showed significant positive correlations among three CoI elements, and between enjoyment and three CoI elements, self-regulation, satisfaction, as well as significant negative correlations between boredom and three CoI elements, self-regulation and satisfaction. Moreover, the results revealed that three elements of the CoI were positively correlated with satisfaction, which is partially consistent with H1a, H1b and H1c. Also, teaching presence was positively correlated with social presence ($r = 0.555$), and cognitive presence ($r = 0.659$), which is partially consistent with H2a and H2b.

4.2. Assessment of measurement model

First, four confirmation factor analysis (CFA) were conducted to verify the factor structure of observed variables. All factor loadings were significant at $p < 0.001$ level. The fit indices of the three-factor model for the CoI (χ^2/df = 3.177, CFI = 0.911, TLI = 0.904, RMSEA = 0.069, and SRMR = 0.048), of the two-factor model for the academic emotions (χ^2/df = 3.613, CFI = 0.980, TLI = 0.971, RMSEA = 0.087 and SRMR = 0.021), of the one-factor model of self-regulation (χ^2/df = 4.563, CFI = 0.951, TLI = 0.932, RMSEA = 0.088 and SRMR = 0.038), and of the one-factor model for satisfaction (χ^2/df = 0.894, CFI = 1.000, TLI = 1.000, RMSEA = 0.000 and SRMR = 0.004) indicated a good fit of the collected data and the model (Hair et al., 2019). The full measurement model included seven latent constructs (teaching presence, social presence, cognitive presence, enjoyment, boredom, self-regulation and satisfaction) and 58 observed variables. Standardized factor loadings which represented the relationships between each indicator and the corresponding latent variable ranged from 0.532 to 0.929, indicating that all the latent constructs were well represented by their indicators. Then, to keep the multidimensional nature of the construct explicit and allow the unique component of a facet to relate to other constructs in the model, we divided the items into three or four parcels according to three presences of the CoI framework using an internal-consistency approach (Little et al., 2002). Also, in order to control for inflated measurement errors due to multiple items for the latent variables, we divided the items for self-regulation into three parcels using an item-to-construct balance approach (e.g., successively assigning highest and lowest loading items across parcels; Little et al., 2002). A latent variable SEM was run upon the hypothetical model illustrated in Figure 1. Hair et al. (2019) proposed model-fit indices for estimating the measurement model. They are: (1) Chi-square/degree of freedom (χ^2/df); (2) Tucker-Lewis index (TLI); (3) Root mean square error for approximation (RMSEA); (4) Comparative fit index (CFI); and (5) Standardized root mean residual (SRMR). The final model fitted well, χ^2/df = 2.341, RMSEA = 0.054, CFI = 0.909, TLI = 0.903, SRMR = 0.046.

4.3. Testing hypotheses

Figure 2 displays the final model with standardized path coefficients. The path coefficients between latent variables were all significant, except for the relationship between teaching presence and satisfaction ($\beta = 0.066$, $p = 0.124$). As shown in Figure 2, the direct effects of social presence ($\beta = 0.262$, $p = 0.015$) and cognitive presence ($\beta = -0.243$,

TABLE 2 Descriptive statistics and correlation coefficients between variables.

Variables	1	2	3	4	5	6	7
1 Teaching presence	1						
2 Social presence	0.555***	1					
3 Cognitive presence	0.659***	0.772***	1				
4 Enjoyment	0.493***	0.728***	0.694***	1			
5 Boredom	−0.485***	−0.608***	−0.579***	−0.685***	1		
6 Self-regulation	0.367***	0.518***	0.580***	0.440***	−0.395***	1	
7 Satisfaction	0.496***	0.711***	0.618***	0.824***	−0.703***	0.454***	1
Mean	4.427	3.872	4.115	3.773	2.113	5.351	3.770
SD	0.511	0.697	0.562	0.870	0.905	0.788	0.898
Skewness	−0.931	−0.591	−0.411	−0.774	0.736	−0.282	−0.895
Kurtosis	2.190	0.607	1.116	0.741	0.270	1.223	0.964

***$p < 0.001$.

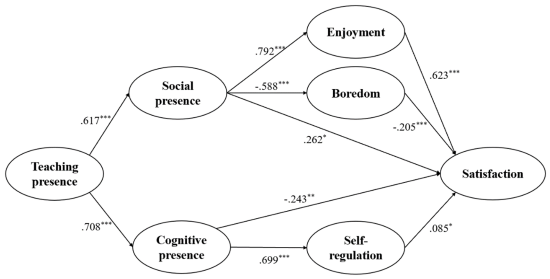

FIGURE 2
Structural equation model.

TABLE 3 Standardized direct and indirect effect values of the determinants on satisfaction.

Hypothesis: Path	Result	Path coefficient	95% CI	
			UP	Down
H1a: Teaching presence→satisfaction	Unsupported	0.066	−0.011	0.155
H1b: Cognitive presence→satisfaction	Unsupported	−0.243**	−0.441	−0.085
H1c: Social presence→satisfaction	Unsupported	0.262*	0.065	0.483
H2a: Teaching presence→social presence	Supported	0.617***	0.545	0.682
H2b: Teaching presence→cognitive presence	Supported	0.708***	0.646	0.772
H3a: Teaching presence→social presence→ enjoyment→satisfaction	Supported	0.304***	0.228	0.400
H3b: Teaching presence→social presence→ boredom→satisfaction	Supported	0.074***	0.040	0.120
H4: Teaching presence→cognitive presence→self-regulation→satisfaction	Supported	0.042*	0.012	0.085

The probability associated with the standardized indirect effects was estimated using the two-sided bias-corrected confidence interval bootstrap test of Mplus 7.4 (confidence level = 95%; bootstrap = 2000). CI, confidence interval. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

$p = 0.007$) on satisfaction were statistically significant. Hence, although three presences of the CoI were positively correlated with satisfaction, they did not predict satisfaction like the hypotheses. H1a, H1b and H1c were all unsupported. The direct effects of teaching presence on social presence ($\beta = 0.617$, $p < 0.001$) and cognitive presence ($\beta = 0.708$, $p < 0.001$) were statistically significant. Therefore, H2a and H2b were fully supported.

The standardized direct and indirect effect values of the determinants on satisfaction are presented in Table 3. The results of the mediation analysis showed that the relationship between teaching presence, social presence and satisfaction was completely mediated by academic emotion. The mediating effect of enjoyment ($\beta = 0.304$, $p < 0.001$) and the mediation effect of boredom ($\beta = 0.074$, $p < 0.001$) between the two presences and satisfaction were significant. Hence, H3a and H3b were supported. Likewise, the results of the mediation analysis showed that the mediating effect of self-regulation ($\beta = 0.042$, $p = 0.027$) between teaching presence, cognitive presence and satisfaction was significant. Hence, H4 was supported.

5. Discussion

5.1. The relationships between the community of inquiry framework and satisfaction

Teaching presence, social presence and cognitive presence were all found to be significantly and positively correlated with satisfaction. However, the results of SEM revealed that the direct effect of teaching presence on satisfaction was non-significant, social presence had a significant positive direct effect on satisfaction, and cognitive presence had a significant negative direct effect on satisfaction, which were inconsistent with previous studies (e.g., Khalid and Quick, 2016; Richardson et al., 2017; Kucuk and Richardson, 2019). First, the direct effect of teaching presence on satisfaction might be weakened by indirect effects through social presence and academic emotion as well as through cognitive presence and self-regulation, implying that the dynamic relationships among three elements might affect the relationship between teaching presence and satisfaction. Second, the direct effect of social presence on satisfaction was significantly positive, which was contrary to our hypothesis but consistent with several previous studies (e.g., Harrison et al., 2014; Richardson et al., 2017; Martin and Bolliger, 2018). Actually, Richardson et al. (2017) indicated a strong, positive relationship between social presence and satisfaction and found that the strength of the relationship was moderated by the course length, discipline area. More specifically, the correlation between social presence and satisfaction tended to be stronger with the longer duration of courses (more than 6 weeks) and varied across discipline area. Likewise, in the present study, students' perception of the online courses was collected based on all discipline areas they had been participated. Also, online mode might last in a long term because of the COVID-19 pandemic. As such, social presence is particular important for satisfaction under this condition. At last, contrary to our hypothesis and previous studies (e.g., Hosler and Arend, 2012; Kang et al., 2014), cognitive presence had a significant negative direct effect on satisfaction. A possible explanation for the result is that some subjects and teaching activities are not suitable to migrate online. For instance, Tan et al. (2020) claimed that for courses involving complex instruments and systems, laboratory work or field visits, one's physical presence still provides an unparalleled advantage over online classes. The substitute of online physical experiment demonstration for hands-on experiment and lack of opportunities to practice might influence the satisfaction about course arrangements. Indeed, students' perception of the CoI framework in the present study was collected based on all types of online courses they participated during this period, which might consist of subjects that were not appropriate for online mode. Besides, participants in the present study reported heavy academic assignments. Under this condition, cognitive presence might strengthen the stressful experience leading to the opposite direction of satisfaction. To sum up, although the relationships between three elements and satisfaction were

not consistent with our hypotheses, the results could be explained by combining with information of our sample, and also suggested that it is possible to explore mechanisms between the CoI and satisfaction.

5.2. Understanding the dynamics among three elements of the community of inquiry framework

Consistent with the CoI framework and previous studies (e.g., Garrison et al., 2010; Ju et al., 2011; Law et al., 2019), results in the present study showed that teaching presence was significantly and positively correlated with and predicted social presence and cognitive presence, supporting the central role of teaching presence in establishing and maintaining social and cognitive presence (Garrison et al., 2010). Indeed, teaching presence encompasses the design and implementation of the online environment to ensure critical thinking and social processes happen meaningfully, more specifically, to maintain a good online teaching atmosphere of open communication and groupwork as well as to enhance deep and meaningful learning (Bissessar et al., 2020). Bissessar et al. (2020) took a participant's statement as an example, suggested that experienced instructor is good at leading the learning and discussion session with high atmosphere and giving systematic guidance to students to help them make improvements through their feedback and comments. Likewise, in face of the sudden challenge of online learning, instructors in the present study who were dominant in the design and implementation of the online courses, structured content in a better way to understand, and created group discussion to simulated the atmosphere like in regular classroom, pursing to make courses suit for the online mode. Therefore, instructors should realize the importance of themselves in the online context, pay more attention to organize the content, offer clear directions, promote learners' active participation and conversation (Ju et al., 2011), and increase the quality of the interaction between students and instructors (Law et al., 2019). Moreover, Akyol and Garrison (2008) suggested that the role of teaching presence could be seen as a process by showing that although teaching presence did not change over time in general, direct instruction of teaching presence increased over 9 weeks while facilitating discourse of teaching presence decreased between the first and second weeks. They explained that during the first 3 weeks, students needed more encouragement and support to express their opinions, and then the need decreased and stabilized after they recognize the expectations of online discussion. Hence, the dynamics among three presences need to be better understand over a long period of time, which should be further investigated in the future.

5.3. The mediating role of academic emotion

Zembylas et al. (2008) claimed that there co-existed positive and negative emotions in online learning, forming particular emotional climates that influenced students; learning experiences throughout the course. Likewise, the result revealed that the effect of teaching presence and social presence on satisfaction was positively mediated by enjoyment, while negatively mediated by boredom.

Consistent with previous studies, emotional experience was tightly associated with teaching presence (e.g., O'Regan, 2003; Dweck, 2007) and social presence (e.g., Garrison et al., 2010; Ke, 2010). Interestingly, the mediating effect of enjoyment was much stronger than boredom, suggesting that social presence might be more tightly associated with positive emotions. It suggested that well-designed courses and proper instructions can encourage students to engage more in social interaction and communication, thus creating an active and positive atmosphere and bring students more enjoyable experiences. Indeed, Angelaki and Mavroidis (2013) found more than 85% of the students associated the elements of social presence with positive emotions while less than 50% did not relate them at all with negative feelings. Some interviewers in Ke (2010) study reported that social interactions increased the enjoyment of the class. Therefore, academic emotion which is influenced by teaching and social presence might be an important variable influencing students' satisfaction. For practice, instructors should pay more effort on the two presences to encourage positive emotions during the process of online learning, for instance, making the learning materials more appealing and organizing interesting learning activities.

5.4. The mediating role of self-regulation

Although the direct effect of cognitive presence on satisfaction was negative, the results revealed that teaching presence and cognitive presence had a significantly positive effect on satisfaction *via* self-regulation. This was consistent with the assertation made by Cho et al. (2017) that self-regulated learners participate in the learning process actively and support teaching efforts by responding to the questions raised by the instructors. Also, Pellas (2014) suggested that the self-regulation in online courses was positively correlated with students' cognitive engagement, which refers to students' active participation and intellectual efforts to construct new knowledge in the learning process using cognitive and metacognitive strategies. Therefore, under the instruction and help of teachers, students could understand their learning environment, construct knowledge and manage resource through cognitive presence (Kucuk and Richardson, 2019), which would help them develop self-regulated learning and increase satisfaction.

It is worth noting that in the present study, students not only took time to participate in online courses, but also faced heavy academic assignments after classes. Setting clear goals of the courses and structuring learning materials would help students use the skills of self-regulation to make schedule and have positive experiences (e.g., satisfaction, success) in online learning. For example, self-regulation skills, such as time management, have been proved to be extremely critical for students' success and engagement in learning during their university career (Krause and Coates, 2008). Therefore, teaching presence, cognitive presence and satisfaction could be bridged by self-regulation which plays a critical role in online learning. Instructors could design instructional and inspirational teaching content that lead students to employ self-regulated learning strategies. Also, any sub-process of self-regulation could be intervened to stimulate student motivation (Eom and Ashill, 2016).

6. Conclusion

The present study aimed to explore students' perception and satisfaction of online courses, as well as the core mechanisms underlying it when universities in China were fully closed due to the COVID-19 pandemic. We tested our hypotheses by running a SEM model to explore the relationships among three elements of the CoI framework

and the mediating role of academic emotion and self-regulation between three presences and satisfaction. The results revealed the central role of teaching presence that teaching presence was positively correlated with and predicted social presence and cognitive presence. Moreover, both enjoyment and boredom played the mediating roles between the teaching presence, social presence and satisfaction, respectively. Self-regulation played the mediating role between teaching presence, cognitive presence and satisfaction. The results of the study showed high value of the CoI framework to evaluate the quality of online courses in the position of student. Also, the present study provided empirical evidence for the dynamics of the CoI framework as well as core variables associated with the intersection among three presences.

7. Limitations and future study

Several limitations of the present study should be noted and addressed by future research. First, the data was collected from February to March in 2020, at the beginning of the spring semester in China. Longitudinal study during the whole semester could be conducted to explore the dynamic change of the three elements over time. Second, participants in the present study took various courses online simultaneously. Different teachers, classmates, class atmospheres and teaching modes might exert possible effect on learners' responses to the CoI questionnaire. Future study should examine how these potential factors affect students' perception of online courses. Third, only enjoyment and boredom were selected as representative positive and negative academic emotions, respectively, in the present study. In fact, students often feel mixed feelings and complex emotions in the online educational context. Future study could take these factors into account to broaden the understanding of academic emotions. Finally, in the future study, it would be valuable to further show how the forms of social, teaching and cognitive presences emerged.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board, Department of Psychology, RUC. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

This work was supported by National Natural Social Science Foundation of China (Major Program) (19ZDA021).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1046737/full#supplementary-material

References

Akyol, Z., and Garrison, D. R. (2008). The development of a community of inquiry over time in an online course: understanding the progression and integration of social, cognitive and teaching presence. *JALN* 12, 3–22. doi: 10.24059/olj.v12i3.72

Akyol, Z., and Garrison, D. R. (2011). Assessing metacognition in an online community of inquiry. *Internet High. Educ.* 14, 183–190. doi: 10.1016/j.iheduc.2011.01.005

Allen, I. E., and Seaman, J. (2010). Learning on demand: online education in the United States, 2009 Sloan Consortium. *NJ1* 21:29.

Alqurashi, E. (2019). Predicting student satisfaction and perceived learning within online learning environments. *Distance Educ.* 40, 133–148. doi: 10.1080/01587919.2018.1553562

Anderson, T., Rourke, L., Garrison, D. R., and Archer, W. (2001). Assessing teaching presence in a computer conferencing context. journal of asynchronous learning. *Networks* 5:1875. doi: 10.24059/olj.v5i2.1875

Angelaki, C., and Mavroidis, I. (2013). Communication and social presence: the impact on adult learners' emotions in distance learning. *Eur. J. Open Dist. E-Learn* 16, 78–93.

Artino, A. R. (2007). Online military training: using a social cognitive view of motivation and self-regulation to understand students' satisfaction, perceived learning, and choice. *Q. Rev. Dist. Educ.* 8, 191–202.

Bao, W. (2020). COVID-19 and online teaching in higher education: a case study of Peking University. *Hum. Behav. Emerg. Tech.* 2, 113–115. doi: 10.1002/hbe2.191

Bissessar, C., Black, D., and Boolaky, M. (2020). International online graduate Students' perceptions of CoI. *Eur. J. Open Dist. E Learn.* 23, 61–83. doi: 10.2478/eurodl-2020-0005

Borkotoky, D. K., and Borah, G. (2021). The impact of online education on the university students of Assam in COVID times[J]. *Indian J. Sci. Technol.* 14, 1028–1035. doi: 10.17485/IJST/v14i13.1809

Borup, J., West, R. E., and Graham, C. R. (2012). Improving online social presence through asynchronous video. *Internet High. Educ.* 15, 195–203. doi: 10.1016/j.iheduc.2011.11.001

Broadbent, J., and Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: a systematic review. *Internet High. Educ.* 27, 1–13. doi: 10.1016/j.iheduc.2015.04.007

Çakıroğlu, Ü., and Kılıç, S. (2020). Understanding community in synchronous online learning: do perceptions match behaviors? *Open Learn.* 35, 105–121. doi: 10.1080/02680513.2018.1500888

Chen, T., Peng, L., Jing, B., Wu, C., Yang, J., and Cong, G. (2020). The impact of the COVID-19 pandemic on user experience with online education platforms in China. *Sustainability* 12:7329. doi: 10.3390/SU12187329

Cho, M. H., Kim, Y., and Choi, D. (2017). The effect of self-regulated learning on college students' perceptions of community of inquiry and affective outcomes in online learning. *Internet High. Educ.* 34, 10–17. doi: 10.1016/j.iheduc.2017.04.001

Cleveland-Innes, M., and Campbell, P. (2012). Emotional presence, learning, and the online learning environment. *Int. Rev. Res. Open Dist. Learn.* 13, 269–292. doi: 10.19173/irrodl.v13i4.1234

Dweck, C. (2007). *Mindset: The new psychology of success: How we can learn to fulfill our potential*. New York, NY: Ballantine Books.

Eom, S. B., and Ashill, N. (2016). The determinants of students' perceived learning outcomes and satisfaction in university online education: an update. *Decis. Sci. J. Innov. Educ.* 14, 185–215. doi: 10.1111/dsji.12097

Garrison, D. R. (2003). Cognitive presence for effective asynchronous online learning: the role of reflective inquiry, self-direction and metacognition. *Pract. Dir.* 4, 47–58.

Garrison, D. R., Anderson, T., and Archer, W. (2001). Critical thinking and computer conferencing: a model and tool to assess cognitive presence. *Am. J. Dist. Educ.* 15, 7–23. doi: 10.1080/08923640109527071

Garrison, D. R., Anderson, T., and Archer, W. (2010). The first decade of the community of inquiry framework: a retrospective. *Internet High. Educ.* 13, 5–9. doi: 10.1016/j.iheduc.2009.10.003

Garrison, D. R., and Arbaugh, J. B. (2007). Researching the community of inquiry framework: review, issues, and future directions. *Int. High. Educ.* 10, 157–172. doi: 10.1016/j.iheduc.2007.04.001

Garrison, D. R., Cleveland-Innes, M., and Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: student perceptions of the community of inquiry framework. *Internet High. Educ.* 13, 31–36. doi: 10.1016/j.iheduc.2009.10.002

Gunawardena, C., Lowe, C., and Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *J. Educ. Comput. Res.* 17, 397–431. doi: 10.2190/7MQV-X9UJ-C7Q3-NRAG

Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2019). *Multivariate data analysis. 8th* Edn. Hampshire, United Kingdom: Cengage Learning.

Harrison, R., Gemmell, I., and Reed, K. (2014). Student satisfaction with a web-based dissertation course: findings from an international distance learning Master's program in public health. *Int. Rev. Res. Open Dist. Learn.* 15, 182–202. doi: 10.19173/irrodl.v15i1.1665

Holme, T. A. (2020). Introduction to the journal of chemical education special issue on insights gained while teaching chemistry in the time of COVID-19. *J. Chem. Educ.* 97, 2375–2377. doi: 10.1021/acs.jchemed.0c01087

Hosler, K. A., and Arend, B. D. (2012). The importance of course design, feedback, and facilitation: student perceptions of the relationship between teaching presence and cognitive presence. *Educ. Media Int.* 49, 217–229. doi: 10.1080/09523987.2012.738014

Joo, Y. J., Lim, K. Y., and Kim, E. K. (2011). Online university Students' satisfaction and persistence: examining perceived level of presence, usefulness and ease of use as predictors in a structural model. *Comput. Educ.* 57, 1654–1664. doi: 10.1016/j.compedu.2011.02.008

Ju, Y., Yon, K., and Kyung, E. (2011). Online university student' satisfaction and persistence: examining perceived level of presence, usefulness and ease of use as predictors in a structural model. *Comput. Educ.* 57, 1654–1664. doi: 10.1016/j.compedu.2011.02.008

Kang, M., Liew, B. T., Kim, J., and Park, Y. (2014). Learning presence as a predictor of achievement and satisfaction in online learning environments. *Int. J. E-Learn.* 13, 193–208.

Ke, F. F. (2010). Examining online teaching, cognitive, and social presence for adult students. *Comp. Educ.* 55, 808–820. doi: 10.1016/j.compedu.2010.03.013

Khalid, M. N. M., and Quick, D. (2016). Teaching presence influencing online students' course satisfaction at an institution of higher education. *Int. Educ. Stud.* 9, 62–70. doi: 10.5539/ies.v9n3p62

Kilis, S., and Yıldırım, Z. (2018). Investigation of community of inquiry framework in regard to self-regulation, metacognition and motivation. *Comp. Educ.* 126, 53–64. doi: 10.1016/j.compedu.2018.06.032

Kozan, K., and Richardson, J. C. (2014). Interrelationships between and among social, teaching, and cognitive presence. *Internet High. Educ.* 21, 68–73. doi: 10.1016/j.iheduc.2013.10.007

Kranzow, J. (2013). Faculty leadership in online education: structuring courses to impact student satisfaction and persistence. *J. Online Learn. Teach.* 9, 131–139.

Krause, K. L., and Coates, H. (2008). Students' engagement in first-year university. *Assess. Eval. High. Educ.* 33, 493–505. doi: 10.1080/02602930701698892

Kucuk, S., and Richardson, J. C. (2019). A structural equation model of predictors of online learners' engagement and satisfaction. *Learn. J.* 23, 196–216. doi: 10.24059/olj.v23i2.1455

Kuo, Y. C., Walker, A. E., Schroder, K. E. E., and Belland, B. R. (2014). Interaction, internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet High. Educ.* 20, 35–50. doi: 10.1016/j.iheduc.2013.10.001

Ladyshewsky, R. K. (2013). Instructor presence in online courses and student satisfaction. *Int. J. Schol. Teach. Learn.* 7:113. doi: 10.20429/ijsotl.2013.070113

Law, K. M. Y., Geng, S., and Li, T. (2019). Student enrollment, motivation and learning performance in a blended learning environment: the mediating effects of social, teaching, and cognitive presence. *Comput. Educ.* 136, 1–12. doi: 10.1016/j.compedu.2019.02.021

Little, T. D., Cunningham, W. A., Shahar, G., and Widaman, K. F. (2002). To parcel or not to parcel: exploring the question, weighing the merits. *Struct. Equ. Model. Multidiscip. J.* 9, 151–173. doi: 10.1207/S15328007SEM0902_1

Luo, Y., Xie, M., and Lian, Z. (2019). Emotional engagement and student satisfaction: a study of Chinese college students based on a nationally representative sample. *Asia Pac. Educ. Res.* 28, 283–292. doi: 10.1007/s40299-019-00437-5

Martin, F., and Bolliger, D. U. (2018). Engagement matters: student perceptions on the importance of engagement strategies in the online learning environment. *Learning* 22, 205–222. doi: 10.24059/olj.v22i1.1092

Moore, J. C. (2011). A synthesis of Sloan-C effective practices. *JALN* 16, 91–115. doi: 10.24059/OLJ.V14I3.167

Moore, M. G., and Kearsley, G. (2012). *Distance education: A systematic view of online learning* (*3rd Ed.*). Belmont, VA: Wadsworth Cengage Learning

Moorhouse, B. L. (2020). Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic. *J. Educ. Teach.* 46, 609–611. doi: 10.1080/02607476.2020.1755205

Morosanova, V. I. (2013). Self-regulation and personality. *Procedia Soc. Behav. Sci.* 86, 452–457. doi: 10.1016/j.sbspro.2013.08.596

O'Regan, K. (2003). Emotion and E-learning. *JALN* 7, 78–92.

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., and Perry, R. P. (2011). Measuring emotions in students' learning and performance: the achievement emotions questionnaire (AEQ). *Contemp. Educ. Psychol.* 36, 36–48. doi: 10.1016/j.cedpsych.2010.10.002

Pekrun, R., Goetz, T., Titz, W., and Perry, R. P. (2002). Academic emotions in Students' self-regulated learning and achievement: a program of qualitative and quantitative research. *Educ. Psychol.* 37, 91–105. doi: 10.1207/S15326985EP3702_4

Pellas, N. (2014). The influence of computer self-efficacy, metacognitive self- regulation and self-esteem on student engagement in online learning pro- grams: evidence from the virtual world of second life. *Comput. Hum. Behav.* 35, 157–170. doi: 10.1016/j.chb.2014.02.048

Pintrich, P. R., Smith, D. A. F., Garcia, T., and Mckeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (Mslq). *Educ. Psychol. Meas.* 53, 801–813. doi: 10.1177/0013164493053003024

Putwain, D. W., Becker, S., Symes, W., and Pekrun, R. (2018). Reciprocal relations between Students' academic enjoyment, boredom, and achievement over time. *Learn. Instr.* 54, 73–81. doi: 10.1016/j.learninstruc.2017.08.004

Puzziferro, M. (2008). Online technologies self-efficacy and self-regulated learning as predictors of final grade and satisfaction in college-level online courses. *Am. J. Dist. Educ.* 22, 72–89. doi: 10.1080/08923640802039024

Reisoglu, I., Islamoglu, H., Çebi, A., Çolak, C., and Bahçekapılı, T. (2016). The relationship of presence, self-regulation, and achievement in educational social networks in G. Chamblee and L. Langub (Eds.), Society for Information Technology & Teacher Education International Conference (pp. 2283-2285). Savannah, GA, United States: Association for the Advancement of Computing in Education (AACE). Available at: https://www.learntechlib.org/primary/p/172345/ []

Richardson, J. C., Maeda, Y., Lv, J., and Caskurlu, S. (2017). Social presence in relation to students' satisfaction and learning in the online environment: a meta-analysis. *Comput. Hum. Behav.* 71, 402–417. doi: 10.1016/j.chb.2017.02.001

Shea, P., and Bidjerano, T. (2010). Learning presence: towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Comp. Educ.* 55, 1721–1731. doi: 10.1016/j.compedu.2010.07.017

Shea, P., Hayes, S., Uzuner, S., Vickers, J., Bidjerano, T., Pickett, A., et al. (2012). Learning presence: additional research on a new conceptual element within the community of inquiry (CoI) framework. *Internet High. Educ.* 15, 89–95. doi: 10.1016/j.iheduc.2011.08.002

Shea, P., Hayes, S., Vickers, J., Gozza-Cohen, M., Uzuner, S., Mehta, R., et al. (2010). A re-examination of the community of inquiry framework: social network and content analysis. *Internet High. Educ.* 13, 10–21. doi: 10.1016/j.iheduc.2009.11.002

Short, J., Williams, E., and Christie, B. (1976). *The social psychology of telecommunication*. Hoboken: John Wiley and Sons Ltd..

Tan, H. R., Chng, W. H., Chonardo, C., Ng, M. T. T., and Fung, F. M. (2020). How chemists achieve active learning online during the COVID-19 pandemic: using the community of inquiry (CoI) framework to support remote teaching. *J. Chem. Educ.* 97, 2512–2518. doi: 10.1021/acs.jchemed.0c00541

UNESCO (United Nations Educational, Scientific and Cultural Organization). (2020). *Monitoring of school closures*. Available at: https://www.unesco.org/en/covid-19/education-response

Wang, J. C., and Wang, X. Q. (2019). *Structural equation modeling: Applications using Mplus. 2nd* Edn. Hoboken: John Wiley & Sons.

Wise, A., Chang, J., Duffy, T., and Del Valle, R. (2004). The effects of teacher social presence on student satisfaction, engagement, and learning. *J. Educ. Comput. Res.* 31, 247–271. doi: 10.2190/V0LB-1M37-RNR8-Y2U1

Zembylas, M., Theodorou, M., and Pavlakis, A. (2008). The role of emotions in the experience of online learning: challenges and opportunities. *Educ. Media Int.* 45, 107–117. doi: 10.1080/09523980802107237

Zhang, Q., He, Y. J., Zhu, Y. H., Dai, M. C., Pan, M. M., Wu, J. Q., et al. (2020). The evaluation of online course of traditional Chinese medicine for MBBS international students during the COVID-19 epidemic period. *Integr. Med. Res.* 9:100449. doi: 10.1016/j.imr.2020.100449