International Journal of Educational
Technology in Higher Education

**RESEARCH ARTICLE**                                                    **Open Access**

# Unveiling the dynamics and impact of emotional presence in collaborative learning

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## Abstract

This study aims to understand the dynamics and impact of emotional presence in a collaborative learning environment and its effects on the learning process and outcomes. Emotional presence, defined as the experience of emotion arising from cognitive appraisals in learner-environment interactions, encompasses four dimensions: interest-curiosity, emotional regulation, expression management, and emotional awareness. Using a mixed-methods approach, we surveyed 33 Japanese college students engaged in collaborative learning activities and conducted in-depth interviews with 10 participants to gather qualitative insights. The study revealed that emotional presence evolves throughout the collaborative process, with increased emotional regulation in response to complex tasks, reflecting learners' adaptations to varying task demands. It highlighted the importance of emotional regulation in shaping the learning process and improving outcomes in collaborative learning. Our findings suggest that heightened emotional presence, with increased emotional awareness and regulation, fosters cognitive development and learner well-being, supporting more effective and fulfilling collaborative learning experiences. The study also emphasizes the crucial role of cognitive appraisal in shaping emotional experiences, significantly influencing outcomes in technology-enhanced environments. The study concludes by proposing future research directions, such as examining the longitudinal impacts of emotional presence and exploring interventions to enhance emotional regulation skills in diverse learning contexts.

**Keywords:** Emotional presence, Emotional dynamics, Collaborative learning, Cognitive appraisal, Blended learning

## Introduction

### Emotional dynamics in learning

Studies in both individual and collaborative learning consistently demonstrate a close relationship between emotions and various facets of learning (Artino et al., 2012; Marchand & Gutierrez, 2012). In particular, numerous studies highlight the significant impact of emotions on learning outcomes or academic performance (Mega et al., 2014).

In individualized learning environments, Hayat et al. (2020) reported that emotions affect metacognitive learning strategies and academic performance. In online learning environments, Wang et al. (2022) discovered a similar result, finding that academic emotions serve as the mediator connecting engagement and learning outcomes. Conversely,

other researchers (Cassady & Johnson, 2002; Chin et al., 2017) revealed that negative emotions, such as anxiety, often hinder academic performance.

In collaborative learning environments, emotions are also crucial, directly impacting academic performance (Ramirez-Arellano et al., 2019). Huysken et al. (2019) and Renninger et al. (2019) found that active social interactions during collaborative learning arouse interest, enhancing motivation and engagement (Baker, 1999). Collaborative learning, where students work together to solve problems or complete tasks, promotes social interaction, shared goals, and co-construction of knowledge. These elements lead to beneficial outcomes across educational levels and disciplines (Howe & Zachariou, 2019; Miyake & Kirschner, 2014), demonstrating the powerful role of emotional engagement in driving academic success.

One of the most intriguing aspects of collaborative learning is the distinctive emotional landscape it reveals, which differs from that of individual learning (Chang & Yang, 2023). Interaction and cooperation among students in collaborative learning can elicit a wide range of emotions, both positive and negative (Hayashi, 2019; Näykki, et al., 2021). In a pretest–posttest experiment with online learners, Chang and Yang (2023) revealed that collaborative learning tends to induce significantly higher positive emotions among learners who prefer a non-linear and broad approach to learning. Furthermore, Järvelä and Renninger (2014) argued that productive socio-emotional interactions in the collaborative process can significantly enhance participation.

Beyond emotions, research highlights the significance of emotional dynamics in learning. D'Mello and Graesser (2012) investigated university students' emotional responses in individualized tutorial sessions and found that unresolved issues often lead to emotional shifts from confusion and frustration to boredom. Similarly, Di Leo et al. (2019) observed these emotional dynamics in elementary students solving challenging mathematics problems. In both cases, timely interventions resulted in re-engagement and flow.

Emotional dynamics in collaborative learning, however, contrasts sharply with those in individual learning. In collaborative learning, emotions are driven by fluctuations in social interactions, leading to interpersonal challenges that directly affect students' learning journeys (Isohätälä et al., 2020; Mänty et al., 2020). Camacho-Morles et al. (2019) studied 100 adolescent pairs and found that emotions like enjoyment, boredom, and anger significantly influenced how students regulated their effort and, consequently, learning performance. However, these studies have not fully addressed when and how these emotional changes occur.

Moreover, Järvenoja et al. (2019) found that students constantly appraise their emotional and cognitive states in collaborative learning, both individually and collectively, in response to challenges. This ongoing self-assessment is seen as crucial for attaining emotional and cognitive balance necessary for successful collaboration (Khosa & Volet, 2014; Näykki et al., 2021). Despite this, the cognitive aspects on how learners appraise learning stimuli within a collaborative setting have not been empirically examined, indicating a gap in the current research.

Recent research highlights that emotions significantly influence student participation and contributions in technology-enhanced learning environments, as emphasized by Chang and Yang (2023). However, findings are mixed (Parlangeli et al., 2012), suggesting situational factors like task design, incentives, and the influence of technology also play

a role (Henrie et al., 2015). Therefore, there is a pressing need for empirical research to understand how these environments shape students' emotional trajectories and engagement in collaborative contexts.

While studies have acknowledged emotional shifts in collaborative learning, the impact of these changes on learning processes and outcomes remains unexplored. This gap indicates a need for in-depth empirical studies to examine the effects of emotional dynamics in collaborative settings on learning and performance. Additionally, there is a critical need for research on the cognitive appraisal of learning stimuli within collaborative, technology-enhanced environments. Addressing this gap would shed light on the interplay between cognitive appraisal, emotional dynamics, and learning navigation in collaborative learning.

### Research framework

To address the research gaps, we outline our perspective and research framework as follows.

First, we align with Pekrun (2006) and Lazarus (1991), who emphasize the role of cognitive appraisal in emotional responses, which are crucial in collaborative learning due to its emotional and cognitive aspects. According to Lazarus's cognitive-motivational-relational theory of emotion (1991), cognitive appraisal evaluates how individuals perceive the environment based on personal and group significance, influencing emotions. Pekrun's control-value theory further highlights that appraisals of control and value in learning trigger emotional arousals. Therefore, we believe that cognitive appraisal should be a core aspect of our framework in exploring emotional dynamics in collaborative learning.

Second, we adopt Author's (2023) conceptualization of emotional presence, which integrates Lazarus's (1991) theory for a comprehensive perspective. Emotional presence is defined as the experience of emotion during ongoing interactions between a learner and the situated learning environment in the epistemic engagement of learning (Author, 2023). Notably, Author's framework includes intrapersonal and interpersonal dimensions, making it well-suited for measuring emotional dynamics in collaborative settings. Currently, a small but growing body of research on emotional presence in online learning (e.g., Cleveland-Innes & Campbell, 2012; Jiang & Koo, 2020; Kang et al., 2007; Sarsar & Kisla, 2016) were found lacking consistency in definitions and measurement instruments. For example, Cleveland-Innes and Campbell (2012) define emotional presence as outward emotional expression, while Kang et al. (2007) define it as the perceived emotional state and management. As for measurement, Cleaveland-Innes and Campbell (2012) developed a six-item scale, Kang et al. (2007) a three-dimensional, 13-item scale, and Sarsar and Kisla (2016) a 21-item scale with two dimensions. Although contextually relevant, these instruments have limitations in their psychometric properties, affecting their reliability and scope.

Addressing these discrepancies, Author's (2023) Emotional Presence Scale (EPS) presents a more unified and comprehensive approach. It consolidates previous models into a cohesive four-factor, 16-item framework that captures a broader spectrum of emotional experiences, offering improved reliability and applicability in diverse learning environments. *The interest-curiosity dimension,* the first factor of the EPS, measures

discrete emotions of interest-curiosity in knowledge exploration and construction, integral to epistemic engagement in learning. *The emotional regulation dimension,* the second factor of the EPS, focuses on strategies that learners use to regulate their emotions throughout the learning process, crucial for managing both positive and negative emotional experiences. *The expression management dimension,* the third factor of the EPS, assesses learners' ability to manage emotional expressions by appraising contextual cues and cultural norms, ensuring their responses align with personal significance and societal expectations. *The emotional awareness dimension,* the fourth factor of the EPS, measures learners' ability to recognize and describe the type and changes in their emotions and identify the reasons behind the occurrence.

This framework proposes a novel approach to measuring emotional dynamics in collaborative learning, drawing on Lazarus's (1991) classical emotion theory. By applying this framework to collaborative learning environments, we aim to capture the dynamic interplay between students' ongoing appraisals of learning stimuli, their resulting emotional experiences, and their subsequent coping strategies. This deeper understanding of emotional dynamics has the potential to transform how we support student success in collaborative learning environments.

### Research questions
To achieve the research objectives, we formulated the following research questions:

- RQ1: How does emotional presence evolve between the beginning and end of a collaborative learning activity in a blended learning context?
- RQ2: How do changes in emotional presence relate to variations in students' meaning-making of the collaborative learning process, as measured by cognitive presence, and learning outcomes, as measured by task performance?
- RQ3: How do students perceive their emotional presence and its fluctuations during the collaborative learning activity?

### Method
This study was conducted in an undergraduate-level course in a small private university in Tokyo, Japan, during the fall term of 2019. The research procedure received approval from the Ethics Review Board of the university (#2019–31), ensuring all necessary ethical considerations were addressed in the study.

### Setting
Over the 10-week course, a 3-week collaborative activity involving planning and implementing a microteaching session was designed following the guidelines for an inquiry-based collaborative learning design suggested by de Lange and Nerland (2018), Fernandez (2010), and Garrison (2017). The activity involved students in a series of inquiry processes, encompassing problem introduction, exploration and comprehension of the problem, integration of information for problem-solving, and ultimately, resolution, as outlined in the cognitive presence scale.

Students were grouped randomly into 16 teams of three or four members each, engaging in collaborative lesson planning and material creation using online platforms (Google Docs, MOODLE, etc.). The activities included a 30-minute microteaching session, recorded for the face-to-face portion of the course. The recorded sessions were later assessed either in a classroom setting or through online platforms, integrating both face-to-face and online components of the course. Progressing through four inquiry phases (planning; exploration; development; implementation and evaluation), the activity established a natural environment to study emotional shifts. After the activity, each student composed an individual reflection note online.

The collaborative learning activity's final grade accounted for 35% of the total course grade. This was based on four tasks: the lesson plan (10%), the teaching materials (5%), a 30-minute microteaching session (5%), and an individual reflection note (15%). While the first three tasks were group assessments, the individual reflection note was evaluated on an individual basis.

## Participants

Quantitative data were gathered from 33 voluntary participants, predominantly female (69.7%, $n = 23$), juniors (39.4%, $n = 13$), and Japanese (87.9%, $n = 29$). To gain qualitative insights, focus-group interviews were conducted with 10 selected participants based on the following criteria: (i) full participation in all stages of the microteaching activity, (ii) completion of the EPS survey at both the beginning and end of the process, and (iii) inclusion of at least two participants from the same group. Additionally, to ensure diverse perspectives, participants were selected from at least two different microteaching topics and varied in age range and country of origin (see Table 1).

## Measurements

### Data were collected using the following instruments

*The Emotional Presence Scale (EPS),* developed and validated by Author (2023), was used to measure the level of emotional presence at different stages of the collaborative learning activity. Comprising 16 items distributed across four dimensions of emotional presence, it employed a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questions underwent slight modification to align with the context of this study. Demographic data, including age range and gender, were also added. The EPS has a Cronbach's Alpha reliability score of 0.861.

*The Cognitive Presence Scale (CPS),* a critical component of the Community of Inquiry (CoI) framework, was used to measure the extent of student's cognitive or meaning-making processes while engaging in collaborative learning. Garrison et al. (2001) define cognitive presence as 'the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry' (p.11). The CPS consists of 12 items on a 5-point Likert scale. It has favorable reliability and construct validity (Arbaugh et al., 2008) and holds a Cronbach Alpha of reliability of 0.950.

*An emotion record sheet,* a one-page, open-ended reflective sheet, was used to document the experience of emotions during the three weeks of the collaborative learning activity. Each emotion record sheet was divided into four main sections,

**Table 1** List of participants in this study

| Participant ID | Gender | Age | Microteaching group | Microteaching topic | Country |
|---|---|---|---|---|---|
| S01* | F | 21 | BL1 | Blended learning | Japan |
| S02* | F | 20 | BL1 | Blended learning | US |
| S03 | F | 19 | BL2 | Blended learning | Japan |
| S04 | F | 21 | BL2 | Blended learning | Japan |
| S05* | F | 20 | BL3 | Blended learning | Japan |
| S06* | F | 20 | BL3 | Blended learning | Japan |
| S07* | F | 18 | BL3 | Blended learning | Peru |
| S08 | F | 20 | BL4 | Blended learning | Japan |
| S09 | F | 20 | BL4 | Blended learning | Japan |
| S10 | M | 21 | BL4 | Blended learning | Japan |
| S11 | M | 21 | BL5 | Blended learning | Japan |
| S12 | M | 20 | BL6 | Blended learning | Hong Kong |
| S13 | M | 20 | BL7 | Blended learning | Japan |
| S14 | F | 20 | GM1 | Gamification | Japan |
| S15 | F | 21 | GM1 | Gamification | Japan |
| S16* | F | 21 | GM2 | Gamification | Japan |
| S17* | M | 20 | GM2 | Gamification | US |
| S18* | M | 19 | GM2 | Gamification | Japan |
| S19 | F | 19 | GM3 | Gamification | Japan |
| S20 | F | 19 | GM3 | Gamification | Japan |
| S21 | F | 21 | GM3 | Gamification | Japan |
| S22* | F | 20 | GM4 | Gamification | Japan |
| S23* | F | 19 | GM4 | Gamification | Japan |
| S24 | M | 21 | GM4 | Gamification | Japan |
| S25 | M | 19 | GM5 | Gamification | Japan |
| S26 | M | 20 | GM5 | Gamification | Japan |
| S27 | F | 21 | GM6 | Gamification | Japan |
| S28 | F | 21 | GM6 | Gamification | Japan |
| S29 | M | 18 | GM7 | Gamification | Japan |
| S30 | F | 20 | GM7 | Gamification | Japan |
| S31 | F | 21 | GM7 | Gamification | Japan |
| S32 | F | 20 | GM8 | Gamification | Japan |
| S33 | F | 20 | GM8 | Gamification | Japan |

* Participants selected for the interview

corresponding to the stages of the activity: planning, exploration, development, and implementation and evaluation. This structure allowed participants to freely document their experience of emotions in various forms, such as sentences, phrases, or single words, specific to each stage of the activity.

*The focus group interview* explored participants' overall experiences of the microteaching activity, including perceptions of emotional presence, attitudes, thoughts, and feelings. The questions covered the four dimensions of emotional presence to complement the quantitative data gathered from the EPS. The interview questions were pilot tested with eight participants. Feedback from this pilot study was used to refine the questions, ensuring their clarity and neutrality.

*Task performance* was assessed by a group grade for the entire collaborative learning activity, which combined three group grades for the three group tasks and an individual grade for the reflection note. In assessing the performance of each task, a set of grading rubrics was developed by the researchers, taking into account both task requirements and common learning outcomes based on Bloom's Taxonomy.

### Data collection

To mitigate researcher bias, a triangulation method integrating data from three sources —questionnaires, focus group interviews, and emotion record sheets —was implemented to cross-verify findings.

The EPS was conducted twice, once in the first week (Time 1) of the collaborative learning activity, and again in the final third week (Time 2) to gauge changes in emotional experiences. In contrast, the CPS was assessed singularly at Time 2, aiming to understand participants' meaning-making during the collaboration. Regarding emotion record sheets, interviewees were invited to reflect on and document their experience of emotions during the activity before the start of the focus group interviews. Focus group interviews were conducted separately with each group, resulting in a total of four focus group interviews. Each session lasted approximately 30 minutes, comprised of 14 questions, and was recorded using a voice recorder.

To measure task performance, the instructor and teaching assistant, who were also researchers in this study, evaluated the four tasks—lesson plan, teaching materials, microteaching video, and individual reflection notes —using established assessment rubrics. Inter-rater reliability was computed to ensure consistency and reduce bias. The teaching assistant's ratings were initially compared with those of the instructor's, and discrepancies were resolved through constructive discussions until consensus was achieved. The intraclass correlation coefficients of all four tasks exceeded 0.900, indicating an 'excellent' level of agreement as per Cicchetti (1994) and Koo and Li (2016).

### Data analyses

To answer RQ1, a paired samples t-test analysis was conducted to compare each participant's emotional presence scores at the beginning (Time 1) and end (Time 2) of the collaborative microteaching activity. The EPS was scored by calculating the mean of the ratings of all items. Additionally, Cohen's *d* was used to calculate the effect size, which measures the magnitude of the difference between the paired observations (Cohen, 1988). Content analysis of emotion record sheets was conducted to capture students' emotional shifts across the four phases of the microteaching activity. The researcher carefully reviewed the content three times, focusing on identifying students' emotional shifts throughout the four phases.

To answer RQ2, bivariate regression analysis was conducted to examine how changes in emotional presence were associated with cognitive presence and task performance.

To answer RQ3, content analysis of the focus group interview transcripts was carried out, examining students' perceptions of their changes in emotional presence during the microteaching activity. A qualitative analysis software, QDA Miner Lite version 2.0.7, was used to systematically code the content of the interview transcripts. Participants were given the opportunity to review and confirm the transcript accuracy

and interpretation to ensure their perspectives were accurately reflected, minimizing researcher misinterpretation. An inductive coding technique, allowing for multiple codes within a unit of meaning (Miles et al., 1994), was applied. After carefully reviewed the content three times, the researcher associated coded messages with relevant text for accuracy. Emerging themes such as 'emotional dynamics' and 'negative emotive experience' were identified. These codes were then grouped into primary clusters (e.g., emotional dynamics, expression management) aligned with the dimensions of emotional presence and research questions.

### Findings

Prior to conducting further data analyses, a normality test using a Shapiro–Wilk's test was carried out to assess the distribution of the data. The test indicated that emotional presence data, measured at two different times during the activity, were approximately normally distributed, with a skewness of -0.665 (SE = 0.41) for Time 1, and -0.237 (SE = 0.41) for Time 2. The reliability of the measurements from both times showed a mean Cronbach's alpha value of 0.751. The Shapiro–Wilk's test also showed that CPS data were normally distributed, with a skewness of -0.248 (SE = -0.47). The reliability of the CPS was 0.840. These results indicate that the two sets of data were normally distributed, and thus, parametric tests assuming normality will be conducted. The Shapiro–Wilk's and Kolmogorov–Smirnov tests both revealed significant results for all four tasks. These results demonstrate that this data violates the normality assumption, necessitating the use of non-parametric statistical procedures.

### RQ1: Changes in emotional presence over time

Paired samples t-test analysis was performed at the construct and dimensional levels of emotional presence (see Table 2). At the construct level, the level of emotional presence increased significantly toward the end of the microteaching activity ($M = 3.82$, $SD = 0.47$) when compared with the beginning stage ($M = 3.66$, $SD = 0.34$), $t$ (32) = -3.29, $p = 0.002$. The calculated Cohen's d value for the change in emotional presence indicated a medium effect size, at 0.57.

**Table 2** Changes in emotional presence and its four dimensions over time

|  | Time | Mean | SD | $t$ | df | $p$ (2-tailed) |
|---|---|---|---|---|---|---|
| Emotional presence | Time 1 | 3.66 | .34 |  |  |  |
|  | Time 2 | 3.82 | .47 | -3.29 | 32 | .002** |
| - Interest-curiosity | Time 1 | 3.61 | .57 |  |  |  |
|  | Time 2 | 3.85 | .64 | -2.70 | 32 | .011* |
| - Emotional regulation | Time 1 | 3.76 | .44 |  |  |  |
|  | Time 2 | 3.81 | .54 | -.51 | 32 | .616 |
| - Expression management | Time 1 | 3.59 | .64 |  |  |  |
|  | Time 2 | 3.86 | .57 | -2.78 | 32 | .009** |
| - Emotional awareness | Time 1 | 3.62 | .46 |  |  |  |
|  | Time 2 | 3.80 | .60 | -1.74 | 32 | .091 |

** Result is significant at .01 level

* Result is significant at .05 level

At the dimensional level, all four dimensions showed an increase in mean value at Time 2 compared to Time 1. Among them, interest-curiosity, $t(32) = -2.70$ ($p = 0.011$), and expression management, $t(32) = -2.78$ ($p = 0.009$) increased significantly over time. There was a 0.24 increase for interest-curiosity from Time 1 ($M = 3.61$, $SD = 0.57$) to Time 2 ($M = 3.85$, $SD = 0.64$); and a 0.27 increase for expression management from Time 1 ($M = 3.59$, $SD = 0.64$) to Time 2 ($M = 3.86$, $SD = 0.57$). Emotional regulation increased from Time 1 ($M = 3.76$, $SD = 0.44$) to Time 2 ($M = 3.81$, $SD = 0.51$) but not significantly, $t(32) = -0.506$ ($p = 0.616$). Similarly, the level of emotional awareness increased from Time 1 ($M = 3.62$, $SD = 0.46$) to Time 2 ($M = 3.80$, $SD = 0.60$), but not significantly, $t(32) = -1.74$ ($p = 0.091$).

The data from the emotion record sheets were qualitatively analyzed according to the four phases of the microteaching activity—planning, exploration, development, and implementation and evaluation. Changes in emotional presence were noted at each phase, with its concomitant demands.

In the *planning phase* of the collaborative activity, emotions of nervousness, anxiety, and excitement were mostly frequently mentioned. Nervousness was often associated with meeting new members, while feelings of relief was related to having familiar faces in the group. Overall, participants were nervous but excited to embark on this activity with the new group.

In the *exploration phase*, the most frequently cited emotions were interest-curiosity and confusion. For instance, participants recalled feeling '*confused with the topic*', '*feeling curious about the new topic*'. Additionally, they expressed excitement about learning more, seeing its relevance to their future careers. A range of other emotions were also mentioned, including feeling neutral, doubtful, stressed, relaxed, hopeful, nervous, and anxious. These varied emotive experiences were attributed to the different aspects of the exploration phase.

During the *development phase*, participants integrated an instructional design model into their lesson plan and created teaching materials. The predominant emotions during this phase were similar to those in the exploration phase, notably interest-curiosity and confusion. Participants faced challenges, as highlighted by S18 who stated, "*Developing the material was the hardest part as we had to make intense information easy and understandable.*" Positive emotions like interest, excitement, and hope arose, particularly from cognitive and moral support of group members. Other emotions noted included enjoyment, hopefulness, doubtfulness, stress, and a sense of being troubled.

The *implementation and evaluation phase* involved teaching the lesson to a peer group and reciprocally observing their lesson, followed by reviewing the recorded microteaching video with another peer group for assessment. The most highly cited emotions were interest-curiosity and nervousness, followed by excitement, stress, and worry. Participants attributed their interest-curiosity to the innovative teaching methods observed in other groups. As the session concluded, many experienced reliefs and a sense of accomplishment, although S22 expressed regret about their group's performance, feeling that they could have done better.

The key findings reveal that students experienced an increase in emotional presence during the activity, specifically a heightened sense of interest and curiosity in

knowledge exploration. These findings suggest that collaborative activities can evoke dynamic emotional experiences.

### RQ2: Relationships among changes in emotional presence, cognitive presence and task performance

Since the task performance data did not follow a normal distribution, Spearman's correlation analyses were used to assess the correlations among the constructs (see Table 3).

At the construct level, the change of emotional presence and cognitive presence showed a significant and positive relationship ($rs = 0.55$, $p < 0.01$). The change in emotional presence was significantly correlated only with the lesson plan ($rs = 0.60$, $p < 0.01$), indicating relationships between emotional presence, cognitive presence, and task performance in the lesson plan. However, no significant correlations were found for the remaining tasks – teaching materials, microteaching video, and individual reflection note. This suggests that these variables do not have established relationships.

At the dimensional level, the change in emotional regulation was significantly correlated with the lesson plan ($rs = 0.62$, $p < 0.01$). Apart from that, all other dimensions of emotional presence showed a weak correlation ($rs = 0.36$ -0.37, $p < 0.05$) or no correlation with each task.

The central findings reveal the interconnectedness between emotional presence, cognitive presence, and task output. Notably, increased emotional regulation positively affects task output. This indicates a significant relationship between the constructs.

### RQ3: Students' perceptions of emotional presence

To understand students' perceptions of emotional presence in the blended collaborative learning activity, focus group interview data were analyzed according to the four dimensions of emotional presence.

As for *emotive experience*, participants underwent diverse emotional shifts during the activity. Generally, there was a gradual increase in interest-curiosity as they delved into new information. S23, initially uninterested in microteaching, found the topic intriguing after exploring more information. Similar sentiments were echoed by S22, whose interest grew with understanding. Yet, S01 described her experience as '*fluctuating like a wave*'. Confusion, stemming from knowledge gaps and language barriers, became evident. While several students initially found the content confusing, clarity emerged as the activity progressed. Another emotional shift occurred concerning stress, nervousness, and anxiety. Initial uncertainties, such as meeting new group members and grappling with assigned topics, led to heightened unrest. Collaboration, particularly in meeting unexpected demands and deadlines, induced negative emotions. For instance, S02, who was most fluent in English in a team of Japanese natives, felt the added pressure of their reliance on her.

Regarding *emotional awareness*, varying levels were observed among the participants. S01 and S02 demonstrated complete awareness of their emotions throughout the activity, whereas S16 and S17 were predominantly unaware of their positive emotional experiences, only recognizing negative aspects. S16 articulated, '*Negative emotions, I was totally aware of them (laughing). Oh my God, pretty stressed*!' This heightened awareness stemmed from being significantly affected by negative experiences, coupled with busy

**Table 3** Correlations for change of emotional presence and its four dimensions, cognitive presence, and task performance

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Change (emotional presence) | 0.2 | 0.3 | 1 | | | | | | | | | |
| 2. Change (interest-curiosity) | 0.2 | 0.5 | .475** | 1 | | | | | | | | |
| 3. Change (emotional awareness) | 0.2 | 0.6 | .676** | .199 | 1 | | | | | | | |
| 4. Change (emotional regulation) | 0.04 | 0.5 | .564** | -.034 | .126 | 1 | | | | | | |
| 5. Change (expression management) | 0.3 | 0.6 | .436* | .195 | .004 | .121 | 1 | | | | | |
| 6. Cognitive presence | 3.9 | 0.5 | .551** | .255 | .276 | .568** | .115 | 1 | | | | |
| 7. Task 1—Lesson Plan | 7.8 | 0.8 | .602** | .164 | .341 | .624** | .143 | .427* | 1 | | | |
| 8. Task 2—Teaching Material | 4.4 | 0.3 | .182 | .363* | .372* | -.035 | -.172 | .182 | .100 | 1 | | |
| 9. Task 3—Microteaching Video | 4.6 | 0.6 | .060 | .143 | .143 | -.053 | .069 | .109 | -.063 | -.055 | 1 | |
| 10. Task 4—Individual Reflection Note | 10.2 | 1.4 | .202 | .159 | .204 | -.081 | .160 | .267 | .160 | .052 | .231 | 1 |

** Correlation is significant at the .01 level (2-tailed)

* Correlation is significant at the .05 level (2-tailed)

schedules and the completion of other assignments under tight deadlines. Additionally, the pressure to 'perform' and being recorded on the final day of microteaching, contributed to elevated stress levels along the way.

Regarding *emotional regulation*, participants employed diverse strategies to navigate positive and negative emotions. 'Savoring the good experience' emerged as a method to regulate positive emotions, with S17 and S18 utilizing the enjoyable aspects of gamification to plan an exciting future class. Amidst heightened negative emotions, most participants opted for the 'refocusing on planning' strategy, believing that addressing issues directly in their planning would be the most effective way to alleviate emotions. However, S17 recounted using a 'self-blame avoidance' strategy to cope with stress, finding solace in the idea that teammates shared responsibility for the issues. Expressing thoughts or feelings directly on the team's communication platform (such as Google Docs or LINE) was the chosen approach for most.

Regarding *expression management*, participants faced various instances where expressing emotions during stressful situations was necessary. These situations often pertained to collaborative issues, including unequal participation, meeting task deadlines, and managing expectations among members. When deciding to communicate their concerns, participants first evaluated the group culture and the appropriateness of expressing such emotions. On certain occasions, some students, such as S23, chose to withhold their concerns altogether, prioritizing group harmony over individual expression.

The core findings indicate that complex emotive experiences in collaborative learning can lead to heightened awareness of both personal and collective states. Significantly, negative emotional experiences, such as frustrations and nervousness, induce cognitive appraisals that evaluate the suitability of expression and regulation strategies.

## Discussion

This study explored changes in emotional presence at different stages of collaborative learning and its effects on learning processes and outcomes in a university class. The study found that emotional fluctuations in collaborative learning demonstrate its dynamic nature. Emotional presence varied with different phases and task demands, showing a significant correlation between enhanced emotional regulation and cognitive presence. Notably, effective management of negative emotions aided task sustainability in collaborative learning environments.

First, consistent with previous research, the present study revealed that emotional fluctuations occur in collaborative learning, as demonstrated by Isohätälä et al. (2020) and Järvenoja et al. (2019). Students experienced emotional shifts across two distinct periods, starting with initial nervousness during the planning phase, to curiosity and confusion in the exploration phase, and culminating in hope and relief during the implementation and evaluation phase. These fluctuations were mainly driven by factors such as unequal participation in group tasks, perceived control over group outcomes, and task complexity, as revealed by participants in the focus group interviews. As Author (2023) explains, these emotional transitions reflect the students' ongoing adaptation process. This multifaceted process involves navigating both online and face-to-face elements, engaging effectively with team members, comprehending and completing tasks, and maintaining cognitive and affective well-being while achieving learning objectives.

Furthermore, the study uncovered that emotional presence varied not only across different phases but also in response to various task demands. This finding can be explained by two theories. Pekrun's (2006) control-value theory suggests that task demand influences incentive value, leading to diverse emotional experiences; whereas Lazarus's (1991) cognitive-motivational-relational theory sees adaptation to task demands as continuous cognitive appraisals triggering changes in emotional presence. Both theories agree that changes in internal emotional processes, including cognitive components such as the awareness, expression, and regulation of emotion, are crucial for academic sustainability and success.

The study presents another noteworthy finding: a significant correlation exists between enhanced emotional regulation, a key dimension of emotional presence, and cognitive presence. First, learners who apply positive emotional regulation strategies exhibit a higher level of cognitive presence. The increase in cognitive presence is attributed to heightened regulation of positive epistemic emotions of interest-curiosity, which acts as a motivational force in knowledge exploration. This finding aligns with Litman's (2008) argument that learners who satisfy their curiosity for new knowledge or effectively navigate the uncertainty caused by lack of knowledge are better at attaining learning goals. While previous research, such as Järvenoja et al. (2019), has focused on negative emotional regulation in the context of challenges faced during collaborative learning, our study highlights the importance of positive emotional regulation. Further, our study suggests that emotional regulation, which involves both indulging in interest-curiosity and managing negative emotions, enables learners to meet situational demands. This process aligns with Boekaerts and Pekrun's (2016) argument, suggesting that such regulation is instrumental in achieving both short-term and long-term goals.

The study reveals that negative emotional regulation and careful expression management significantly aid in maintaining task sustainability in collaborative learning environments. It may do so by mitigating task-irrelevant cognitive activities and reducing the risk of burnout (Eysenck, 1979, p.365). Our study showed that learners utilized both adaptive and maladaptive strategies to regulate negative emotions in collaborative tasks. Common adaptive strategies included 'refocusing on planning' to tackle teamwork challenges like meeting task deadlines. Simultaneously, learners also employed maladaptive strategies such as emotional suppression to avoid straining relationships. While previous research (e.g., Seibert et al., 2017) emphasizes the effectiveness of adaptive strategies, our study highlights that in high-context cultures like Japan, emotional suppression might be more prevalent due to cultural norms favoring indirect or subtle communication (Author, 2012). In Japan, cultural norms emphasizing harmony and indirect expression tend to influence emotional experiences and coping strategies as discussed in Ozkul and Aoki (2007) and Matsumoto et al. (2008). This tendency toward emotional suppression aims to maintain group harmony and avoid conflict, reflecting broader societal values (Nisbett, 2003). Our findings highlight the need for culturally sensitive educational strategies that acknowledge diverse methods of emotional regulation. Further research is necessary to explore these dynamics in other high-context cultures and to enhance collaborative learning across diverse settings.

According to Burić et al. (2016), emotional suppression in academic settings is linked to increased learning enjoyment and pride. In our study, some participants prioritized

collective objectives over expressing negative emotions during conflicts. They used technological tools such as LINE, a popular SNS in Japan, to subtly convey emotional cues, representing a novel way to regulate negative emotions. This aligns with our observation of increased expression management in collaborative activities. Therefore, our study highlights the significant role of cognitive appraisal on the influence of cultural and environmental factors on expression management, crucial for maintaining group harmony and individual well-being in collaborative learning.

Moreover, the study extends beyond previous research, such as Järvenoja et al. (2019), which explored emotional regulation strategies in collaborative learning. We found a direct correlation between enhanced emotional regulation and improved learning outcomes, particularly in task performance during lesson planning. The perceived importance and demand of the lesson plan in microteaching activities likely contribute to this correlation. The reflective nature of the lesson plan influenced learners' collaboration and marked the quality of their collaborative work. Effective emotional regulation strategies facilitated better handling of collaborative challenges, leading to improved social and cooperative behaviors and enhancing overall collaborative task performance. Supporting this, studies by Gumora and Arsenio (2002) and Thompson (1991) highlight the importance of emotional regulation in academic success. Eisenberg et al. (1995) note that failing to manage negative emotions can adversely affect social competency. Thus, our findings suggest that emotional regulation strategies help overcome immediate collaborative challenges and play a vital role in overall academic and social effectiveness.

Our study underscores the critical role of emotional regulation, a key aspect among the four dimensions of emotional presence, in influencing volitional and learning regulation strategies, aligning with Boekaerts' dual processing model (Boekaerts & Pekrun, 2016). This model emphasizes dual pathways of emotional appraisals that lead to learning mastery and well-being. This interplay between emotional regulation, learning mastery, and well-being is vital in collaborative settings. Additionally, technology enables effective self-regulation and group-regulation strategies, thereby enhancing interaction and the overall collaborative learning experience.

## Conclusion

This study significantly advances our understanding of emotional presence in educational contexts, clarifying the dynamic nature of emotional changes across various stages and tasks in inquiry-based collaborative learning. Notably, it emphasizes the crucial role of cognitive appraisal in shaping emotional experiences and underscores the influential interplay between emotional and cognitive presences, which ultimately impacts the outcomes of collaborative learning. This research offers practical insights for instructional designers and educators, providing them with effective pedagogical strategies to foster positive emotional transitions and effective emotional regulation in collaborative learning, particularly in technology-enhanced environments. For example, instructional designers and educators can enhance online collaborative classes by incorporating activities that help students recognize and articulate their emotions. Starting and ending lessons with short reflection sessions where students share their feelings about the collaborative process builds emotional awareness and empathy. Another example is integrating technology like SNS during collaborative activities so that students can readily express their emotions and diffuse conflicts when

needed, as found in our study. Additionally, creating a supportive, collaborative culture that celebrates collective achievements further enhances students' emotional well-being and academic performance.

However, it is crucial to acknowledge certain limitations. The data were derived from a relatively small student cohort, requiring cautious interpretation of the observed effect sizes. Future studies with larger samples sufficient for quantitative analyses are necessary to validate and strengthen our findings. Furthermore, the collaborative activity lasted only three weeks, which may limit the generalizability of the results to longer-term emotional changes in collaborative learning contexts. Further research is needed to explore emotional shifts over extended periods, such as a semester, a year, or beyond to provide insights into how emotional dynamics evolve over time. Longer studies might reveal patterns of emotional adaptation, resilience, and sustained engagement that short-term studies cannot capture. Moreover, this study focused exclusively on the cognitive aspect of presence, omitting the teaching and social dimensions of the CoI framework. Future research incorporating these dimensions could provide a more comprehensive understanding of the interrelations between emotional presence and the broader spectrum of experiences encountered by university students in blended collaborative learning environments. For instance, teaching presence, involving instructional design and facilitation, could show how teacher interventions impact students' emotional regulation and motivation. Social presence, encompassing the sense of community and interpersonal relationships, could illuminate how peer interactions and group dynamics influence emotional well-being and collaborative efficacy.

**Abbreviations**
EPS    Emotional presence scale
CPS    Cognitive presence scale
CoI    Community of Inquiry

## Declarations

**Ethics approval and consent to participate**
This study was approved by the Institutional Review Board of International Christian University, approval number 2019-31. Written informed consent was obtained from all study participants.

**Competing interests**
The authors report no competing interests.

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