Hong Kong higher education students' perceived adjustments in their community of inquiry presence during political turmoil and the COVID-19 pandemic

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Abstract

This study adopted a quantitative approach to explore learning adjustment in terms of the students' perceived adjustments in teaching, cognitive and social presence in the community of inquiry (CoI) framework from face-to-face classroom to online learning, and then from online to blended learning in the case of a higher education institution in Hong Kong. The online CoI survey was conducted to collect data from a convenience sample of 212 participating students who experienced the transition from classroom to online learning, and then the transition from online to blended learning in the case of the higher education institution. Analysis of variance, pairwise comparisons, correlation and multi-group analyses were performed on the collected data. The analytical results indicated that the students perceived four adjustments in their CoI presences in the online classroom and blended learning. (1) Classroom learning exhibited the strongest CoI presence while online learning rendered the weakest CoI presence. (2) Cognitive presence was the most important while social presence was the least important for learning. (3) All correlations among the CoI presence were positive with large correlations in online and blended learning modes. (4) All the teaching, cognitive and social adjustments were positively and largely correlated. These findings provide implications for further studies on exploring the explanation for the student's learning adjustment and investigating the learning improvement strategies for online education.

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Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
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1. Introduction

Many face-to-face classroom learning activities in Hong Kong were obliged to change to online learning due to the political turmoil and a series of protests and confrontations in Hong Kong from late September to December in 2019. For example, the management of the Hong Kong Polytechnic University which was occupied by the activists requested that all the students and staff members stay away from the campus and decided to substitute all classroom face-to-face learning activities with online mode. Then, the change from the online mode to the blended mode at the Hong Kong Polytechnic University was caused by the outbreak of the COVID-19 pandemic in February 2020. The management of the Hong Kong Polytechnic University implemented a special arrangement for the staff members to choose to work at home or office while the students were not required to go to the campus for learning and were provided with more interactive activities for learning through blended learning to reduce the risk of spreading COVID-19 in the community.

Meanwhile, the Hong Kong Polytechnic University students have experienced adjusting from classroom learning to online learning from online learning to blended learning. In classroom learning, the students have face-to-face contact with their teachers and classmates and learn through the teachers' delivery of concepts and discourse in the classrooms. In online learning, the students learn by viewing the learning materials posted on the online education platform by themselves at any place and any time outside the classrooms. They can ask questions and discuss with their teachers and peer students through the discussion forum at the online education platform or communication means (e.g., email, phone and instant messaging). Blended learning is mainly online learning complemented with interactive meetings among the students and the teachers together with the learning materials available online for access. For the interactive meetings in the case institution, the students and the teachers can have virtual face-to-face interactions using video conferencing technology.

Students' adjustment to a new learning environment has been addressed as a crucial determinant of their learning achievements. For example, some previous studies (e.g., Yau et al. [1]) reported that students' successful adjustment from secondary (or high) school to the university environment has an impact on their future achievements. The researchers considered their change in learning achievement outcomes to investigate the students' learning adjustment. Their grade point averages (GPAs), course grades and examination scores are widely accepted as definitive tools to operationalize the students' learning achievement outcomes [2]. In this institution, the students were given examinations for classroom learning. However, regardless of e-portfolios [3] and other online assessment practices [4] additional assignments were used to replace the examinations for online and blended learning modes making the summative assessments in the different learning modes and the students' GPAs incomparable. Instead, the researchers adopted the Community of Inquiry (CoI) framework proposed by Garrison and Archer [5] for two reasons. First, the students' community is essential for achieving their learning outcomes [5-9]. Second, students with higher perceptions of CoI have higher course scores [10].

The CoI framework contains three overlapping and interrelating elements: (1) teaching presence which refers to activities that lead to learning outcomes such as course design, discourse facilitation and direction of cognitive and social processes for students [11]. (2) Social presence which is the degree to which one can communicate and develop interpersonal connections with others as a community [12]. (3) Cognitive presence which is the extent to which one can perform intellectual activities of constructing and confirming meaning through sustained discourse [13].

The researchers carried out an empirical study to explore how the students adjusted their learning in terms of their perceived CoI adjustments (i.e., teaching adjustment, social adjustment and cognitive adjustment) from classroom to online learning, then from online to blended learning given all these issues of students' learning adjustment and the CoI framework.

This study addressed the following research questions and attempted to explore the participating students' answers to them:

Among classroom, online and blended learning:
1. Is there any significant difference among the elements in the CoI framework?
2. If yes, how are these CoI elements compared?

For each transition from one learning mode to another learning mode:
3. What is the extent to which each of the CoI elements was adjusted?
4. How are any two of the CoI adjustments (e.g., teaching adjustment and social adjustment) correlated?

The significance of this study is that this study explores the dynamics of collaborative learning as suggested by Garrison and Arbaugh [14]. Similarly, according to Reynard [15] classroom pedagogy is teacher-oriented while online learning is student-oriented. Shifting from classroom learning mode to online learning mode requires an understanding of the students' perspectives on how they adjust their learning from one learning environment to another to get an insight into what quality online education should be.

2. Literature Review

The literature on CoI can be classified into two categories: one category is CoI framework without new elements while the other category is CoI framework with new elements. The first category contains the studies [16-20] focused on the original CoI framework only. In the second category, previous studies [21-26] introduced one or more new elements to the CoI framework. This second category can be further classified into the following two sub-categories: one sub-category is CoI framework revision while the other sub-category is CoI framework extension. In CoI framework revision, the internal CoI's three-element structure is revised by integrating a new element into the structure. The new element has a mediating or moderating effect on any of the original CoI elements. In the CoI framework extension, the internal CoI's

three-element structure is not revised. A new element is put alongside the original CoI's three-element structure and viewed as an external element. The external element may be influenced by any of the original CoI elements.

2.1. CoI Framework without New Elements

There are many previous studies on the CoI framework without new elements. For example, Garrison et al. [16] and Gutiérrez-Santiuste et al. [17] reported that cognitive presence is influenced by teaching presence and social presence. Gutiérrez-Santiuste et al. [17] found that the influence on cognitive presence by social presence is larger. Garrison et al. [16] added that "teaching presence is perceived to influence social presence" (p. 31). Armellini and De Stefani [18] identified that social presence has a mediating effect between cognitive presence and teaching presence. Some other studies investigated good practices of the CoI framework. For example, Fiock [19] combined seven principles of good practice by Sorensen and Baylen [20] and the CoI framework to form a guide for practitioners and online instructors. Armellini and De Stefani [18] addressed that the CoI framework provides a fundamental method for the blended and online educational experience.

2.2. CoI Framework with New Elements: CoI Framework Revision

The study by Lin et al. [21] integrated the new element of self-efficacy into the original CoI framework as an example of a change to the framework because it had a mediating effect. According to Ma et al. [22], learning presence is a significant partial mediating factor and therefore integrated into the CoI framework. Shea and Bidjerano [23] regarded learners' self-efficacy and effort regulation as learner presence and integrated them into the original CoI framework to form the revised CoI framework. Shea and Bidjerano [24] found the moderating effect of learner presence in terms of self-regulated learning among the original CoI elements.

2.3. CoI Framework with New Elements: CoI Framework Extension

The study by Akyol and Garrison [25] which is one of the examples of CoI framework extension identified significant relationships among the CoI constructs and two new constructs called students' perceived learning and satisfaction in the online course. Law et al. [26] extended the CoI framework by introducing new elements called student enrollment, learning performance and learning motivation as they found that student enrollment and learning motivation influence the three elements in the original CoI framework while the three elements in the CoI framework influence learning performance.

2.4. Insights from the Literature Review

The proposed study is a study on the CoI framework without new elements as it attempted to explore the adjustments in the original CoI elements and their inter-relationships without involving any new elements. Akyol et al.'s [27] study is like the proposed study which explored the difference in the students' perceived CoI adjustments and their interrelationships in three learning modes while Akyol et al. [27] explored the difference in the students' perceived CoI elements in two learning modes which are online and blended learning modes.

When conducting this study, the researchers were aware of the recent study by Law et al. [28] in the literature that investigated students' learning adjustments based on their CoI adjustments. Law et al. [28] adopted a qualitative approach to investigate the CoI adjustments by the same sample of the participating students and found that interactions among the teachers and the students are the biggest challenge that affect the students' cognitive presence in online learning. The major limitation of the study by Law et al. [28] is the generalization of the findings and the comprehensiveness of the study because of the small sample size nature of a qualitative approach. This limitation can be compensated by the quantitative approach with a larger sample size in this study. Moreover, the CoI adjustments by the same sample and their inter-relationships were not thoroughly explored in previous studies.

3. Methodology

The students at the case institution that participated in this study faced the transition from face-to-face learning to online learning from early September to mid-December in 2019, then changed to using blended learning from early January to early June in 2020.The blended learning mode used by the students was an online driver model [29] in which the students mainly learn by reading the teaching materials posted at the institution's online platform Moodle at any place and any time while they can have interactive meetings with the teachers and classmates at any place at the scheduled time slots with the use of video conferencing apps Teams and Zoom. Furthermore, the students and the teachers could post messages at the discussion forum on Moodle.

3.1. Research Design

A priori analysis was first performed to obtain a sample size using the application G*Power 3.1 [30-32]. A one-way repeated measures analysis of variance (ANOVA) statistical test was entered into G*Power software as a parameter as it would be used to analyze the collected data from a survey designed for this study. As a result, G*Power generated the minimum sample size of 168 given the medium effect size [33] f = 0.25, significance level at 5% and 3 groups of learning modes (i.e., classroom, online and blended learning modes).

3.2. Research Instrument

An online questionnaire was created for the study's survey using the CoI survey instrument which was designed by Arbaugh et al. [6] and Swanet al. [7]. The reliability and validity of this instrument were empirically confirmed by many studies such as those by Garrison et al. [16] and Kozan and Richardson [34]. On the online questionnaire, some measuring items collected the demographics and backgrounds of the participating students while the measuring items denoted by TP1 to TP13, SP1 to SP9 and CP1 to CP12 were measured on a 5-point [35] scale with 5 points meaning "strongly agree", 4 points meaning "agree", 3 points meaning "neutral", 2 points meaning "disagree" and 1 point meaning "strongly disagree". Figure 1 shows the TP1 of the online questionnaire with the options for the participants to fill in. The other measuring items TP2 to TP13, SP1 to SP9, and CP1 to CP12 on the online questionnaire are shown in Figures 2, 3, and 4 respectively.

Figure 1.
TP1 of the online questionnaire with the options.

Figure 2.
TP2 to TP13 of the online questionnaire.

14. Getting to know other course participants gave me a sense of belonging in the course in: **(SP1)**

15. I was able to form distinct impressions of some course participants in: **(SP2)**

16. Online or web-based communication is an excellent medium for social interaction in: **(SP3)**

17. I felt comfortable conversing through the online medium in: **(SP4)**

18. I felt comfortable participating in the course discussions in: **(SP5)**

19. I felt comfortable interacting with other course participants in: **(SP6)**

20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust in: **(SP7)**

21. I felt that my point of view was acknowledged by other course participants in: **(SP8)**

22. Online discussions help me to develop a sense of collaboration in: **(SP9)**

Figure 3.
SP1 to SP9 of the online questionnaire.

23. Problems posed increased my interest in course issues in: **(CP1)**

24. Course activities piqued my curiosity in: **(CP2)**

25. I felt motivated to explore content related questions in: **(CP3)**

26. I utilized a variety of information sources to explore problems posed in this course in: **(CP4)**

27. Brainstorming and finding relevant information helped me resolve content related questions in: **(CP5)**

28. Online discussions were valuable in helping me appreciate different perspectives in: **(CP6)**

29. Combining new information helped me answer questions raised in course activities in: **(CP7)**

30. Learning activities helped me construct explanations/solutions in: **(CP8)**

31. Reflection on course content and discussions helped me understand fundamental concepts in this class in: **(CP9)**

32. I can describe ways to test and apply the knowledge created in this course in: **(CP10)**

33. I have developed solutions to course problems that can be applied in practice in: **(CP11)**

34. I can apply the knowledge created in this course to my work or other non-class related activities in: **(CP12)**

Figure 4.
CP1 to CP12 of the online questionnaire.

3.3. Data Collection

The CoI survey was carried out using convenience sampling. After the second semester of 2019-2020 and 2020-2021 ended, 683 students from various majors (such as business, languages, science, engineering, health studies, social sciences, humanity, and design) at the case institution were asked to complete an online questionnaire. These students had experienced the learning adjustment from classroom to online mode and then from online to blended mode. 212 students agreed to participate in the CoI survey by implied consent [36] when completing the online questionnaire to indicate their learning experience at three different times (i.e., classroom, online and blended learning times). The sample size n = 212 exceeds the minimum sample size requirement which is 168 generated by G*Power statistical software and the participation rate was 31%.

3.4. Reliability and Validity Tests

Cronbach [37] coefficient alpha (α) could be used to evaluate the internal consistency reliability of TP1 to TP13 for teaching presence (TP), SP1 to SP9 for social presence (SP) and CP1 to CP12 for cognitive presence (CP). The measuring items TP11 to TP13 in the original CoI survey were used for online learning only. These TP11 to TP13 were changed to fit the case in this study with classroom, online and blended learning modes. The construct validity of these measuring items was tested by exploratory factor analysis (EFA) as the new TP11 to TP13 might bring the new factor structure that was not explored in the previous studies.

3.5. Analysis

One-way repeated measures ANOVA was adopted to explore the difference of each CoI presence among the three groups of learning modes while pairwise comparisons were used to compare the extents of each CoI presence among these three groups and to indicate the extent of teaching adjustment, social adjustment and cognitive adjustment. Correlation analysis was adopted to explore the relationship between any two of teaching adjustment, social adjustment, and cognitive adjustment for the transition from classroom to online learning and the transition from online to blended learning. The statistical package SPSS 25.0 was used for these statistical analyses. Then, multi-group analysis was conducted to identify the difference in terms of the correlations between each construct and to investigate the effects of the CoI models.

4. Results

Among the 212 participating students, 143 (67.45%) of them were year 1 students while 69 (32.55%) of them were year 2 or above students. The year 1 students are regarded as early-stage students while the year 2 or above students are regarded as later stage students. All of them were 18 years old or above. In this regard, consent from the parents of the

participating students was not requested.

4.1. Reliability and Validity

The internal consistency reliability of the online CoI survey is shown in Table 1 in which alpha values for TP, SP, and CP in the classroom (i.e., 0.974, 0.989, and 0.984 respectively), online (i.e., 0.97, 0.989 and 0.984 respectively) and blended learning (i.e., 0.979, 0.986 and 0.973 respectively) were all higher than 0.7, meeting the acceptable condition for ensuring the internal consistency reliability of the online CoI survey [38].

The construct validity of the online CoI survey was tested by verifying that TP1 to TP13, SP1 to SP9 and CP1 to CP12 could be clustered to measure TP, SP and CP respectively using EFA with varimax rotation which attempts to minimize the number of measuring items with high loadings [39] and cluster them as a measure. The sample size n = 212 was fair for factor analysis Comrey and Lee [40]. Barlett [41] test of sphericity and Kaiser-Meyer-Olkin (KMO) index (Kaiser, 1970; 1974; Kaiser & Rice, 1974) were used as a measure of sampling adequacy for factor analysis. The SPSS-generated results of Bartlett's test of sphericity for the three learning modes were all significant at p < 0.000 with the values χ^2 (561) ≈ 10,102.476 and KMO index = 0.936 for classroom learning, χ^2 (561) ≈ 14,227.808 and KMO index = 0.962 for online learning, and χ^2 (561) ≈ 11,663.174 and KMO index = 0.932 for blended learning. All KMO index values were larger than the minimum KMO index value of 0.6 recommended by Tabachnick and Fidell [42] indicating that factor analysis was appropriate [39].

Table1.
Combined mean scores and internal consistency reliability of the online CoI measuring items.

CoI element	Measuring item (n = 212)	Classroom learning		Online learning		Blended learning	
		Item mean	A	Item mean	α	Item mean	α
TP	TP1	4.25		2.53		3.23	
	TP2	4.22		2.56		3.26	
	TP3	4.23		2.58		3.27	
	TP4	4.28		2.65		3.32	
	TP5	4.23		2.58		3.25	
	TP6	4.23		2.62		3.27	
	TP7	4.20	0.974	2.53	0.989	3.23	0.984
	TP8	4.19		2.57		3.23	
	TP9	4.20		2.56		3.23	
	TP10	4.21		2.56		3.26	
	TP11	4.23		2.58		3.27	
	TP12	4.24		2.65		3.31	
	TP13	4.21		2.66		3.28	
SP	SP1	3.89		2.31		2.94	
	SP2	3.87		2.27		2.91	
	SP3	3.75		2.29		2.89	
	SP4	3.80		2.33		2.92	
	SP5	3.84	0.970	2.30	0.989	2.94	0.984
	SP6	3.83		2.33		2.95	
	SP7	3.82		2.32		2.94	
	SP8	3.83		2.27		2.93	
	SP9	3.83		2.30		2.96	
CP	CP1	4.45		3.06		3.76	
	CP2	4.47		3.07		3.75	
	CP3	4.47		3.04		3.74	
	CP4	4.45		3.10		3.80	
	CP5	4.49		3.09		3.79	
	CP6	4.39		3.08		3.73	
	CP7	4.49	0.979	3.09	0.986	3.78	0.973
	CP8	4.50		3.08		3.78	
	CP9	4.47		3.08		3.77	
	CP10	4.48		3.07		3.75	
	CP11	4.42		3.08		3.75	
	CP12	4.45		3.12		3.78	

Note: Teaching presence (TP), Social presence (SP) and Cognitive presence (CP).

In factor analysis, each measuring item is associated with an eigenvalue. According to Cattell [43], these eigenvalues are ranked from the highest to the lowest and plotted against the measuring items (or components in SPSS) in the scree plots as shown in Figure 5. The first three components recorded the eigenvalues 17.479, 7.388 and 2.234 explaining 51.46%, 21.73% and 6.57% of the variance respectively for classroom learning (see Figure 1(a)). For online learning, the first three components recorded the eigenvalues 25.537, 3.399 and 1.275 explaining 75.11%, 10% and 3.75% of the variance respectively (see Figure 1(b)). For blended learning, the first three components recorded the eigenvalues 19.543, 6.258 and 2.485 explaining 57.48%, 18.41% and 7.31% of the variance respectively (see Figure 1(c)).
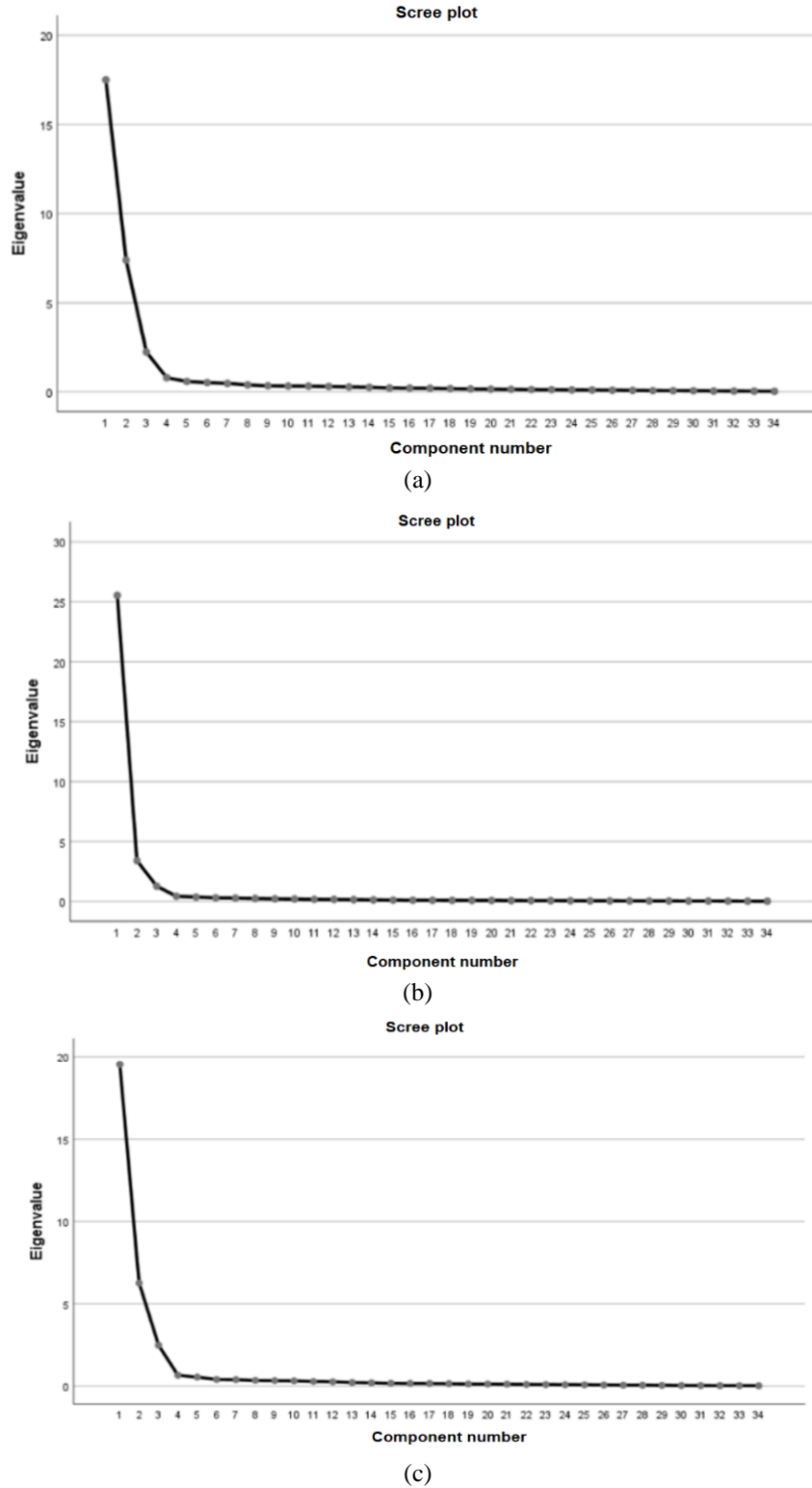

(a)

(b)

(c)

Figure 5.
Scree plot for the online CoI survey for (a)classroom, (b) online, and (c) blended learning.

Using Cattell's [43] scree test, all these first three components with eigenvalues over 1 were extracted for varimax rotation which led to the factor loadings of the measuring items in Table 2. The high loading is set at the cutoff point of factor loading 0.4 [44]. According to Table 2, the construct validity of TP1 to TP13, SP1 to SP9, and CP1 to CP12 was confirmed as they loaded highly (> 0.4) on TP, SP and CP respectively.

Table 2.
CoI elements and factor loadings among the three learning modes.

| Measuring items | Learning mode | | | | | | | | |
| | Classroom learning | | | Online learning | | | Blended learning | | |
	TP	SP	CP	TP	SP	CP	TP	SP	CP
TP1	0.795			0.752			0.829		
TP2	0.793			0.799			0.875		
TP3	0.795			0.779			0.849		
TP4	0.806			0.710			0.807		
TP5	0.744			0.762			0.831		
TP6	0.778			0.778			0.831		
TP7	0.771			0.732			0.815		
TP8	0.784			0.746			0.842		
TP9	0.749			0.722			0.821		
TP10	0.739			0.759			0.853		
TP11	0.808			0.785			0.842		
TP12	0.798			0.758			0.821		
TP13	0.698			0.750			0.785		
SP1		0.774			0.771			0.821	
SP2		0.850			0.784			0.837	
SP3		0.777			0.784			0.818	
SP4		0.833			0.785			0.854	
SP5		0.863			0.799			0.863	
SP6		0.878			0.812			0.873	
SP7		0.857			0.799			0.852	
SP8		0.849			0.775			0.831	
SP9		0.849			0.790			0.846	
CP1			0.844			0.838			0.850
CP2			0.876			0.800			0.810
CP3			0.892			0.811			0.853
CP4			0.903			0.843			0.836
CP5			0.832			0.845			0.792
CP6			0.844			0.815			0.840
CP7			0.896			0.857			0.868
CP8			0.862			0.857			0.873
CP9			0.882			0.861			0.882
CP10			0.900			0.846			0.869
CP11			0.904			0.855			0.884
CP12			0.900			0.839			0.857

4.2. ANOVA and Pairwise Comparisons

One-way repeated measures ANOVA was applied to the data collected from the participating students experiencing the classroom, online and blended learning modes. Table 3 shows the means for TP, SP and CP as well as their standard deviations.

Table3.
Means and standard deviations of the CoI elements among the three learning modes.

| Learning modes | CoI element | | | | | |
| | TP | | SP | | CP | |
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Classroom	4.22	0.50	3.83	0.68	4.46	0.60
Online	2.59	0.99	2.30	1.16	3.08	0.78
Blended	3.26	0.71	2.93	0.91	3.77	0.58

Significant differences among the CoI elements were found with all p < 0.000 for TP, SP and CP from the SPSS-generated Wilks' lambda values (λ). The results were $\lambda = 0.301$ for TP, $\lambda = 0.308$ for SP and $\lambda = 0.325$ for CP. The analytical results also indicated the effect size using partial eta squared η^2. These were the large effects $\eta^2 = 0.70$ for TP, $\eta^2 = 0.69$ for SP and $\eta^2 = 0.68$ for CP [33]. The CoI elements were adjusted in the same direction among the three learning modes as shown in Figure 6.
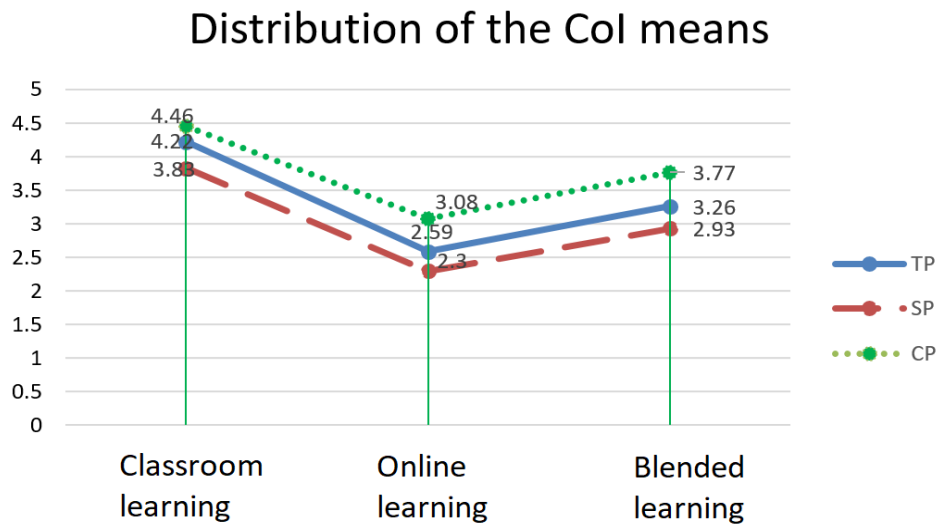

Figure 6.
Distribution of the CoI means among the three learning modes.

Table 4 shows the results of the pairwise comparisons with each of the differences (or adjustments) being significant at p < 0.000. All the mean CoI adjustments from classroom to online learning modes were negative values indicating the decreasing students' perceptions of CoI presences in this transition. The students strongly agreed to the CoI presences with mean CoI values around 4 (i.e., mean value for TP = 4.22, mean value for SP = 3.83 and mean value for CP = 4.46) in classroom learning; they tended to disagree with the CoI presences with a mean for teaching adjustment = -1.63, a mean for social adjustment = -1.53 and a mean for cognitive adjustment = -1.38. The students' perceptions of CoI presences increased in the transition from online to blended learning with a mean for teaching adjustment = 0.67, a mean for social adjustment = 0.63 and a mean for cognitive adjustment = 0.69 resulting in the status that the students agreed to TP and CP, as reflected by the mean for TP = 3.26 and a mean for CP = 3.77 but a bit disagreed on the social adjustment as reflected by the mean for social adjustment = 2.93. According to Figure 2 and Table 3, when comparing across the learning modes, there were the largest students' perceived CoI presences in classroom learning, the medium students' perceived CoI presences in blended learning and the smallest students' perceived CoI presences in online learning. When comparing the CoI elements, there were the largest students' perceived CP, the medium students' perceived TP and the smallest students' perceived SP among the three learning modes.

Table 4.
Results of pairwise comparisons.

Mean CoI value	Learning mode			Mean CoI adjustment	Learning adjustment	
	Classroom learning	Online learning	Blended learning		From classroom to online [1]	From online to blended [2]
Mean for TP	4.22	2.59	3.26	Mean for teaching adjustment	-1.63 *	0.67 *
Mean for SP	3.83	2.30	2.93	Mean for social adjustment	-1.53 *	0.63 *
Mean for CP	4.46	3.08	3.77	Mean for cognitive adjustment	-1.38 *	0.69 *

Note: * The difference is significant at the 0.000 level.
   1: Learning adjustment is obtained by subtracting the mean CoI in online learning from the mean CoI in classroom learning.
   2: Learning adjustment is obtained by subtracting the mean CoI in blended learning from the mean CoI in online learning.

4.3. Correlation

In Table 5, all correlations were significant and positive. According to Cohen [33], guideline on the correlation strength, for classroom learning mode, there was a large correlation r = 0.674 between TP and SP, a medium correlation r = 0.490 between TP and CP and a small correlation r = 0.182 between SP and CP. For online and blended learning modes, all correlations r > 0.5 were large [33].

Table 5.
Results of correlation analysis among the CoI elements.

Learning modes	CoI element	SP	CP
Classroom	TP	0.674 *	0.490 *
	SP	1	0.182 *
Online	TP	0.867 *	0.743 *
	SP	1	0.685 *
Blended	TP	0.885 *	0.838 *
	SP	1	0.886 *

Note: * r is significant at the 0.01 level (2-tailed).

A CoI adjustment is the difference between the extent of a student's perceived CoI presence in one learning mode and that in another learning mode. For the transition from classroom to online learning, each CoI adjustment is the difference between the students' perceptions of each CoI element in online learning and the perceptions of that CoI element in classroom learning. The results of correlation analysis among the CoI adjustments from classroom learning to online learning and from online learning to blended learning are shown in Table 6. The correlation between any two of teaching adjustment, social adjustment and cognitive adjustment were all significant, positive and large with r > 0.5 [33] from classroom to online learning mode and from online to blended learning mode.

Table 6.
Results of correlation analysis among the CoI adjustments.

Transition	CoI adjustment	Social adjustment	Cognitive adjustment
From classroom learning to online learning	Teaching adjustment	0.885 *	0.838 *
	Social adjustment	1.000 *	0.886 *
From online learning to blended learning	Teaching adjustment	0.724 *	0.784 *
	Social adjustment	1.000 *	0.807 *

Note: * r is significant at the 0.01 level (2-tailed).

4.4. Multi-Group Analysis

The CoI elements were mapped initially based on the cycle session activity proposed by Nolan-Grant [45]. The teaching activities are designed to involve TP and to enable the CP of students in the teaching and learning activities. These interactions involved enhanced SP as the students would share and discuss with their peers in various means which led to the improvement of new content and teaching methods. Multi-group analysis with the aid of the structural equation modeling approach was adopted to explore the hypothesized relationships of the CoI theoretical models for various learning modes including classroom, online and blended approaches.

Table 7 summarizes the covariances between each construct and Figure 7 summarizes the results of correlation for each construct of the CoI model. The results reveal that TP and SP show the highest correlation for all learning modes followed by TP and CP. SP and CP show the weakest correlation among all of them. The results also indicate that the classroom learning mode has a higher correlation between the CoI measures compared with blended learning while online learning shows the lowest correlation.

Table 7.
The multi-group path covariance results.

Models	Covariances	Estimate	Standard error	Correlation
Classroom	TP ↔ CP	0.414	0.055	7.459 *
	CP ↔ SP	0.407	0.060	6.817 *
	SP ↔ TP	0.398	0.052	7.677 *
Online	TP ↔ CP	0.565	0.721	7.831 *
	CP ↔ SP	0.685	0.087	7.835 *
	SP ↔ TP	0.927	0.106	8.766 *
Blended	TP ↔ CP	0.310	0.044	7.069 *
	CP ↔ SP	0.321	0.053	6.035 *
	SP ↔ TP	0.552	0.066	8.418 *

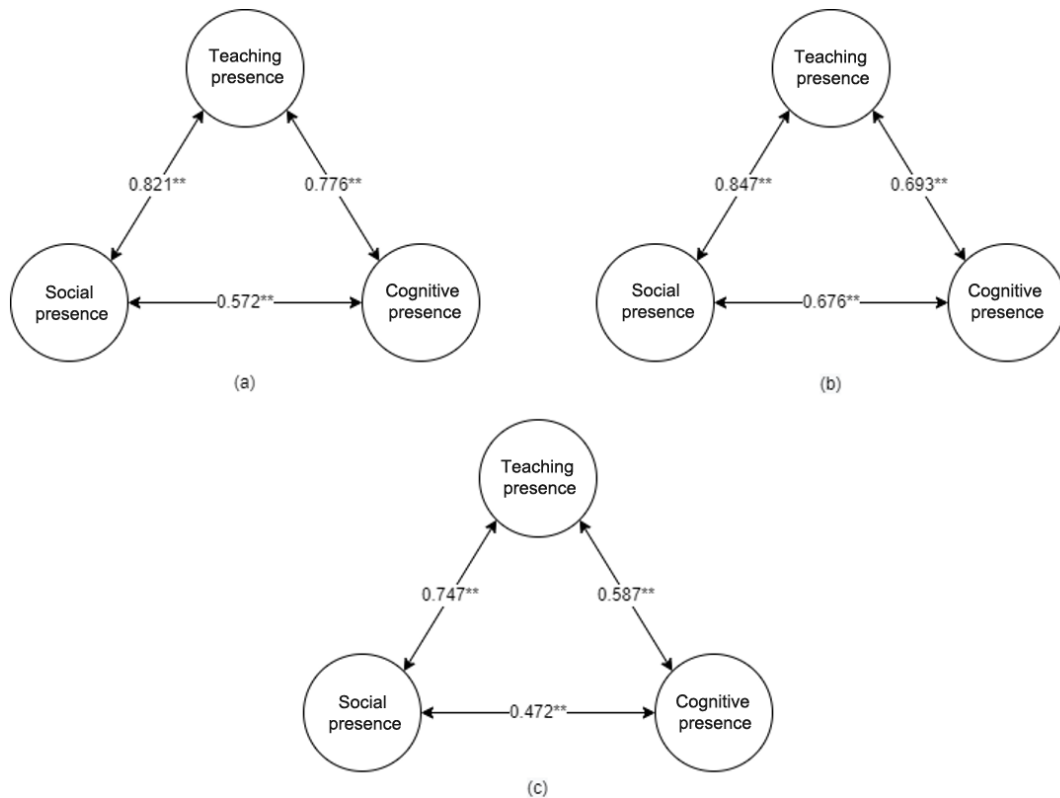**Note:** * r is significant at the 0.01 level (2-tailed).

Figure 7.
Multi-group correlations for (a) classroom, (b) blended, and (c) online learning.
   Note: r is significant at 0.01 level.

5. Discussion

The first two research questions were addressed to compare the students' perceptions of the CoI elements. The last two research questions were addressed to explore the importance of the students' learning adjustment in terms of the scales and the relationships among the CoI adjustments. The findings for these research questions from the students' perspectives are:

- Finding 1: All the CoI presences (i.e., TP, SP, and CP) in classroom learning were the largest while all these CoI presences in online learning were the smallest.
- Finding 2: Cognitive presence was the largest while social presence was the smallest in the classroom, online and blended learning.
- Finding 3: All correlations among the CoI presences were positive with large correlations in online and blended learning modes.
- Finding 4: All the teaching, cognitive and social adjustments were positively and largely correlated with each other.

5.1. Discussion on the Finding 1

Finding 1 is in line with Akyol et al.'s [27] finding that the students using blended learning have higher perceived CoI presences than those of the students using online learning when comparing between online learning and blended learning in this study. Moreover, the qualitative content analysis by Law et al. [28] asserts that interactions among teachers and students are the biggest challenge affecting CP in online learning resulting in the smallest perception of CP in online learning in finding 1. In this study, the students ranked TP the highest in classroom learning and the lowest in online learning as they might find face-to-face or virtual interaction among their peer students and teachers which is lacked in online learning was essential for teaching. According to Mayer [46] detailed step-by-step demonstrations, explanations, animations and simulations are determinants for students' better learning. Face-to-face interaction in classroom learning and virtual interaction in blended learning facilitate step-by-step demonstrations, explanations, animations, and simulations as well as discussions among students [47] resulting in the students' higher perceived CP in the interactive classroom and blended learning settings while lower perceived CP in a non-interactive online setting. The result of the highest students' perceived SP in classroom learning and the lowest students' perceived SP in online learning supports Akyol et al.'s [27] idea that interaction is important for social development. The interaction in classroom learning and blended learning could help the students to develop social relationships among their classmates and teachers while face-to-face interaction in classroom learning was more helpful.

5.2. Discussion on the Finding 2

Finding 2 can be explained as CP was the most important while SP was the least important in the students' views indicating that the students regarded their ability to construct meaning and build knowledge as the most important while

teachers' direct instruction was also important but their capability of developing social relationships was the least important to their learning no matter what learning mode they have. Students regard learning as their own responsibility, the teachers and classmates can help while the teachers are more helpful.

5.3. Discussion on the Finding 3

According to Garrison et al. [16], students' perceived TP directly influences their perceived SP and CP while SP has the mediating effect between TP and CP in online and blended learning. This study found the conditions for these influences. These conditions were the significant, strong and positive correlations between any two of TP, SP and CP in the students' perceptions of online and blended learning modes. For classroom learning, TP was significantly and strongly correlated with SP but TP was significantly and medially correlated with CP in the students' perceptions implying that the teachers helped much in the students' social development but not so much in the students' meaning construction and knowledge building. This may be due to the fact that the students' learning activities were not limited to classroom learning. The students could learn from many other sources on campus such as libraries, academic advising and students' discussions. In classroom learning, SP was significantly but weakly correlated with CP in the students' perceptions which means that the students might perceive their social activities on campus were not associated much with their learning activities. The students' social development in classrooms could be associated more with other face-to-face social interactions which might not be related to their learning unlike the stronger correlation between SP and CP in online and blended learning modes. These social interactions include sports, games, leisure and recreation activities on campus.

5.4. Discussion on the Finding 4

The students' perceived CoI presences were the strongest in classroom learning, then decreased from classroom to online learning and increased from online to blended learning. There were significant, strong and positive correlations between teaching adjustment and social adjustment between teaching adjustment and cognitive adjustment and between social adjustment and cognitive adjustment in all three learning modes. This finding 4 shows that all CoI presences scaled down together from classroom to online learning, then scaled up together from online to blended learning indicating that one CoI adjustment has a significant influence on another CoI adjustment. This finding supports the feature of the interconnected three presences in the CoI framework and is consistent with many previous findings such as the findings by Law et al. [26] and Ma et al. [22]. The weakening of students' sense of the TP, SP, and CP when transiting from classroom to online learning and the strengthening of students' sense of each presence when transiting from online to blended learning provide implications for follow-up studies to understand why the weakening and strengthening effects occur and investigate developing learning improvement strategies for the transitions. For example, Mayer [46] investigated the learning effects of multimedia learning and found that people learn better from multimedia learning than from reading text. For online learning, multimedia technology can be integrated into the online learning materials for better students' sense of TP. The students had a higher sense of SP in blended learning than they had in online learning as they might value the virtual interaction that facilitated their social development in blended learning or the students might not have other students' contact information and might not have a social gathering environment for social development. In this case, the teachers and the educational administrators must become facilitators for connecting the students together and providing an online social gathering environment (e.g., an online orientation platform) to enhance the students' sense of SP in online and blended learning. For the students' better sense of CP in online and blended learning, the educational administrators must consider providing online resources (e.g., online libraries, electronic books, online academic advising and counseling and an online instant feedback system) as many as the students can have when they have classroom learning on campus.

6. Concluding Remarks and Implications

The outburst of the COVID-19 pandemic reinforces implementing online and blended learning modes rapidly around the world. People are getting used to online and blended learning trends. Then, the pedagogical quality of online learning and blended learning modes is a major concern. This study investigated this important quality issue by exploring the students' learning adjustment from classroom to online from online to blended learning using CoI adjustments as an indicator. The findings 1 to 4 of this study can be interpreted from the participating students' views as:

(1) Among the three learning modes, classroom learning exhibited the strongest CoI presences while online learning rendered the weakest CoI presences.
(2) Among the three CoI presences, CP was the most important while SP was the least important for learning.
(3) All TP, SP and CP were inter-influenced while their influences were larger in online and blended learning.
(4) All TP, SP and CP were adjusted in the same direction from one learning mode to another learning mode and their adjustments were largely influenced by each other.

Understanding the students' perspectives on how they adjust their learning from classroom to online and then to blended learning can help education management set a policy and improve pedagogic quality for online education. Exploring the dynamics of collaborative learning adjustments from classroom to online and then to blended learning provides instructors with insight into what quality online education should be. However, the pedagogical quality of online learning and blended learning modes is not only contributed by learning adjustment. Adjustments by teachers and educational administrators are also essential elements for ensuring the pedagogical quality of online and blended learning modes. Further investigation of these issues should be explored.

There is a concern that the development of CoI requires a period. To the best of the authors' knowledge, the semester

remains long enough to allow the learning community to form to some extent. It can be concluded that regardless of the differences in terms of duration, the students were given plenty of time to develop CoI in the three learning environments by providing each the duration of face-to-face, online, and blended modes. Future research that explores the CoI adjustments from one learning to another should consider the effect of the duration of each learning mode well.

Three limitations are identified in this study. They provide implications for further research. First, the effect of the students' technical skills and technology adoption was not considered well as online learning technology cannot help students learn if that technology is not used. Technical issues related to the acceptance and use of online learning technology should also be a major research focus. Second, this study cannot explain the quantitative results. This limitation suggests that qualitative interviews could be used to explore explanation. Third, the effects of different majors of studies on the students' learning adjustments were not considered well as there was a problem of obtaining insignificant statistical results from the smaller groups of the participating students categorized based on their majors. Future research should consider categorizing a larger sample of the participants based on their majors and analyzing the results of their CoI survey may bring more convincing insights about the effects of different majors on the students' learning adjustments.

References

[1] H. K. Yau, H. Sun, and A. L. F. Cheng, "Adjusting to university: The Hong Kong experience," *Journal of Higher Education Policy and Management,* vol. 34, no. 1, pp. 15-27, 2012. https://doi.org/10.1080/1360080X.2012.642328

[2] C. E. J. Clark and G. Post, "Preparation and synchronous participation improve student performance in a blended learning experience," *Australasian Journal of Educational Technology,* vol. 37, no. 3, pp. 187-199, 2021. https://doi.org/10.14742/ajet.6811

[3] B. K. Song, "E-portfolio implementation: Examining learners' perception of usefulness, self-directed learning process and value of learning," *Australasian Journal of Educational Technology,* vol. 37, no. 1, pp. 68-81, 2021. https://doi.org/10.14742/ajet.6126

[4] A. Stack *et al.*, "Investigating online tests practices of university staff using data from a learning management system," *Australasian Journal of Educational Technology,* vol. 36, no. 4, pp. 72-81, 2020. https://doi.org/10.14742/ajet.4975

[5] D. R. Garrison and W. Archer, *A transactional perspective on teaching and learning: A framework for adult and higher education*. Bingley, United Kingdom: Emerald, 2000.

[6] J. B. Arbaugh *et al.*, "Developing a community of inquiry instrument: Testing a measure of the community of inquiry framework using a multi-institutional sample," *The Internet and Higher Education,* vol. 11, no. 3-4, pp. 133-136, 2008. https://doi.org/10.1016/j.iheduc.2008.06.003

[7] K. Swan, D. R. Garrison, and J. C. Richardson, *A constructivist approach to online learning: The community of inquiry framework. In C. R. Payne (Ed.), Information Technology and Constructivism in Higher Education: Progressive Learning Frameworks*. Hershey, Pennsylvania: IGI Global. https://doi.org/10.4018/978-1-60566-654-9.ch004 2009.

[8] K. Swan, D. Matthews, L. Bogle, E. Boles, and S. Day, "Linking online course design and implementation to learning outcomes: A design experiment," *The Internet and Higher Education,* vol. 15, no. 2, pp. 81-88, 2012. https://doi.org/10.1016/j.iheduc.2011.07.002

[9] K. Swan, S. L. Day, L. R. Bogle, and D. B. Matthews, "A collaborative, design-based approach to improving an online program," *The Internet and Higher Education,* vol. 21, pp. 74-81, 2014. https://doi.org/10.1016/j.iheduc.2013.10.006

[10] A. J. Rockinson-Szapkiw, J. Wendt, M. Whighting, and D. Nisbet, "The predictive relationship among the community of inquiry framework, perceived learning and online, and graduate students' course grades in online synchronous and asynchronous courses," *International Review of Research in Open and Distributed Learning,* vol. 17, no. 3, pp. 18-35, 2016. https://doi.org/10.19173/irrodl.v17i3.2203

[11] T. Anderson, L. Rourke, D. R. Garrison, and W. Archer, "Assessing teaching presence in a computer conferencing context," *Journal of Asynchronous Learning Networks,* vol. 5, no. 2, pp. 1-18, 2001. https://doi.org/10.24059/olj.v5i2.1875s

[12] D. R. Garrison, *Communities of inquiry in online learning: social, teaching and cognitive presence. In P. L. Rogers, G. A. Berg, J. V. Boettcher, C. Howard, L. Justice and K. Schenk (Eds.), Encyclopedia of Distance and Online Learning*, 2nd ed. Hershey, Pennsylvania: IGI Global. https://doi.org/10.4018/978-1-60566-198-8.ch052, 2009.

[13] D. R. Garrison, T. Anderson, and W. Archer, "Critical thinking, cognitive presence, and computer conferencing in distance education," *American Journal of Distance Education,* vol. 15, no. 1, pp. 7-23, 2001. https://doi.org/10.1080/08923640109527071

[14] D. R. Garrison and J. B. Arbaugh, "Researching the community of inquiry framework: Review, issues, and future directions," *The Internet and Higher Education,* vol. 10, no. 3, pp. 157-172, 2007. https://doi.org/10.1016/j.iheduc.2007.04.001

[15] R. Reynard, "Hybrid learning: Challenges for teachers," *The Journal,* vol. 5, no. 5, pp. 1-5, 2007.

[16] D. R. Garrison, M. Cleveland-Innes, and T. S. Fung, "Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework," *The Internet and Higher Education,* vol. 13, no. 1-2, pp. 31-36, 2010. https://doi.org/10.1016/j.iheduc.2009.10.002

[17] E. Gutiérrez-Santiuste, C. Rodríguez-Sabiote, and M.-J. Gallego-Arrufat, "Cognitive presence through social and teaching presence in communities of inquiry: A correlational–predictive study," *Australasian Journal of Educational Technology,* vol. 31, no. 3, pp. 349-362, 2015. https://doi.org/10.14742/ajet.1666

[18] A. Armellini and M. De Stefani, "Social presence in the 21st century: An adjustment to the C ommunity of I nquiry framework," *British Journal of Educational Technology,* vol. 47, no. 6, pp. 1202-1216, 2016. https://doi.org/10.1111/bjet.12302

[19] H. Fiock, "Designing a community of inquiry in online courses," *The International Review of Research in Open and Distributed Learning,* vol. 21, no. 1, pp. 135-153, 2020. https://doi.org/10.19173/irrodl.v20i5.3985

[20] C. K. Sorensen and D. M. Baylen, *Learning online: adapting the seven principles of good practice to a web-based instructional environment. In A. Orellana, T. L. Hudgins and M. Samonson (Eds.), The Perfect Online Course: Best Practices for Designing and Teaching. Charlotte*. New York: Information Age Publishing, 2009.

[21]   S. Lin, T.-C. Hung, and C.-T. Lee, "Revalidate forms of presence in training effectiveness: Mediating effect of self-efficacy," *Journal of Educational Computing Research,* vol. 53, no. 1, pp. 32-54, 2015. https://doi.org/10.1177/0735633115588772

[22]   Z. Ma, J. Wang, Q. Wang, L. Kong, Y. Wu, and H. Yang, "Verifying causal relationships among the presences of the community of inquiry framework in the Chinese context," *International Review of Research in Open and Distributed Learning,* vol. 18, no. 6, pp. 213-230, 2017. https://doi.org/10.19173/irrodl.v18i6.3197

[23]   P. Shea and T. Bidjerano, "Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments," *Computers & Education,* vol. 55, no. 4, pp. 1721-1731, 2010. https://doi.org/10.1016/j.compedu.2010.07.017

[24]   P. Shea and T. Bidjerano, "Learning presence as a moderator in the community of inquiry model," *Computers & Education,* vol. 59, no. 2, pp. 316-326, 2012. https://doi.org/10.1016/j.compedu.2012.01.011

[25]   Z. Akyol and D. R. Garrison, "The development of a community of inquiry over time in an online course: Understanding the progression and integration of social, cognitive and teaching presence," *Journal of Asynchronous Learning Networks,* vol. 12, no. 3-4, pp. 3-22, 2008. https://doi.org/10.24059/olj.v12i3.72

[26]   K. M. Law, S. Geng, and T. Li, "Student enrollment, motivation and learning performance in a blended learning environment: The mediating effects of social, teaching, and cognitive presence," *Computers & Education,* vol. 136, pp. 1-12, 2019. https://doi.org/10.1016/j.compedu.2019.02.021

[27]   Z. Akyol, D. R. Garrison, and M. Y. Ozden, "Online and blended communities of inquiry: Exploring the developmental and perceptional differences," *The International Review of Research in Open and Distributed Learning,* vol. 10, no. 6, pp. 65-83, 2009. https://doi.org/10.19173/irrodl.v10i6.765

[28]   V. T. Law, H. H. Yee, T. K. Ng, and B. Y. Fong, "Transition from traditional to online learning in Hong Kong tertiary educational institutions during COVID-19 pandemic," *Technology, Knowledge and Learning,* vol. 28, no. 3, pp. 1425-1441, 2023. https://doi.org/10.1007/s10758-022-09603-z

[29]   M. B. Horn and H. Staker, "The rise of K-12 blended learning, Innosight Institute White Paper," Retrieved: https://www.christenseninstitute.org/wp-content/uploads/2013/04/The-rise-of-K-12-blended-learning.pdf.   [Accessed November 20, 2019], 2011.

[30]   E. Erdfelder, F. Faul, and A. Buchner, "GPOWER: A general power analysis program," *Behavior Research Methods, Instruments, & Computers,* vol. 28, pp. 1-11, 1996. https://doi.org/10.3758/BF03203630

[31]   F. Faul, E. Erdfelder, A.-G. Lang, and A. Buchner, "G*Power 3: A flexible statistical power analysis program for the social, behavioral and biomedical sciences," *Behavior Research Methods,* vol. 39, no. 2, pp. 175-191, 2007. https://doi.org/10.3758/BF03193146

[32]   F. Faul, E. Erdfelder, A. Buchner, and A.-G. Lang, "Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses," *Behavior Research Methods,* vol. 41, no. 4, pp. 1149-1160, 2009. https://doi.org/10.3758/BRM.41.4.1149

[33]   J. Cohen, *Statistical power analysis for the behavioral sciences*, 2nd ed. Hillsdale, New Jersey: Lawrence Erlbaum, 1988.

[34]   K. Kozan and J. C. Richardson, "New exploratory and confirmatory factor analysis insights into the community of inquiry survey," *The Internet and Higher Education,* vol. 23, pp. 39-47, 2014. https://doi.org/10.1016/j.iheduc.2014.06.002

[35]   R. Likert, "A technique for the measurement of attitudes," *Archives of Psychology,* vol. 140, pp. 1-55, 1932.

[36]   B. Berg and H. Lune, *Qualitative research methods for the social sciences*, 8th ed. Upper Saddle River, New Jersey: Pearson, 2012.

[37]   L. J. Cronbach, "Coefficient alpha and the internal structure of tests," *Psychometrika,* vol. 16, no. 3, pp. 297-334, 1951. https://doi.org/10.1007/BF02310555

[38]   J. C. Nunnally, *Psychometric theory*, 2nd ed. New York: McGraw Hill, 1978.

[39]   J. Pallant, *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*, 7th ed. London, United Kingdom: Open University Press. https://doi.org/10.4324/9781003117452, 2020.

[40]   A. L. Comrey and H. B. Lee, *A first course in factor analysis*, 2nd ed. Hillsdale, New Jersey: Lawrence Erlbaum. https://doi.org/10.4324/9781315827506, 1992.

[41]   M. S. Barlett, "A note on the multiplying factors for various Chi square approximations," *Journal of the Royal Statistical Society,* vol. 16, no. Series B, pp. 296-298, 1954. https://doi.org/10.1111/j.2517-6161.1954.tb00174.x

[42]   B. G. Tabachnick and L. S. Fidell, *Using multivariate statistics*, 6th ed. Upper Saddle River, New Jersey: Pearson, 2013.

[43]   R. B. Cattell, "The scree test for the number of factors," *Multivariate Behavioral Research,* vol. 1, no. 2, pp. 245-276, 1966. https://doi.org/10.1207/s15327906mbr0102_10

[44]   J. P. Stevens, *Applied multivariate statistics for the social sciences*, 5th ed. New York: Routledge. https://doi.org/10.4324/9780203843130, 2009.

[45]   C. R. Nolan-Grant, "The community of inquiry framework as learning design model: A case study in postgraduate online education," *Research in Learning Technology,* vol. 27, pp. 1-15, 2019. https://doi.org/10.25304/rlt.v27.2240

[46]   R. E. Mayer, *Multimedia learning*, 2nd ed. New York: : Cambridge University Press. https://doi.org/10.1017/CBO9780511811678, 2009.

[47]   L. Rourke and T. Anderson, "Using peer teams to lead online discussions," *Journal of Interactive Media in Education,* vol. 1, no. 1, pp. 1-21, 2002. http://doi.org/10.5334/2002-1