Re-Examining the Construct Validity and Causal Relationships of Teaching, Cognitive, and Social Presence in Community of Inquiry Framework

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Abstract
Despite the prevalence of research on the Community of Inquiry framework and its associated measurement instrument, more research is needed to re-evaluate the factor structure, study the effects of covariates or measurement invariance, and explore the relationships among the three presences. Results of this study indicated that (a) teaching, social, and cognitive presence are each multidimensional and higher order constructs; (b) measurement invariance was fully achieved for gender and partially for age, ethnicity, discipline, and online experience; (c) structural relationships of the three main constructs—teaching presence, social presence, and cognitive presence—suggested potential psychometric adjustments. The teaching presence construct in particular should be reconstructed to appropriately reflect and measure the construct as conceptually defined—as a distribution of teaching responsibility and authority—as opposed to how it is currently operationalized in the Community of Inquiry instrument—as a centralization of responsibility and authority with the instructor.

Keywords: Community of Inquiry, structural equation modelling, online education

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The Community of Inquiry (CoI) framework is widely used in the design and study of online learning environments (Halverson, Graham, Spring, Drysdale, & Henrie, 2014; Garrison, 2017). Through the operationalization of three essential presences—*teaching*, *social*, and *cognitive*—a community of inquiry emerges as learners collaboratively construct meaning within the context of shared academic achievement. Even while the statistical and conceptual interdependence of the three presences has been demonstrated (Archibald, 2013), and despite the widespread usage of CoI instrument, Shea et al. (2014) recommended "continued focus to enhance its explanatory power" (p. 16), and Garrison (2017) called for continual development and refinement of both the framework and its associated instrument. Therefore, the present study was designed to (a) re-evaluate the factor structure of the CoI instrument; (b) study the predictive effects of gender, ethnicity, age, online course experience, and course discipline on the CoI measurement model; and (c) explore the casual relationships among the three presences.

Review of Related Literature

The "most widely referenced framework associated with the study of online and blended learning" (Garrison, 2016, p. 68), the CoI is the principal framework for the study and design of purposeful e-learning communities (Garrison, 2017; Halverson et al., 2014). Garrison, Anderson, and Archer (2000) first introduced the framework through their work on computer-based conferencing. Unlike traditional distance-education models, which positioned learning as an individualistic and autonomous activity, computer-based conferencing utilized text-based, asynchronous discussions to connect learners to one another, thus enabling the creation of a community of learners, a community of inquiry.

Garrison et al. (2000) proposed three essential elements, or presences, of these communities of inquiry—*teaching*, *social*, and *cognitive*. The term *presence* is used to connote the idea of fidelity—how *real* the learning and the learning environment are (Hosler & Arend, 2013). The greater the presence, the greater the fidelity, and thus the more realistic—that is, the less mediated—the learning experience is perceived to be. In creating an authentic collaborative-constructivist learning context, then, the three presences work together and support one another. To wit, social presence has been shown to be the mediating factor between cognitive and teaching presence (deNoyelles, Zydney, & Chen, 2014; Joksimović, Gašević, Kovanović, Riecke, & Hatala, 2015; Whiteside, Dikkers, & Swan, 2017), cognitive presence is most indicative of student satisfaction and success (Holser & Arend, 2012; Yang, Quadir, Chen, & Miao, 2016), and teaching presence is understood to be of the greatest value to students (Hodges & Cowan, 2012; Preisman, 2014) and the most critical in establishing purposeful communities of inquiry (Borokhovski, Bernard, Tamim, Schmid, & Sokolvskaya, 2016; Rockinson-Szapkiw, Wighting, & Nisbet, 2016; Rubin & Fernandes, 2013). As such, Archibald (2013) reported that, in creating communities of inquiry, each of three presences is statistically and conceptually interdependent, and Wicks, Craft, Mason, Gritter, and Bolding (2015), and Rockinson-Szapkiw et al. (2016) showed the framework as a whole—through the operationalization of the three presences—to be predictive of learning outcomes.

Social Presence

Learning as a shared experience builds on and from interactions of both intrapersonal and interpersonal relationships. The individual affective and expressive concerns of individuals are thus informative of and shaped by the learning community more generally. In this way, within the CoI framework, *affective communication*, *open communication*, and *group cohesion* together form the social presence construct. *Affective communication* reflects the traditional conception of social presence, the idea that social presence is about the projection and acceptation of the individual into and within the learning community. *Open communication* reflects the significance of a trusting environment to the process of critical discourse. Finally, *group cohesion* reflects the role that shared commitment to the achievement of learning goals plays in the formation of a community of inquiry. Garrison (2015) identified this more complex understanding of social presence—where individual contributors become critical members of a larger, collaborative community—as a change of focus "from the person to the purpose of the communication" (p. 71). In this same way, each of the three subfactors contributes both individually and corporately to the formation of social presence within a community of inquiry.

To this shift from the person to the purposes of communication, within a community of inquiry social presence is operationalized foundationally through identification with shared learning goals, through the purposeful pursuit of specific cognitive ends (Garrison, 2016). As such, Whiteside et al. (2017) identified social presence as the "unifying component that synchronizes

interactions among the instructor, students, academic content, media, tools, instructional strategies, and outcomes within an online learning experience" (p. 2). It is precisely in this way that social presence is understood to be the mediating factor between cognitive and teaching presence (deNoyelles, 2014; Joksimović et al., 2015; Whiteside et al., 2017).

Cognitive Presence

With the purpose of engaging learners in deep and meaningful learning, communities of inquiry are designed around the Practical Inquiry Model (Garrison, Anderson, & Archer, 2001). Based on Dewey's (1933) model of reflective thought, where learners critically assess their beliefs in the context of personal reflection and shared discourse, the Practical Inquiry Model serves to frame the interactions and intersections of personal and private thought in the construction and confirmation of knowledge (Garrison, 2017). According to the model, cognitive dissonance, resulting from a *triggering event*, occurs in the public sphere when existing beliefs do not cohere with, or are unable to make sense of, some stimulus. Personal, reflective *exploration* of the cause of, and possible solutions to, the challenge to existing meaning-making schemes then ensues. *Integration* of these solutions, these new ways of knowing, proceeds, again in a critically reflective manner. Finally, the learner achieves *resolution* of the original cognitive challenge as the new meaning-making scheme is applied and tested in the public sphere. In practice, learners rarely proceed to the higher level of integration and even less so resolution (Archibald, 2013; Goda & Yamada, 2013; Hosler & Arend, 2013; Lee, 2014; Oskoz, 2013; Richardson, Sadaf, & Ertmer, 2013; Stein & Wanstreet, 2013). So, even while the four-step Practical Inquiry shapes the cognitive presence construct, in the study of cognitive presence it is practically important to distinguish between each level.

Successful navigation through this process of constructing personal meaning and confirming public knowledge requires that learners engage in shared metacognition (Garrison, 2016). Garrison and Akyol (2013) identified three functions of metacognition: *knowledge* of cognition, *monitoring* of cognition, and *regulation* of cognition. Knowledge of cognition is a basic understanding of the learning process. Monitoring of cognition is active reflection on the learning process. Regulation of cognition is the enactment of strategies to direct the learning process toward meaningful outcomes.

Ultimately, engagement in metacognition allows learners to make more symmetrical judgements about self-knowledge and the knowledge of others (Brycz, 2014), thus contributing to the achievement of the intended collaborative-constructivist learning outcomes within a community of inquiry (Rubin & Fernandes, 2013). However, for learners to engage in this process of critical assessment and regulation of their own and others' cognition, educators must purposefully steer the process (Wittenbols, 2016). Gašević, Adesope, Joksimović, and Kovanović (2015) demonstrated the importance of facilitating the metacognitive processes of learners through incorporation of scaffolding strategies as a primary element of teaching presence in a community of inquiry.

Teaching Presence

Teaching presence is the cornerstone of the actualization of cognitive presence in learners—increasing learners' awareness of, and their responsibility for, their own and others' contributions to the learning process (Garrison & Akyol, 2013). Inasmuch as shared metacognition serves as a guiding process for, and intended outcome of, communities of inquiry, teaching presence is recognized as the most influential and informative of the three presences (Garrison, 2016). The foundational characteristic of teaching presence was highlighted in a study by Hosler

and Arend (2012), which found that teaching presence accounted for 47% of variance in cognitive presence scores.

Teaching presence is organized around three principles—*design*, *facilitation*, and *direction* (Garrison, 2016). Each of these elements supports both social and cognitive presences. *Design* has to do with the creation of communication (social) and a plan to establish critical discourse (cognitive). *Facilitation* is about establishing community (social) and inquiry dynamics (cognitive). *Direction* means sustaining respect and responsibility (social) and inquiry through resolution (cognitive). Just as each subfactor contributes uniquely to the teaching presence construct, practically each subfactor must be thoughtfully considered and intentionally established (Gallego-Arrufat, Gutiérrez-Santiuste, & Campaña-Jiménez, 2015).

It is important to distinguish this component as teach*ing* and not teach*er* presence, with the realization that all learners, and more foundationally the design of the course as a whole and the individual activities therein, are supportive of the learning environment and overall learning outcomes (Garrison, 2017). Underlying this distinction, Preisman (2014) found that student satisfaction and success are best supported through the execution of the essential teaching presence principles, rather than the presence of the teacher as such. Since the construction of personal meaning within a shared cognitive space requires every member of the learning community to take responsibility for and ownership of their own and others' learning, teaching presence is about the distribution of authority and responsibility—for designing, facilitating, and directing the learning process—throughout the community (Garrison, 2013).

Research Questions

Using the confirmatory factor analysis (CFA) and Structural Equation Modeling (SEM) methodologies, the study sought to address three research questions.

RQ1: Will the CoI instrument yield the same factor structure as previous research?

The multifaceted nature of the CoI construct has been well researched, specifically the three-factor structure. However, under each main factor of teaching, social, and cognitive presence, indicators have been consistently organized into three to four subfactors, which have been part of the operational definitions for the presences. This hierarchical structure or relationship has not yet received any attention in community of inquiry research. The current study hypothesizes that the CoI is not only multidimensional but is also a higher order construct. Teaching presence subsumes three subfactors—design and organization, facilitation, and direct instruction; social presence is comprised of three subfactors—affective expression, open communication, and group cohesion; and cognitive presence is built on four subfactors—triggering event, exploration, integration, and resolution. To understand communities of inquiry fully, then, it is critical to understand the contributions and interactions of each of the subfactors.

RQ2: Will the CoI instrument maintain the same factor structure in RQ1 with covariates of gender, ethnicity, age, online course experience, and course discipline?

To answer this question, the study applies the multiple indicators multiple causes (MIMIC) method to examine the essential psychometric property—measurement invariance. MIMIC is appropriate since it requires smaller sample sizes and can examine a larger number of comparison groups more parsimoniously than other methods, such as multiple groups (Brown, 2015).

RQ3: What are the causal relationships among teaching, social, and cognitive presences?

Existing research (Garrison et al., 2010; Shea et al., 2009b) focuses on the predictive relationship of teaching presence on cognitive presence with social presence as a mediator. In a

correlational and regression study, however, Kozan and Richarson (2014) asserted the mediating relationship of cognitive presence. In this study, a series of structural models were tested to investigate causal relationships among the CoI presences.

Methods

Participants and Setting

All students enrolled in at least one course in the spring 2017 term in the online MBA program at a higher education institution in Maryland were invited to participate in the study. Data were gathered from 579 of 908 participants (a 63.8% response rate). Students were emailed an invitation including a summary of the study, a link to the Qualtrics survey, and a statement of informed consent. The survey consisted of three demographic questions, one question about online learning experience, and the CoI survey instrument (34 items). See Table 1 for demographic information.

Table 1
Demographic Information

	N = 579	
	n	**%**
Gender		
Male	331	57.2
Female	246	42.5
Missing	2	0.3
Age		
22–30	170	29.3
31–40	311	53.7
41–62	75	13.0
Missing	23	4.0
Ethnic Background		
African American	67	11.6
American Indian/Alaskan	2	0.3
Asian	126	21.8
Pacific Islander	4	0.7
Other including mixed	55	9.5
White	322	55.6
Missing	3	0.5
# of Online Courses Taken		
1–4 Courses	220	38.0
5–10 Courses	188	32.5
>10 Courses	124	21.4
Missing	47	8.1
*Max = 70		
Course Discipline		
Science	212	36.6
Non-Science	367	63.4

Instrument

The CoI instrument (Arbaugh et al., 2008) measures the interactions between the presences. Even though the instrument has been validated in numerous studies (Bangert, 2009; Carlon et al., 2012; Garrison, Cleveland-Innes, & Fung, 2010; Horzum & Uyanki, 2015; Kozan & Richardson, 2014; Shea, & Bidjerano, 2009a; Yu & Richardson, 2015), Garrison (2017) called for ongoing development and refinement of it.

Presently, the majority of CoI studies focus on confirming the three-factor structure. There is limited research on the 10 subfactors underlying teaching, social, and cognitive presence. Similarly, multiple inter-item error covariances have been found in the CoI instrument (Arbaugh et al., 2008; Diaz, Swan, & Ice, 2010), and Garrison (2017) has called for the refinement of the items along with the creation of an abbreviated instrument.

Additionally, while the effects of demographics and discipline have been noted (Arbaugh, 2013; Arbaugh, Bangert, & Cleveland-Innes, 2010; Garrison et al., 2010; Shea & Bidjerano, 2009a; Wicks, Craft, Mason, Gritter, & Bolding, 2015), more research is needed to understand how covariates such as gender, ethnicity, age, online course experience, and discipline affect the CoI factor structure (Garrison, 2017; Wicks et al., 2015).

Finally, while Garrison et al. (2010), Joksimović et al. (2015), and Shea and Bidjerano (2009b) have confirmed the mediating relationship of social presence with teaching and cognitive presence, Kozan and Richardson (2014) proposed that cognitive presence could be construed as the mediating variable between teaching and social presence, and suggested further research to validate their findings.

Results

The analyses in this study were conducted with Mplus 8.0 (Muthén & Muthén, 2017). Missing data patterns and multivariate normality assumption were examined before CFA and SEM analyses were carried out. Besides the online course experience variable (missing = 8.1%), the maximum missingness (4.0%) of the dataset on all variables was below the 5% cutoff point (Klein, 2015). Furthermore, with a maximum likelihood estimator, Mplus can accommodate up to 50% missing data per variable without compromising the validity of the analyses (Brown, 2015).

Multivariate normality, a critical assumption for SEM analyses, can be difficult to detect. According to Byrne (2011), a violation of this assumption leads to inaccurate results. Maximum Likelihood Robust estimator (maximum likelihood parameter estimates with robust standard errors) in Mplus, also known as MLR estimator, introduced by Satorra and Bentler (1988), incorporates a scaling correction factor and is used to adjust for non-normality. In this study, the scaling correction factor of 1.355 (>1) suggested multivariate non-normality of the data.

To determine the global model fit, the following widely used indexes (Brown, 2015) were adopted: (a) chi-square as an index to test model absolute fit is used in reference with other indexes because of its sensitivity to sample size; (b) comparative fit index (CFI) and Tucker-Lewis Index (TLI) as comparative/incremental fit indices above .90 and .95 indicating acceptable and excellent fit, respectively; (c) root mean square error of approximation (RMSEA) below .08 and .05 indicating acceptable and excellent fit; (d) standardized root mean square residual (SRMR) at .08 and .05 indicating acceptable and excellent fit; and (e) Akaike information criterion (AIC) used to compare model parsimony with non-nested models with lower AIC values indicative of better fit.

CFA Analyses

CFA analyses were conducted to examine the factor structure of the CoI instrument. The initial three-factor model did not fit satisfactorily (CFI = .861; TLI = .851; RMSEA = .073 with 90% CI of .070–.076; and SRMR = .067). A 10-factor model was fitted and resulted in improved fit (CFI = .929; TLI = .918; RMSEA = .054 with 90% CI of .051–.058; and SRMR = .044). Model modification indexes, factor loadings, *R*-square and normalized residual variances were reviewed and indicated that the model fit could be further improved.

As a result, an item in the teaching presence subscale, "T4: The instructor clearly communicated important due dates/time frames for learning activities," was eliminated due to much lower factor loading (.494) compared with other indicators and high residual variance (.756). Also, the descriptive statistics of the item revealed much weaker correlations with two other congeneric items (.392 and .421). In addition, one item in the social presence subscale, "S9: Online discussions help me to develop a sense of collaboration," and an item in the cognitive presence subscale, "C6: Online discussions were valuable in helping me appreciate different perspectives," were also removed due to cross-loadings on multiple subfactors. Item S9 had almost equal factor loadings on both the *affective expression* and *open communication* subfactors; and Item C6 loaded significantly on the *affective expression* and *group cohesion* subfactors of the social presence subscale. Furthermore, two sets of measurement error covariances were also incorporated into the final model. The final 10-factor CFA model (M3) achieved excellent model fit (see Table 2).

Table 2.
Results of Model Fitting for CFA, MIMIC, and SEM Models

Model	Chi-Square/DF	P-value	CFI/TLI	RMSEA	SRMR	AIC
M1: 3-factor CFA	2134.022/524	.0000	.861/.851	.073 (.070–.076)	.067	43367.690
M2: 10-factor CFA	1304.153/482	.0000	.929/.918	.054 (.051–.058)	.044	42179.316
M3: 10-Factor CFA Final	792.817/387	.0000	.962/.954	.043 (.038–.047)	.036	37732.687
M4: Higher-Order 3-Factor	901.742/419	.0000	.954/.949	.045 (.041–.049)	.052	37832.848
M5: MIMIC Model	1096.400/559	.0000	.950/.945	.043 (.039–.047)	.047	34091.329
M6: SEM Models	901.742/419	.0000	.954/.949	.045 (.041–.049)	.052	37832.848

While all 10 factors correlated strongly with each other, further examination revealed three concentrated clusters of significantly high correlations. Correlations between the design and organization, facilitation, and direct instruction factors ranged from .827 to .975; correlations between the affective expression, open communication, and group cohesion factors ranged from .644 to .877; and correlations between the triggering events, exploration, integration, and resolution factors ranged from .761 to .921 (see Table 3). This pattern conforms to the CoI conceptual framework and suggested a higher-order factor structure should be explored.

Table 3.
Correlations of CFA 10-Factor Model

	2	3	4	5	6	7	8	9	10
1: Design & organization	.869	.827	.403	.405	.389	.687	.577	.711	.652
2: Facilitation		.975	.569	.435	.467	.768	.652	.807	.744
3: Direct instruction			.653	.482	.502	.804	.722	.840	.782
4: Affective expression				.644	.687	.678	.620	.665	.587
5: Open communication					.877	.564	.548	.567	.506
6: Group cohesion						.574	.544	.694	.493
7. Triggering event							.844	.921	.835
8: Exploration								.881	.761
9: Integration									.848
10: Resolution									

Subsequently, a higher order three-factor model (M4) was fitted and achieved excellent fit (CFI = .953; TLI = .948; RMSEA = .044 with 90% CI of .040–.048; and SRMR = .042). Compared with the 10-factor model, this higher order model is more parsimonious (Δdf = 32) and theoretically more interpretable. Therefore, M4 was accepted as the final measurement model. The final instrument (31 items) achieved a high reliability (Cronbach's alpha = .968); with the teaching, social, and, cognitive presence subscales yielding high reliability of .956, .893, and .958, respectively.

MIMIC Model

To examine the measurement invariance of the model, the study tested and analyzed how well the final measurement model (M4) would hold when five covariates of age, gender, ethnicity, online course experience, and course discipline were present. The model (M5) demonstrated an excellent overall fit (see Table 2). Measurement invariance was observed for all covariates, with a few exceptions. Ethnicity had significant positive effects on teaching presence (.119, p = .008) and cognitive presence (.151, p = .000). Discipline had negative effects on all three presences, but a significant effect was found only on social presence (-.127, p = .010). Online experience had a significant positive effect on social presence (.132, p = .005). Additionally, age had a significant positive effect on cognitive presence (.120, p = .009). Gender was the only covariate that achieved measurement invariance across all presences. See Table 4 for results of the MIMIC model.

Table 4.

MIMIC Model: Covariate Effects on Latent Factors

Covariates	**Latent Variables**		
	Teaching Presence	Social Presence	Cognitive Presence
Age	.094 (.036)	.069 (.147)	.120 (.009*)
Ethnicity	.119 (.008*)	.039 (.432)	.151 (.000*)
Gender	.091 (.033)	-.079 (.096)	.079 (.071)
Discipline	-.106 (.021)	-.127 (.010*)	-.102 (.025)
Online experience	.043 (.303)	.132 (.005*)	.068 (.120)

*Indicates statistically significant effects at the level of .01.

Structural Models

To investigate the causal relationships of the three presences, three-structure models were fitted based on prior research. As equivalent models (Kline, 2016), all three structural models presented share the same excellent fit (see M6 in Table 2.).

Model A tested the predictive relationship of teaching presence on cognitive presence, with social presence as the mediator (see Figure 1). This model confirmed the results of previous studies (Garrison et al., 2010; Joksimović et al., 2015; Shea & Bidjerano, 2009b): Teaching presence had statistically significant predictive effects on cognitive presence (.651) and social presence (.555). Additionally, the mediating effect of social presence was lower but still statistically significant (.333). The resultant total effect of teaching presence on cognitive presence was .836.

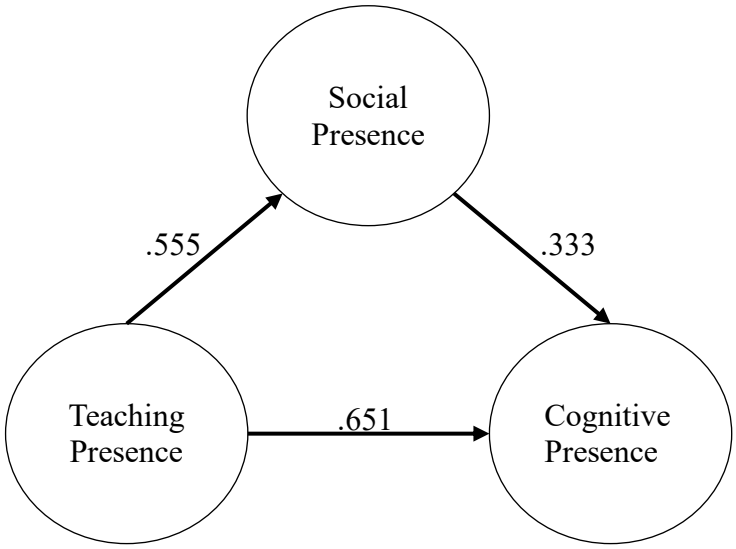

Figure 1. Model A: Social presence as the mediator between teaching and cognitive presence.

Model B (Figure 2) was based on the result of the correlational study by Kozan and Richardson (2014), which contended the mediating effect of cognitive presence. Teaching presence (.836) and cognitive presence (.766) had statistically significant predictive effects on social presence. However, with cognitive presence mediating the relationship, the predicative effect of teaching presence on social presence diminished (-.011, p = .895). The result suggests that when cognitive presence is controlled for, the predictive relationship of teaching presence on social presence disappears.

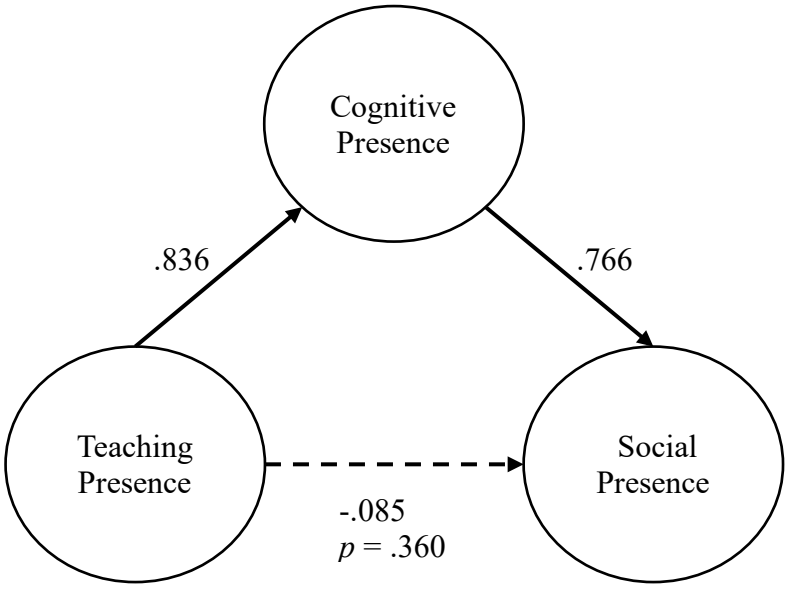

Figure 2. Model B: Cognitive presence as the mediator between teaching and social presence.

To build upon the results of Model B, a final structural model, Model C, had social presence as the predictor and cognitive presence as the mediating variable (see Figure 3). The results indicated that social presence had a statistically significant positive effect on cognitive presence (.767), and cognitive presence had a statistically significant positive effect on teaching presence (.845). However, social presence had a nonsignificant negative effect on teaching presence (-.008 p = .894).

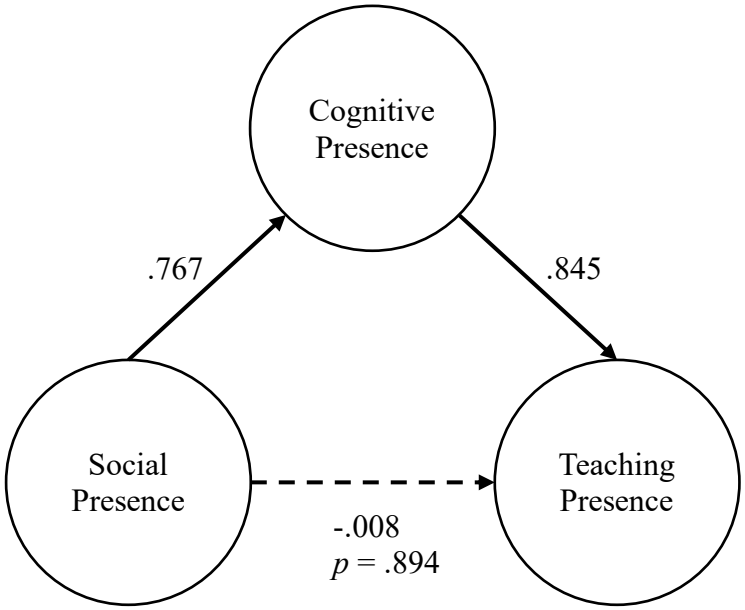

Figure 3. Model C: Social presence as the predictor and teaching presence as response variable.

Discussion

The purpose of this research was to reevaluate the construct validity of the CoI scale through a different lens, by introducing a hierarchical structure that corresponds to the construct operationalization of three presences by Garrison (2017), and further to confirm and rethink the causal relationships among the presences.

Construct Validity & Other Psychometric Implications

Since both the 10-factor model and three-factor higher order model fit much better than the often accepted and tested first-order three-factor model, it suggests that teaching, social, and cognitive presence are each multidimensional and hierarchical, and are best studied as such. The procedure of establishing sound factor structure before testing hierarchical relationship conforms to the typical psychometric research practice suggested by Brown (2015).

Two levels of estimation bias emerge as a consequence of ignoring the multidimensional and hierarchical nature of the constructs. At the item level, when the measurement model does not achieve satisfactory fit, the factor structure becomes unclear, and congeneric items should not be considered equally weighted or tau equivalent. This increases estimation bias when combining these items across factors to form a summated scale. At the subconstruct level, it entails substantial estimation bias to assume each subconstruct is equally weighted under higher order constructs. In the CoI measurement framework, a first-order three-factor measurement model essentially ignores the 10 subfactors, and in turn, might lead to inaccurate results. On the other hand, accounting for

the 10 subfactors offers important insights as researchers learn about the contribution of each subfactor to the higher order construct.

Specifically, in this study, the social presence subscale, in comparison with the teaching and cognitive presence subscales, was found to be significantly less well-defined, as indicated by the lack of clean factor structures, with numerous items cross-loading equally strongly on multiple subfactors. The deleted item, S9, demonstrated equally strong loadings on all subfactors under social presence. In addition, S7 also cross-loaded on the open communication subfactor, further indicating that open communication and group cohesion factors lack divergent validity and may potentially be combined, thus lending support to the proposal by Kreijans, Van Acker, Vermeulen, and Van Buren (2014) to parse social presence into two distinct elements. The removal of Item T4 from the teaching presence subscale and Item C6 from the cognitive presence subscale further demonstrated the value of considering the contribution of specific items and the subfactors more generally. As called for by Garrison (2017), this inclusion of subfactors and consideration of individual items therein will allow for the production of an abbreviated instrument with higher content validity through the elimination of ambiguous and overlapping items.

While this study established the divergent validity of the three traditional factors—teaching, social, and cognitive presences—the subfactors underlying each presence did not demonstrate clear divergent validity. Brown (2015) argued that factor correlations above .80 implied poor divergent validity. The facilitation and direction subfactors in teaching presence and triggering event and integration subfactors of cognitive presence were extremely highly correlated, well above .80 (.975 and .921, respectively), suggesting that they might not be sufficiently divergent. Further research should continue to parse each item, each subfactor, and the factors more generally to see how the CoI survey might be further refined in these directions.

Measurement Invariance

This study provides additional insights into the interactions of typical covariates with community of inquiry scores. First, this study adds confirmation to research on the predictive effects of discipline on community of inquiry scores (Arbaugh, 2013; Arbaugh et al., 2010; Garrison et al., 2010; Shea & Bidjerano, 2009a; Wicks et al., 2015). Specifically, this study found that social presence was negatively affected by the "hardness" (i.e., increased objectivity of content knowledge) of the discipline. As such, this study reinforces the idea that a community of inquiry is best supported in educative spaces where cognitive challenges can be explored and meaning co-constructed, rather than in spaces where meaning is *transmitted to* more than it is *transformed by* learners (Garrison, 2016). Second, this study found that ethnicity has a significant effect on both teaching and cognitive presence. While Vladimirschi (2013) has noted the influence of culture on communities of inquiry, these results are difficult to interpret in any meaningful way, as ethnicity is not a continuous variable. Further research should also be given to understanding the interaction of age and cognitive presence, and online experience and social presence, each of which was shown to be significant in this study. Since the MIMIC approach of examining measurement invariance is limited only to factor means, more stringent constraints, such as equal factor loadings and equal error variances, were not tested. Nevertheless, the results pointed out that additional effort is warranted to further refine the CoI instrument.

Causal Relationships of Presences

In testing the casual relationships of presences, this study presented results from several equivalent models to confirm with previous research. As Kline (2015) suggested, it would be impossible to derive a preferred model with global model-fit indices as criteria because the model-fitting indices for all equivalent models are the same. Hence, the preferred models should be judged

on theoretical and conceptual grounds. Then, and only then, can the factor loadings be interpreted to infer the causal relationships.

As originally proposed and subsequently studied, within a community of inquiry, teaching presence predicts cognitive presence through the mediation of social presence. This study, however, adds support to the suggestion by Kozan and Richardson (2014) that it is possible to understand cognitive presence as mediating teaching and social presence (Garrison et al., 2010; Joksimović et al., 2015; Shea & Bidjerano, 2009b). In this view, social presence is a product rather than a predictor of cognitive presence. Garrison's (2017) suggestion that social presence emerges just as "participants identify first with academic goals" (p. 30) ultimately supports the view of cognitive presence informing social presence. Accordingly, social presence results from learners' commitment to a common academic goal, based on an agreement to explore ideas and perspectives collaboratively (Winne, 2015; Zhao, Sullivan, & Mellenius, 2014).

At the same time, it makes little conceptual sense to view social presence as the intended outcome of a community of inquiry. The ultimate purpose of an educative environment in general, and a community of inquiry in particular, is cognitive engagement. As Garrison (2017) put it, "[s]tudents join educational environments for academic purposes and not for social reasons" (p. 45). So, while social presence may indeed result from a community engaged in open and critical discourse, social presence cannot be viewed as the ultimate or intended result of that engagement. To this understanding—and in line with the manner in which the CoI framework was conceived and conceptualized—social presence can never be the response variable, though its fit as either the predictor or mediating variable might still otherwise be open.

The positioning of social presence as the mediating variable is, however, finally anchored upon inspection of the teaching presence construct. The literature on the Community of Inquiry is explicit about the function and purpose of teaching presence. Teaching presence is essentially about the distribution of teaching authority and responsibility throughout the learning community (Garrison, 2017). It is about the decentralization of authority (Vaughn, 2013) and the scaffolding of student engagement in teaching functions (Gallego-Arrufat et al., 2015). Thus, communities of inquiry, through the distribution of teaching authority and responsibility, enable learners to practice (Vaughan, 2013) and become more proficient at leading and engaging in a process of ongoing, shared metacognition (Kovanović et al., 2015; Malmberg et al., 2015), resulting in the construction of more justifiable beliefs in the context of shared knowledge within a community of learners (Lafuente, Remesal, & Valdivia, 2014). This construal of teaching presence positions the teacher within the community, not outside or in front of it.

Despite the conceptual commitment of teaching presence to the distribution of the teaching function throughout the learning community, all 13 of the teach*ing* presence items ask specifically and exclusively about the role of the teach*er*. To wit, 12 of the items begin with the phrase "The instructor," and the one remaining item begins with the phrase "Instructor actions." In this way, the teaching presence subscale, while valid as a scale measuring *some* factor, does not actually measure teaching presence so defined. Thus, as it stands, and insofar as the functions it describes are logically prior to its results (viz., the creation of social and cognitive presences), the teaching presence construct must necessarily serve as the predictor variable. As a result, in its present condition, the framework can only be studied as originally conceptualized—even if there are statistical and conceptual indications that other constructions might be possible or even preferable.

So, while Garrison (2017) called for further refinement of the teaching presence scale, this study demonstrates the need to significantly reconceptualize the teaching presence construct as it is represented and measured in the CoI survey instrument, ensuring that the items reflect and relate

to teaching presence as a distributed rather than centralized function. What is more, if operationalized as theorized, teaching presence could potentially fit any role—predictor, mediator, or outcome—within the framework. Indeed, rightly framed, teaching presence might make the most conceptual sense as the outcome of a community of inquiry—quite in line with Garrison's (2017) work on, and notions of, shared metacognition.

Gašević et al. (2015) demonstrated the positive effects of student-led teaching presence functions (as defined by the CoI survey) on cognitive presence, offering that "integrating externally-facilitated regulation scaffolds into the design component of teaching presence . . . provided students with the opportunities to co-regulate their learning" (p. 62). Taking Garrison's (2017) view that "[e]ducation is a formally constructed type of social learning" (p. 26), then it is indeed the case that "shared metacognition holds promise to understand and support thinking and learning collaboratively" (pp. 62–63). Thus—and as shown by Gašević et al. (2015)—if teaching presence is operationalized in just such a shared and collaborate fashion, and the coregulation of learning is both requisite for, and an intended outcome of, a community of inquiry, its fit as the outcome variable within a community of inquiry makes considerable conceptual sense. Of course, more research is first needed to remake the teaching presence scale, tying it more tightly to its conceptual mooring. This part of the project has the further potential to address the suggestions by Shea et al. (2014) to account for the presence of the learner within the CoI framework, while at the same time heeding Garrison's (2017) concern with keeping the theory grounded in collaborative constructivism. Once the teaching presence scale is revised, research can then set about remaking the model however makes best statistical and conceptual sense. In all, this line of inquiry will significantly affect all future research on the CoI framework.

Conclusions

Overall, this study adds new insight into the psychometric properties of the CoI instrument and casual relationship among the presences, allowing for new research opportunities in these directions. More specifically, this study provides at least three important insights for additional use and study of the CoI framework and instrument. First, a three-factor higher order model is superior to the traditional three-factor model typically used. Future studies should utilize the three-factor higher order model, which will produce a more refined understanding of the interaction among the three primary factors and their associated 10-subfactors. Findings from these studies will provide insights on designing specific course elements to achieve the most meaningful student learning experiences and outcomes. Second, future studies should seek to uncover how age, ethnicity, and online experience affect CoI scores and possibly also the configuration of the instrument. Finally, this study demonstrates the need to revisit the entire teaching presence scale as it is represented in the CoI instrument, and more specifically to revise the teaching presence items to reflect the construct's commitment to the distribution of teaching authority and responsibility. Work in this area will significantly inform both how the community of inquiry is understood and more importantly how it is operationalized in classrooms.

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